Focus on Sexuality Research
Series Editor: Heather Hoffmann

Doug P. VanderLaan
Wang Ivy Wong *Editors*

Gender and Sexuality Development

Contemporary Theory and Research

Springer

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Series Editor

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The study of sexuality exists at the crossroads of numerous disciplines, including psychology, biology, sociology, anthropology, medicine, and public health. It presents unique methodological and interpretive challenges as it is exceedingly complex to capture the exquisite interaction of the numerous forces that can influence sexual attitudes, behavior, identity, and physiological responses. Keeping abreast with developments in the field can also be difficult, as single peer-reviewed articles cannot encompass the scope of any one issue, and review articles generally narrow in on a fairly specific question.

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To the little ones in our lives: Frankal, Andie, Lea, Joshua, Emma, Wesley, and Hiro.

Preface

Why Gender and Sexuality Development?

As developmentalists in the areas of gender and sexuality, we have often perceived a disconnect. Previous books taking a developmental perspective lean toward one of these topics or the other, and many heavily so. Yet, our own experiences suggest that scholars, practitioners, stakeholders, and laypersons view these areas as connected in myriad ways. For many years, our intellectual respite has been meetings of the *International Academy of Sex Research* and the *Gender Development Research Conference*, where scholarly work related to gender and sexuality has long figured prominently and alongside one another in the scientific programs. Indeed, part of the draw of these particular academic circles is that while many of our colleagues specialize in one of these areas, they are typically well-versed and genuinely interested in the other. We believe this reflects a tacit appreciation that gender and sexuality are often bound together or, at the very least, that by studying one it is possible to gain valuable insights regarding the other. In the public sphere, gender and sexuality are also often viewed as closely related or interrelated. Examples include sex education curricula as well as the alignment of social groups under the LGBTQ+ banner, just to name a couple. Thus, whereas many volumes have been relatively narrower in scope—focusing often on gender or sexuality—this book covers both topics. We believe focusing on gender *and* sexuality will ultimately benefit readers by fostering broad knowledge and, we hope, will prompt a deeper appreciation for the parallels and overlap in these areas that lead them to often go hand in hand.

Origin Story

Necessity is the mother of invention. As cliché as it might be, this adage is apt in regard to the origin story of this book. In 2015, I (DPV) was starting out in a developmental psychology position as an assistant professor. I knew that one day I wanted to offer a lecture or seminar course that bridged key theories with exciting and emerging areas in gender and sexuality science. Such a course, I thought (and still think!), could generate a high level of enthusiasm and provide a valuable learning experience. As one does, I reviewed texts to see what options were available. I quickly realized that what I was looking for did not exist. If I wanted the particular collection of readings I had in mind, I would have to facilitate its existence.

Later that year at the *International Academy of Sex Research* meeting in Toronto, Canada, I had the opportunity to speak with Heather Hoffmann, who had recently been appointed as the Series Editor for Springer's *Focus on Sexuality Research*. Heather was receptive to the idea of a book on gender and sexuality development and graciously laid out the steps involved. Admittedly, I then proceeded to make zero progress on the book for a couple of years or so as I established my own lab and research program as a new faculty member. Fortunately for me and this book, two critical things happened. First, Heather continued to check in and provide encouragement about proposing the book to Springer. Second, following a serendipitous exchange of contact information on the last day of the 2016 *International Academy of Sex Research* meeting in Malmö, Sweden, Wang Ivy Wong agreed to join as coeditor. Ivy was working as an assistant professor in Hong Kong after studying in the United Kingdom. She was keen to collaborate with a fellow gender and sexuality researcher who was also interested in culture, and who travelled to Asia regularly. Ivy's expertise complemented my own and helped make the scope of the book more comprehensive. Plus, with two editors, we motivated each other to generate and maintain momentum.

We worked out the overall chapter structure in June 2018. Ivy travelled from Hong Kong to Chiang Mai, Thailand, to visit while I was doing field research. Over a couple of hours on a characteristically hot day, we mapped out the book at Smoothie Blues, a nice breakfast place on the corner of Nimman soi 6. In the following months, we were extremely grateful that several well-respected scholars in the field saw merit in the project and signed on as contributors. With their support, we secured a contract from Springer to go forward. From there, we made steady progress as we signed on the full roster of authors and worked with them to provide guidance and feedback on their contributions. The rest, as they say, is history.

Aims

We endeavored to assemble a set of readings that provides a complete treatment of a range of key topics at the forefront of gender and sexuality development research. As is often the case in the life sciences, gender and sexuality can be dissected in various ways and are influenced by many factors that are often interconnected. Thus, multiple levels of analysis, theoretical viewpoints, and methodologies are required to achieve comprehensive understanding. To this end, this book is modeled on an interdisciplinary perspective. Across chapters and often within them, the authors delve into biological, comparative, psychological, cognitive, social, cultural, and/or clinical approaches. In combination, this collection conveys the rich tapestry that is gender and sexuality science. It also provides a depth of insight that would not be obtained via a narrower scope.

This volume also showcases the wealth of knowledge and talent found among gender and sexuality scientists from a variety of regions around the globe. Authors include established, mid-career, and emerging scholars who represent several generations of leaders in the field. In addition to asking these leaders to detail contemporary lines of thinking and empirical knowledge in their respective areas, we prompted them to outline what they perceive to be some of the most important avenues for future inquiry. In this way, this book communicates the current state of the field as well as acts as a springboard for new and important lines of research.

Cutting-edge work in the field is also captured in the several *Spotlight Features* that appear throughout the book. Each feature focuses on a topic that complements the content of the chapter in which it appears. Specifically, these features provide brief synopses of particularly unique and important studies or lines of work. Hence, as the name suggests, each feature shines a spotlight on some of the most innovative research the field currently has to offer.

Through this combination of characteristics, we believe we have achieved a collection of readings that will hold value for many. For those already in the field, this book provides an excellent resource for brushing up on the latest. Those who are newer to the field, including undergraduate and graduate students, stand to gain tremendously from not only the thoughtful and informative chapters and spotlight features, but also from the interdisciplinary approach modeled throughout the book. Beyond academia, the pages in this book present a wealth of knowledge that would be of use to parents, daycare workers, schoolteachers, clinicians, policymakers, or anyone else who has a hand in influencing the experiences of children, adolescents, and their families.

Overview

This book includes 21 chapters and 16 spotlight features covering key background and recent advances. Many of these readings focus on traditional areas of gender and sexuality development theory and research, while several others concentrate on specialized areas that help furnish a more complete view of the gender and sexuality spectrum. We have organized these readings in a way that we hope will be of greatest benefit to readers.

The first five chapters outline foundational principles and perspectives. In Chapter 1, Del Giudice provides an invaluable overview of the various ways in which sex differences can be conceptualized and measured. Chapter 2 illustrates cross-species comparative approaches to the development of sex differences as Wallen reviews research on prenatal steroid hormones and rhesus macaque behavior. The spotlight feature by Faykoo-Martinez and Holmes provides an interesting juxtaposition by focusing on naked mole rats, a species in which the development of sex differences is often suppressed. In Chapter 3, Pasterski and Bibonas focus on biological approaches, carrying the hormonal perspective along with genetic perspectives over to human sex and gender development. Chapter 3 is accompanied by two spotlight features concerning the neuroscience of transgender identity. Guillamon presents key theories and evidence regarding the brain bases of transgender identity, and Burke summarizes current knowledge regarding the effects of gender-affirming hormonal treatments on the brain development of transgender adolescents. In Chapter 4, Coyle and Fulcher review classic and contemporary theories of gender development with a focus on Social Cognitive Theory and spark new study directions by linking it with a developmental model of persuasion. In Chapter 5, Cook and colleagues offer an authoritative review of two decades of advances in theory and research involving cognitive theories, especially the ways in which contemporary research has expanded the measurement and conceptualization of gender identities, broadened the scope of gender-related cognitive constructs, and described gender development processes and their interrelations. Mehta's spotlight feature highlights the potential of modern technology to help researchers study gender in innovative ways. It summarizes recent attempts to measure gender identity as a momentary construct using ecological momentary assessment.

The six chapters that follow cover several key topics of interest within gender development.

Chapter 6 by Leaper offers a comprehensive review of the origins and consequences of childhood gender segregation and incorporates an Integrative Developmental Systems Model. It gives much-needed coverage of gender development in both cisgender children as well as those with transgender or other nonbinary gender identities. Shi and Wong's spotlight complements this chapter by reviewing studies on the social and gender identity outcomes associated with gender-segregated schooling. Chapter 7 by Weisgram adopts bioevolutionary, cognitive, and social perspectives to review the causes and consequences of gender-typed play, an aspect of gender that has been widely discussed in recent years among scientists, parents,

educators, media, merchandisers, and politicians. Chapter 8 by Skinner and McHale brings insight to the study of socialization agents by adopting family systems and cultural ecological frameworks. It reviews family influences on gender development across childhood and adolescence, especially in relation to parent-child, inter-parental, and sibling subsystems. Chapter 9 by Bian focuses on the sociocultural factors shaping women's participation in the STEM domain and beyond, highlighting creative experiments that expose two classes of stereotypes—stereotypes against women's and girls' intellectual abilities, and stereotypes about the culture of the field. Chapter 10 by Brown and Tam offers an important discussion of how gender-based discrimination affects children and adolescents at home, in school, and in media. It also examines how the field has shifted historically and provides an overview of associated legal changes. The spotlight by Kwan and Wong describes research on children's appraisals of gender nonconformity and recent multicultural intervention attempts to ameliorate bias toward gender-nonconforming peers. In Chapter 11, Kreukels and van de Grift, based on their extensive experience as researchers in a large gender clinic, give an overview of various aspects of gender development and sexuality among individuals with differences/disorders of sex development. The spotlight feature by Vilain and Martinez-Patiño, both advisors to the International Olympic Committee, critically discusses the history of gender determination in sports participation and the scientific evidence and rationale of relying on testosterone levels or other markers for such purpose.

Beginning with Chapter 12, the book transitions to topics mainly relating to sexuality—although gender is often integral to these topics as well. Chapter 12 by Li is a must-read on sexuality development in childhood—an important topic that is understudied due to its taboo nature. The spotlight feature by Leander showcases ground-breaking work on children's doctor games and what they reveal about childhood sexual development. In Chapter 13, Fortenberry and Hensel detail creative and thoughtful perspectives on the role of pleasure and its embodiment in adolescent sexual development and in diverse bodies. Löfgren-Mårtenson's accompanying spotlight feature on sexual development among those with intellectual disabilities complements the main chapter and further broadens the reader's perspective. Chapter 14 by Štulhofer and colleagues provides a well-structured overview and synthesis of the many competing theories and empirical findings pertaining to pornography use in adolescence and young adulthood. Although most research in this area has concentrated on heterosexual experiences, Macapagal and Nelson's spotlight feature provides unique insights by focusing on sexually explicit media use among sexual and gender minority youth. In Chapter 15, Stephens and colleagues bring a forensic aspect to this volume with their comprehensive review of theory and research on sexual offending from a lifespan approach.

The next three chapters cover important developmental theory and research related to sexual preferences, sexual orientation, and gender expression. In Chapter 16, Safron and Klimaj deliver a tour de force. Their learning approach offers sound theory to bring together and explain a complex and wide array of sexual preference research findings. Petterson and Vasey's spotlight feature on male bisexuality adds a valuable cross-cultural element that complements this approach. In

Chapter 17, VanderLaan and colleagues navigate theory and research regarding how we might better understand the biological underpinnings of same-sex sexual orientation. The spotlight feature by Swift-Gallant and Monks outlines possible linear and nonlinear associations between hormonal mechanisms and sexual differentiation of brain and behavior. Another spotlight feature by Moskowitz delves into some of the most recent research bearing on the question of whether men's preference for receptive or insertive anal sex might also be influenced by biological mechanisms. In Chapter 18, Choukas-Bradley and Thoma provide an informative overview of emerging knowledge on a particularly important and hot topic: mental health among LGBT youth. This chapter is complemented by a spotlight feature by van der Miesen on the link between autism and gender and sexual diversity, as well as another spotlight feature by MacMullin and VanderLaan on gender expression and mental health among children.

The final three chapters cover fascinating aspects of the human sexual spectrum that have seldom been investigated with development explicitly in mind. As such, we are especially grateful to the authors of these chapters for their willingness to push the envelope by advancing developmental perspectives on these topics. In Chapter 19, Brotto and Milani lead the reader through our evolving understanding of asexuality and propose how we might best conceptualize and study it going forward. In Chapter 20, Hsu and Bailey summarize theory and evidence on erotic target identity inversions, which broaden our conventional understanding of sexual orientation. In Chapter 21, Hamilton and Winward provide a multifaceted discussion of consensual nonmonogamy that includes key background as well as several intersections with development. The spotlight feature by Thompson complements the chapter by summarizing recent innovative work relating to threesomes in young adults.

Terminology

The most apt terminology to employ when discussing gender and sexuality is frequently a matter of controversy and debate. It would not, therefore, have been possible to arrive at a uniform set of terms that were agreed upon by all contributors to this volume. As such, contributors used the terms they felt were most appropriate to convey their ideas. That said, we asked authors to be thoughtful and clear in the meaning of the terms employed. Also, in several instances, authors chose to elaborate on the rationale for their choice of terminology. Thus, this volume offers opportunities to become familiar with the various terms employed as well as to gain insight into some of the differences of opinion regarding terminology in this field.

Mississauga, ON, Canada — Doug P. VanderLaan
Shatin, Hong Kong — Wang Ivy Wong

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Chapter 1
Measuring Sex Differences and Similarities

Marco Del Giudice

Abstract This chapter offers a concise, systematic introduction to quantification in sex differences research. The chapter reviews the main methods used to measure sex differences and similarities, including standardized distances (Cohen's *d* and Mahalanobis' *D*), indices of overlap, variance ratios, and tail ratios. Some less common approaches (e.g., relative distribution methods, taxometrics) are also reviewed and discussed. The chapter examines the strengths and limitations of each method, considers various statistical and methodological factors that may either inflate or deflate the size of sex differences, and discusses the available options to minimize their influence. Other topics addressed include the effective visualization of sex differences/similarities, and the rationale for treating sex as a binary variable despite the complexities of sex-related identity and behavior.

Keywords Cohen's *d* · Gender differences · Gender similarities · Effect size · Mahalanobis' *D* · Measurement · Meta-analysis · Sex differences · Sex similarities

Few topics in psychology can rival sex differences in their power to stir controversy and captivate both scientists and the public. Debates in this area revolve around two types of questions: *explanatory* questions about the role of social learning and biological factors in determining patterns of sex-related behavior, and *descriptive* questions about the size and variability of those effects. These questions are logically distinct and can be addressed independently; however, throughout the history of the discipline the answers have tended to cluster together (see Eagly & Wood, 2013; Lippa, 2005). More often than not, researchers who emphasize socio-cognitive factors typically view sex differences as small, outweighed by similarities, and highly context-dependent. They also tend to worry that exaggerated beliefs about the extent of sex differences and their stability may have pernicious influences on individuals and society (e.g., Hyde, 2005; Hyde et al., 2019; Rippon et al., 2014;

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Unger, 1979). Conversely, most biologically oriented scholars argue that—at least in regard to certain traits—differences between the sexes can be large, pervasive, and potentially universal (e.g., Buss, 1995; Davies & Shackelford, 2008; Ellis, 2011; Geary, 2010; Schmitt, 2015). While not all scholars can be neatly placed in one of these two "camps," the long-standing divide contributes to explain why measurement and quantification are so often at the center of disputes in the field (Eagly & Wood, 2013).

Regardless of one's theoretical background, it is clear that future progress will depend on our ability to quantify differences and similarities as accurately and meaningfully as possible. Doing so requires not only the proper statistical tools, but also awareness of the many factors that may distort empirical findings and make them less interpretable, or even potentially misleading. Despite the importance of these issues, the relevant literature is fragmented; as far as I know, there have been no attempts to organize it in an accessible form. This chapter aims to fill this gap with a concise but systematic introduction to quantification in sex differences research. I begin with a meta-methodological note about the meaning of "sex" and "gender," and the rationale for treating sex as a binary variable despite the complexities of sex-related identity and behavior (a point that necessitates a brief detour into evolutionary biology). In the following section, I review the main approaches to quantification, examine their strengths and limitations, and offer suggestions for visualization. Finally, I discuss various statistical and methodological factors that may inflate or deflate the apparent size of sex differences, and consider the available options to minimize their influence.

1.1 Sex or Gender?

While many authors in psychology and other disciplines treat "sex" and "gender" as synonyms (Haig, 2004), these terms have different histories and implications. The contemporary usage of "gender" as the social and/or psychological counterpart of biological sex was introduced in psychology by Money (1955), though Bentley (1945) had drawn the same distinction 10 years before. Popularized by Stoller (1968), the term was rapidly adopted by feminist scholars in the 1970s (Haig, 2004; Janssen, 2018). The motivation was to distinguish the biological characteristics of males and females from the social roles, behaviors, and aspects of identity associated with male/female labels; usually with the assumption that sociocultural factors are more powerful and consequential than biological ones, and that psychological differences are largely or exclusively determined by socialization (e.g., Oakley, 1972; Unger, 1979). As many have noted over the years, the sex-gender distinction is problematic and ultimately unworkable, which is probably why few authors actually follow it in their writing. Not only does it suggest a clear-cut separation between social and biological explanations; it also presupposes that one already *knows* whether a certain aspect of behavior is biological or socially

constructed in order to pick the appropriate term (Deaux, 1985; Ellis et al., 2008; Haig, 2004).

Having grown uneasy with the sex-gender distinction, some feminist scholars have started to promote the use of the hybrid term "sex/gender" (or "gender/sex") as a way to recognize that biological and social factors are inseparable, encourage critical examination of the processes that lead to observable male-female differences, and underscore the potential for plasticity (Fausto-Sterling, 2012; Hyde et al., 2019; Jordan-Young & Rumiati, 2012; Rippon et al., 2014). Of course this is a legitimate stance; but the new terminology has its own problems, and I suspect that the cure would be worse than the disease. Sex/gender is often described by its proponents as a continuum, or even a multidimensional collection of semi-independent features; from this perspective, a person's sex/gender may be regarded as hybrid, fluid, or otherwise nonbinary (see, e.g., Hyde et al., 2019). Yet, the same term is also used in the context of the distinction between males and females as groups (Jordan-Young & Rumiati, 2012). Some authors have carried this tension to its logical conclusion and suggested that researchers should stop using sex as a binary variable (Joel & Fausto-Sterling, 2016). On this view, "male" and "female" should be replaced with multiple overlapping categories, or even (multi)dimensional scores of gendered self-concepts and attitudes (Hyde et al., 2019; Joel & Fausto-Sterling, 2016). This radical methodological change is justified with the need to overcome the "gender binary." However, the binary nature of sex is not an illusion to dispel but a biological reality, as I now briefly discuss.

1.1.1 The Sex Binary

In the social sciences, sex is usually defined as a collection of traits—X/Y chromosomes, gonads, hormones, and genitals—that cluster together in most people but may also occur in atypical combinations (e.g., Blakemore et al., 2009; Fausto-Sterling, 2012; Helgeson, 2016; Joel, 2012). This definition is the basis for the widely repeated claim that up to 2% of live births are intersex (Blackless et al., 2000). Few researchers and commenters seem aware that the 2% figure is a gross overestimate. To begin, correcting for inaccuracies and counting errors in the original report brings the total frequency down to less than 0.5% (Hull, 2003). More importantly, Blackless et al. (2000) defined intersex very broadly as individuals who deviate from the "Platonic ideal" of sex dimorphism; accordingly, they included several conditions (e.g., Klinefelter syndrome, vaginal agenesis, congenital adrenal hyperplasia) that affect the development of sexual characters but can be classified as "intersex" only in a loose sense (Sax, 2002). If one restricts the term to conditions that involve a discordance between chromosomal and phenotypic sex, or a phenotype that cannot be classified unambiguously as either male or female, the frequency of intersex is much lower—almost certainly less than 0.02% (Sax, 2002; see also Hull, 2003).

A deeper issue with the "patchwork" definition of sex used in the social sciences is the lack of a functional rationale, in stark contrast with how the sexes are defined in biology. From a biological standpoint, what distinguishes the males and females of a species is the size of their gametes: Males produce small gametes (e.g., sperm), females produce large gametes (e.g., eggs; Kodric-Brown & Brown, 1987).[1] Dimorphism in gamete size or *anisogamy* is the dominant pattern in multicellular organisms, including animals. The evolution of two gamete types with different sizes and roles in fertilization can be predicted from first principles, as a result of selection to maximize the efficiency of fertilization (Lehtonen & Kokko, 2011; Lehtonen & Parker, 2014). In turn, anisogamy generates a cascade of selective pressures for sexually differentiated traits in morphology, development, and behavior (see Janicke et al., 2016; Lehtonen et al., 2016; Schärer et al., 2012). The biological definition of sex is not just one option among many, or a matter of arbitrary preference: The very *existence* of differentiated males and females in a species depends on the existence of two gamete types. Chromosomes and hormones participate in the mechanics of sex determination and sexual differentiation, but do not play the same foundational role. Crucially, anisogamy gives rise to a true sex binary at the species level: Even if a given individual may fail to produce viable gametes, there are only two gamete types with no meaningful intermediate forms (Lehtonen & Parker, 2014). This dichotomy is functional rather than statistical, and is not challenged by the existence of intersex conditions (regardless of their frequency), nonbinary gender identities, and other apparent exceptions. And yet, anisogamy is rarely discussed—or even mentioned—in the social science literature on sex and gender, with the obvious exceptions of evolutionary psychology and anthropology.

What are the implications for research? If the sex binary is a basic biological fact, arguments that call for rejecting it on scientific grounds (e.g., Hyde et al., 2019) lose much of their appeal. One can speak of sex differences in descriptive terms—as I do in this chapter—without assuming that such differences are "hardwired" or immune from social influences. From a practical standpoint, sex as a categorical variable is also robust to the presence of a small proportion of individuals who, for various reasons, are not easily classified or do not align with the biological definition. This does not mean that exceptions are unimportant, or that sex should *only* be viewed through a categorical lens. For example, there are methods for ranking individuals of both sexes along a continuum of masculinity-femininity or male-female typicality (e.g., Lippa, 2001, 2010; Phillips et al., 2018; more on this in Sect. 1.2.1). Variations in gender identity and sexual orientation can and should be studied in all their complexity regardless of whether sex is a biological binary. More generally, the existence of a well-defined sex binary is perfectly compatible with large amounts of within-sex variation in anatomy, physiology, and behavior. Indeed, sexual selection often amplifies individual variability in sex-related traits, and can favor the evolution of multiple alternative phenotypes in males and females (Geary, 2010, 2015;

[1] Species with *simultaneous hermaphroditism* (mostly plants and invertebrates) do not have distinct sexes, given that any individual can produce both types of gametes at the same time.

Taborsky & Brockmann, 2010; see also Del Giudice et al., 2018). In the remainder of the chapter I discuss how patterns of quantitative variation between the sexes can be measured and analyzed in detail.

1.2 Quantification of Sex Differences/Similarities

There are many possible ways to quantify sex differences and similarities. In this section I review the methods that are most often employed in the literature. I then discuss some methods that are less common but warrant a closer look, either because of their untapped potential or because of their peculiar limitations. I also address the question of how to visualize quantitative findings effectively and intuitively. Note that the various methods and indices discussed in this section are in no way alternative to one another. Different indices can reveal different aspects of the data, and may be used in combination to gain a broader perspective; other times, one of the indices may be better suited to answer the particular question at hand. The basic formulas are reported and explained in Table 1.1. Additional methods to deal with more complex scenarios can be found in the cited references.

1.2.1 Common Indices of Difference/Similarity

1.2.1.1 Univariate Standardized Difference (Cohen's *d*)

The standardized mean difference is by far the most common and versatile effect size (ES) in sex differences research. Cohen's *d* measures the distance between the male and female means in standard deviation units (using the pooled standard deviation; Table 1.1). Confidence intervals on *d* can be calculated with exact formulas or bootstrapped (Kelley, 2007; Kirby & Gerlanc, 2013). Here I follow the convention of using positive *d* values to indicate higher scores in males. For example, $d = -0.50$ indicates that the female mean is half a standard deviation higher than the male mean. In two major syntheses of psychological sex differences, Hyde (2005) and Zell et al. (2015) summarized hundreds of effect sizes from meta-analyses (see Sect. 1.3.4). They found that about 80% of the effects in the psychological literature are smaller than $d = 0.35$; about 95% are smaller than $d = 0.65$; and only about 1–2% are larger than $d = 1.00$ (absolute values, uncorrected for measurement error; the average across domains was $d = 0.21$ in Zell et al., 2015). For comparison, the size of sex differences in adult height is $d = 1.63$ (average across countries; Lippa, 2009).

The substantive interpretation of *d* values is a persistent source of confusion. The problem can be traced to Cohen (1988), who in a popular book on power analysis offered some conventional rules of thumb for *d:* 0.20 for "small" effects, 0.50 for "medium" effects, and 0.80 for "large" effects. These guidelines have been used countless times to interpret empirical findings and evaluate their importance;

Table 1.1 Common indices for the quantification of sex differences/similarities

Univariate	Multivariate
$d = \frac{m_M - m_F}{S} = \frac{m_M - m_F}{\sqrt{\frac{(N_M-1)S_M^2 + (N_F-1)S_F^2}{N_M+N_F-2}}}$	$D = \sqrt{(\mathbf{m_M} - \mathbf{m_F})^{\mathrm{T}} \mathbf{S}^{-1} (\mathbf{m_M} - \mathbf{m_F})} = \sqrt{\mathbf{d}^{\mathrm{T}} \mathbf{R}^{-1} \mathbf{d}}$
Cohen's d. Standardized univariate difference (distance between the M and F means). Convention: Positive values for $m_M > m_F$, negative values for $m_F > m_M$[a] m_M, m_F: Male/female means S: Pooled standard deviation S_M, S_F: Male/female standard deviations N_M, N_F: Male/female sample sizes	*Mahalanobis' D*. Standardized multivariate difference (unsigned distance between the M and F centroids along the M-F axis)[a] $\mathbf{m_M}$,$\mathbf{F}$: Vectors of male/female means **d**: Vector of d values **S**: Pooled covariance matrix **R**: Pooled correlation matrix
$d_u = g = d\left[1 - \frac{3}{4(N_M+N_F-2)-1}\right]$	$D_u = \sqrt{\max\left[0, \left(\frac{N_M+N_F-k-3}{N_M+N_F-2} D^2 - k\frac{N_M+N_F}{N_M N_F}\right)\right]}$
Small-sample variant of d corrected for bias (approximate formula); also known as *Hedges' g*	Small-sample variant of D corrected for bias k: Number of variables
$OVL = 2\Phi(-\lvert d\rvert/2)$	$OVL = 2\Phi(-D/2)$
Overlapping coefficient. Proportion of overlap relative to a single distribution[a,b] $\Phi(\cdot)$: Normal cumulative distribution function (CDF)	*Overlapping coefficient*. Proportion of overlap relative to a single distribution[a,b] $\Phi(\cdot)$: Normal cumulative distribution function (CDF)
$OVL_2 = \frac{OVL}{2-OVL} = 1 - U_1$	$OVL_2 = \frac{OVL}{2-OVL} = 1 - U_1$
Proportion of overlap relative to the joint distribution[a,b]	Proportion of overlap relative to the joint distribution[a,b]
$U_1 = 1 - \frac{OVL}{2-OVL} = 1 - OVL_2$	$U_1 = 1 - \frac{OVL}{2-OVL} = 1 - OVL_2$
Proportion of nonoverlap relative to the joint distribution[a,b]	Proportion of nonoverlap relative to the joint distribution[a,b]
$U_3 = \Phi(\lvert d\rvert)$	$U_3 = \Phi(D)$
Proportion of individuals in the group with the higher mean who exceed the median individual of the other group[a,b]	Proportion of males who are more male-typical than the median female (= proportion of females who are more female-typical than the median male)[a,b]
$CL = \Phi\left(\lvert d\rvert/\sqrt{2}\right)$	$CL = \Phi\left(D/\sqrt{2}\right)$
Common language effect size. Probability that a randomly picked individual from the group with the higher mean will exceed a randomly picked individual from the other group[a,b]	*Common language effect size*. Probability that a randomly picked male will be more male-typical than a randomly picked female (= probability that a randomly picked female will be more female-typical than a randomly picked male)[a,b]
$PCC = \Phi(\lvert d\rvert/2)$	$PCC = \Phi(D/2)$
Probability of correct classification (predictive accuracy). Probability of correctly classifying a randomly picked individual as male or female with $d/2$ as the decision threshold[a,b,c]	*Probability of correct classification* (predictive accuracy). Probability of correctly classifying a randomly picked individual as male or female with linear discriminant analysis[a–c]
$\eta^2 = \frac{d^2}{d^2+4}$	$\eta^2 = \frac{D^2}{D^2+4}$
Eta squared. Proportion of variance explained by sex[a–c]	*Eta squared*. Proportion of generalized variance explained by sex[a–c]

(continued)

Table 1.1 (continued)

Univariate	Multivariate
$VR = S_M^2/S_F^2$	$VR = \lvert\mathbf{S_M}\rvert/\lvert\mathbf{S_F}\rvert$
Male:Female variance ratio	Male:female generalized variance ratio $\mathbf{S_M}$, $\mathbf{S_F}$: Male/female covariance matrices
$TR_{zSD} = \frac{\Phi(d-z)}{\Phi(-z)}$	$TR_{zSD} = \frac{\Phi(D-z)}{\Phi(-z)}$
Tail ratio. Relative proportion of males:Females in the region located z standard deviations above the female mean (use $-d$ for the relative proportion of females:Males in the region located z standard deviations above the male mean)[a–c]	*Tail ratio*. Relative proportion of males:females in the region located z standard deviations from the female centroid in the male-typical direction (= relative proportion of females:males in the region located z standard deviations from the male centroid in the female-typical direction)[a–c]

[a]The formula assumes equality of variances (univariate case) or covariance matrices (multivariate case) in the population
[b]The formula assumes (multivariate) normality in the population
[c]The formula assumes equal group sizes (i.e., equal proportions of males and females)

unfortunately, this includes the influential papers by Hyde (2005, 2014) and Zell et al. (2015). The irony is that Cohen did *not* intend these numbers as benchmarks to evaluate effect sizes in empirical data, but only as reasonable guesses to use when behavioral scientists want to perform a priori power analysis but have no information about the likely size of the effect.[2] In fact, what counts as "small" or "large" depends entirely on the area of research, the variables under consideration, and the goals of a particular study (Hill et al., 2008; Vacha-Haase & Thompson, 2004). To give just a few examples: A "small" effect can be quite consequential if the phenomenon of interest happens in the tails of the distribution, where average differences are amplified (Sect. 1.2.1.8). Further, the apparent size of an effect can be diminished by measurement error: when measures are contaminated by high levels of noise, differences may appear much smaller than they actually are (Sect. 1.3.3). Even a difference that is genuinely small from a practical standpoint can have significant theoretical implications if rival hypotheses predict no difference at all. In this context, the practice of labeling differences as trivial if they fall below an arbitrary threshold such as $d = 0.10$ (Hyde, 2005, 2014) is especially troubling.[3] Conversely,

[2]In Cohen's own words: "The terms "small," "medium," and "large" are relative, not only to each other, but to the area of behavioral science or even more particularly to the specific content and research method being employed in any given investigation [. . .] In the face of this relativity, there is a certain risk inherent in offering conventional definitions for these terms for use in power analysis in as diverse a field of inquiry as behavioral science. This risk is nevertheless accepted in the belief that more is to be gained than lost by supplying a common conventional frame of reference *which is recommended only when no better basis for estimating the ES index is available*." (Cohen, 1988, p. 25; emphasis added). This must have been one of the least successful warnings in the history of statistics.

[3]Of course, it is always possible to test the null hypothesis that a given difference is exactly zero, or within a range that makes it practically equivalent to zero for the purpose of a particular study. In contrast with standard significance testing, Bayesian methods can directly quantify the evidence in

effects that are "large" by Cohen's standards can be nearly useless if one needs to make highly accurate predictions or classifications; to illustrate, $d = 0.80$ implies a predictive accuracy of about 66%, which is better than chance but may be too low in some applied contexts (see Sect. 1.2.1.5). Also, a conventionally "large" effect may be *comparatively* small if the other effects in the same domain are consistently larger. This is not just the case for Cohen's *d*: The same principle applies to all the effect sizes discussed in this chapter. The idea that the practical importance of an effect can be determined mechanically using fixed conventional guidelines is tempting, but deeply misguided.

1.2.1.2 Multivariate Standardized Difference (Mahalanobis' *D*)

Univariate differences are important, but there are situations in which they may easily miss the forest for the trees. Many psychological constructs are intrinsically multidimensional, from personality and cognitive ability to occupational preferences. When investigators are interested in global sex differences within a certain domain, univariate differences calculated for individual variables can be relatively uninformative (or even positively misleading if they are simply averaged together; see Del Giudice, 2009). The reason is that relatively small differences across multiple dimensions can add up to a substantial overall difference. Moreover, the exact way in which multiple variables combine into a global effect size depends on the sign and size of their mutual correlations, and cannot be judged by simply looking at univariate effects. Sex differences in facial morphology nicely illustrate this point (Fig. 1.1a). On average, men and women differ in individual anatomical features such as mouth width, forehead height, and eye size; but univariate

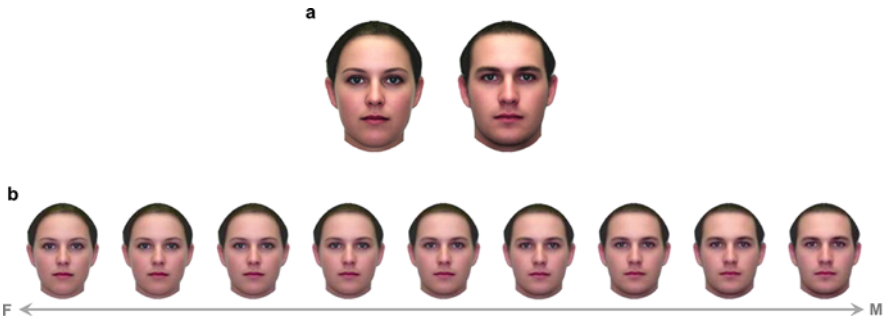

Fig. 1.1 Sex differences in facial morphology. (**a**) Composite male and female faces (averages of 24 pictures each). (**b**) The continuum of male-female typicality in facial features. The figure shows a sequence of morphed faces, from 100% female to 100% male. Adapted with permission from Rhodes et al. (2004). Copyright 2004 by Elsevier Ltd.

support of the null hypothesis (see Dienes, 2016; Kruschke & Liddell, 2018; Wagenmakers et al., 2018).

differences in each of those features (mostly below $d = 1.00$) are too small to accurately distinguish between the sexes. However, the *combination* of multiple features yields two clearly distinct clusters of male vs. female faces, to the point where observers can correctly determine sex from pictures with more than 95% accuracy (Bruce et al., 1993; see Del Giudice, 2013).

The natural metric for measuring global sex differences across multiple variables is Mahalanobis' D, the multivariate generalization of Cohen's d (Huberty, 2005; Olejnik & Algina, 2000; Table 1.1). The value of D is the distance between the centroids (multivariate means) of the male and female distributions, relative to the standard deviation along the axis that connects the centroids. Figure 1.2 illustrates the geometric meaning of D in the case of two variables (for more details see Del Giudice, 2009). The interpretation of D is essentially the same as that of d, with the difference that D is unsigned and cannot take negative values (reflecting the multivariate nature of the comparison). Confidence intervals for D can be obtained with bootstrapping (Kelley, 2005; Hess et al., 2007) or with exact methods, which unfortunately are not always applicable (see Reiser, 2001; Zou, 2007). Procedures for obtaining a pooled correlation matrix are discussed in Furlow and Beretvas (2005). Simple R functions to calculate D with confidence intervals, corrections for bias and measurement error (Sect. 1.3), heterogeneity statistics (see below), and other diagnostics and effect sizes are available at https://doi.org/10.6084/m9.figshare.7934942.

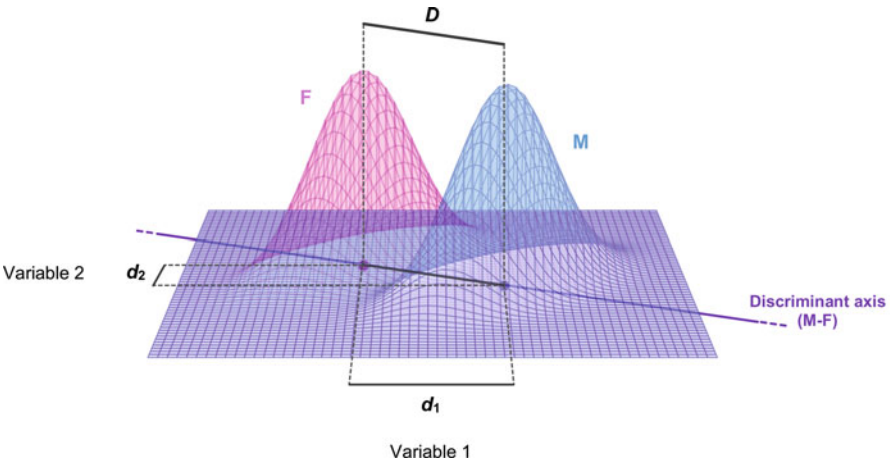

Fig. 1.2 Illustration of Mahalanobis' distance (D) in the bivariate case. D is the standardized distance between the male and female centroids in the bivariate space, taking the correlation between variables into account. (If the variables are uncorrelated, D reduces to the Euclidean distance.) Note that the distributions in the figure are bivariate normal with equal covariance matrices. The axis that connects the male and female centroids can be interpreted as a dimension of male-female typicality or "masculinity-femininity" (M-F) with respect to the relevant variables. Univariate differences are represented as d_1 and d_2

The axis connecting the centroids summarizes the differences between males and females across the entire set of variables, and can be conveniently interpreted as an overall dimension of male-female typicality or masculinity-femininity (M-F) in the domain described by those variables.[4] To illustrate: In the case of facial morphology, the M-F axis would represent a continuum of male-female typicality like the one shown in Fig. 1.1b.[5] This continuum summarizes the combination of anatomical features that make a particular face male- or female-typical. Depending on the size of *D*, the male and female distributions may overlap substantially along the continuum or form largely separate clumps (as in Fig. 1.2). Individual scores on the M-F axis are closely related to the *gender diagnosticity* index proposed by Lippa and Connelly (1990). Gender diagnosticity is the probability that a given individual is male (or, symmetrically, female), estimated with linear discriminant analysis from a set of sexually differentiated variables (e.g., preferences for various occupations or activities). This probability can be used as an index of masculinity-femininity, and is a function of an individual's position along the M-F axis.

In sum, *D* is a convenient index for multivariate differences that generalizes Cohen's *d* and has the same substantive interpretation. Oddly, *D* has been overlooked for decades as a possible measure of group differences (e.g., Huberty, 2002; Vacha-Haase & Thompson, 2004). While *D* has been occasionally discussed as an effect size (Hess et al., 2007; Olejnik & Algina, 2000; Sapp et al., 2007), it has not been used in sex differences research until very recently. An instrumental role in the "rediscovery" of *D* was played by a large-scale analysis of sex differences in personality I performed with my colleagues (Del Giudice et al., 2012), as part of a series of papers on multivariate effect sizes (Del Giudice, 2009, 2013, 2017, 2018). Initial applications of *D* have shown much larger sex differences than previously expected, in domains ranging from personality ($D = 2.71$ in Del Giudice et al., 2012; $D = 2.10$ in Kaiser et al., 2020; uncorrected average $D = 1.12$ in Mac Giolla & Kajonius, 2019; uncorrected average $D = 1.24$ in Lee & Ashton, 2020) and vocational interests ($D = 1.61$ in Morris, 2016) to mate preferences (average $D = 2.41$ in Conroy-Beam et al., 2015). For comparison, the size of multivariate sex differences in facial morphology is about $D = 3.20$ (Hennessy et al., 2005).

An alternative approach followed by some investigators is to combine multiple sex-differentiated variables (e.g., personality items) into a summary score, usually by adding or averaging them together. This method approximates the M-F dimension with a single composite variable; accordingly, effect sizes in these studies are larger than typical univariate differences but smaller than the differences found with

[4] Except in special cases, the M-F axis does not coincide with the discriminant axis. However, the position of an individual point along the M-F axis (i.e., its projection onto the M-F axis in the direction of the classification boundary) is equivalent to its position along the discriminant axis. Thus, scores on the M-F axis provide the same information as discriminant scores.

[5] In this case, "male-female typicality" is arguably preferable to "masculinity-femininity:" studies have shown that when observers make judgements of facial masculinity, they rely on facial cues of body size in addition to sexually dimorphic features (Holzleitner et al., 2014; Mitteroecker et al., 2015).

D in the same domains (e.g., $d = 1.41$ for vocational interests in Lippa, 2010; $d = 1.09$ for personality in Verweij et al., 2016). In a recent paper, Phillips et al. (2018) employed a hybrid method to obtain individual "sex differentiation" scores from brain structure data.[6] First, they computed a differentiation index for each brain feature, based on the ratio of the probability densities in males and females (an approach that is conceptually similar to gender diagnosticity). They then selected a subset of features showing sizable sex differences and averaged them into a summary score. The effect size for this differentiation score was about $d = 1.80$.[7] Depending on how they are constructed, summary scores can be less prone to overfitting the sample data than D (see Sect. 1.3.2); at the same time, they discard information about the correlation structure of the variables and tend to underestimate the overall effect. Note that systematic variation in effect sizes across studies may depend on several factors, from differences in the reference populations (e.g., cross-cultural or age-related effects) to the methods employed to correct for measurement error and other artifacts (more on this in Sect. 1.3.3).

It is worth stressing that multivariate effect sizes like D are not meant to replace univariate indices like Cohen's d. Univariate and multivariate approaches are complementary, and whether one of them provides a more meaningful description of the data is going to depend on the specific question being asked. Criticism of D as an effect size has focused on the supposed lack of interpretability of the M-F axis, and on the fact that D can be inflated by adding large numbers of irrelevant variables (Hyde, 2014; Stewart-Williams & Thomas, 2013). While these points can be readily addressed (see above and Sect. 1.3.2; for a lengthier discussion see Del Giudice, 2013), they do raise the crucial point that D is only meaningful to the extent that it summarizes a coherent, theoretically justified set of variables. A related issue is that many multidimensional constructs in psychology are also hierarchical; for example, the broad-band structure of personality can be usefully described with five broad traits (the *Big Five:* extraversion, openness, agreeableness, conscientiousness, and neuroticism/emotional instability), but each of those traits can be split into multiple narrower traits or "facets" (e.g., the possible facets of extraversion include friendliness, gregariousness, activity, assertiveness, excitement-seeking, and cheerfulness). If sex differences in the lower-order facets of a trait run in opposite directions, they may cancel out at the level of broad traits, leading to underestimates of the actual effect size (see Del Giudice, 2015; Del Giudice et al., 2012). Thus, the choice of the

[6] Of note, Phillips et al. (2018) framed their study as a demonstration that "the sex of the human brain can be conceptualized along a continuum *rather than* as binary" (emphasis added). But this is not what they did: the correlations between sex differentiation scores and other variables were calculated within each sex, meaning that sex was treated as a binary variable and implicitly "controlled for" by analyzing males and females separately.

[7] The paper did not report descriptive statistics for the differentiation score; unfortunately, the raw data were not available for reanalysis (Owen R. Phillips, personal communication, November 2, 2018). I extracted frequencies and central bin values from the histogram in Figure 1 of Phillips et al. (2018) with ImageJ 1.50 (Schneider et al., 2012), and used them to recover approximate sample statistics (females: $M = -0.25$, $SD = 0.29$; males: $M = 0.26$, $SD = 0.27$).

appropriate level of analysis is an important consideration when applying multivariate methods to hierarchical constructs.

Another complication in the interpretation of multivariate indices like D concerns the relative contribution of individual variables to the overall effect. From D values alone, it is impossible to tell whether the multivariate effect reflects the joint contribution of many variables, or the overwhelming contribution of one or a few variables. I have proposed two indices that can be used to aid the interpretation of D (Del Giudice, 2017, 2018). The heterogeneity coefficient H_2 ranges from 0 (maximum homogeneity; all variables contribute equally) to 1 (maximum heterogeneity; the totality of the effect is explained by just one variable). The "equivalent proportion of variables" coefficient EPV_2 (also on a 0–1 scale) estimates the proportion of equally contributing variables that would produce the same amount of heterogeneity, if the other variables in the set made no contribution. Accordingly, smaller values of EPV_2 indicate higher heterogeneity (e.g., $EPV_2 = 0.30$ means that the same amount of heterogeneity would obtain if 30% of the variables contributed equally and the remaining 70% made no contribution to the effect). For example, in the personality dataset analyzed by Del Giudice et al. (2012) the heterogeneity coefficients are $H_2 = 0.90$ and $EPV_2 = 0.16$, suggesting that the overall difference is largely driven by a small subset of variables. Note that there are several possible ways to assign credit to individual variables (e.g., Garthwaite & Koch, 2016); the method used to calculate H_2 and EPV_2 is somewhat ad hoc and will likely be superseded by better alternatives (see Del Giudice, 2018). Still, these indices can be used heuristically to contextualize plain D values and flag patterns that may warrant further attention.

1.2.1.3 Indices of Overlap (OVL, OVL_2)

In contrast with difference metrics, indices of overlap focus on similarity, as they quantify the proportion of the distribution area (or volume/hypervolume) that is shared between males and females. When overlap is high, many males have female-typical scores and many females have male-typical scores. The *overlapping coefficient* (OVL) is the proportion of each distribution that is shared with the other (Bradley, 2006). This is a highly intuitive index of overlap; however, many researchers use a somewhat different index (OVL_2), in which overlap is calculated as the shared area relative to the joint distribution.[8] The corresponding value can be calculated as $1–U_1$, where U_1 is Cohen's coefficient of nonoverlap (Cohen, 1988). Typically, the quantity of interest is overlap rather than nonoverlap; for convenience I use the label OVL_2 to indicate $1–U_1$, the proportion of overlap relative to the joint distribution. While OVL_2 is a common index in psychology, its practical

[8] The difference between OVL and OVL_2 can be visualized by looking at Figure 1.5. OVL = (purple area)/(purple area + blue area) = (purple area)/(purple area + pink area). OVL_2 = (purple area)/(purple area + blue area + pink area).

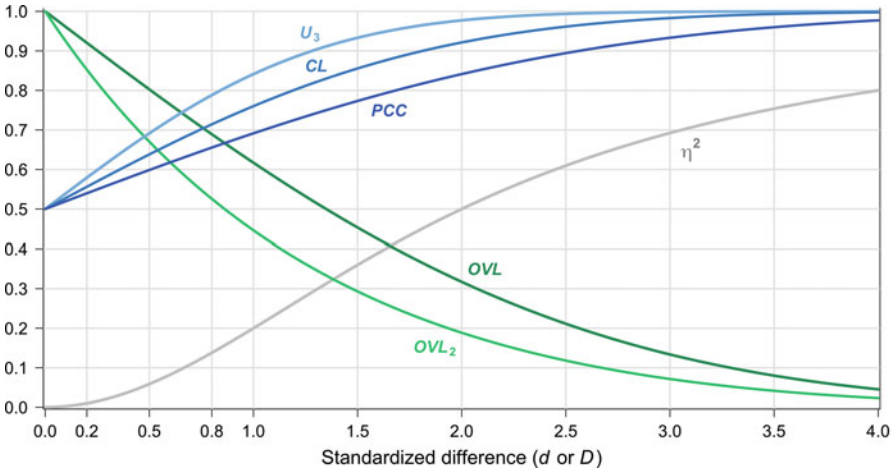

Fig. 1.3 Relations between the standardized mean difference (Cohen's *d* or Mahalanobis' *D*) and various indices of difference/similarity. All conversion formulas assume (multivariate) normality and equality of variances/covariance matrices. See Table 1.1 for details. *OVL* = proportion of overlap on a single distribution. OVL_2 = proportion of overlap on the joint distribution (equals $1–U_1$ in Cohen's terminology). U_3 = proportion of a group above the median of the other group. *CL* = common language effect size ("probability of superiority"). *PCC* = probability of correct classification (assuming equal group sizes). η^2 = proportion of variance explained (assuming equal group sizes)

interpretation is somewhat obscure, and some authors have argued (quite convincingly) that *OVL* is preferable in most contexts (e.g., Grice & Barrett, 2014).

It is easy to convert *d* or *D* values into indices of overlap under the assumption of population normality and equality of variances (in the univariate case), or multivariate normality and equality of covariance matrices (in the multivariate case; Table 1.1). (For brevity, in the remainder of the chapter I will refer to these assumptions as "normality" and "equality of variances/covariances.") The conversion is the same for univariate and multivariate indices, as shown in Fig. 1.3. For example, both $d = 0.50$ and $D = 0.50$ correspond to $OVL = 0.80$ and $OVL_2 = 0.67$, indicating that 80% of each distribution and 67% of the joint distribution are shared between the sexes. Overlap coefficients can also be estimated with nonparametric methods (e.g., Anderson et al., 2012; Schmid & Schmidt, 2006), which may be useful when the standard assumptions are severely violated (see Sect. 1.3.1).

1.2.1.4 Indices of Superiority (U_3, *CL*)

Another way of looking at differences and similarities is to ask what proportion of people in the group with the higher mean would score above the median member of the other group. The answer is provided by Cohen's U_3 coefficient, which can be obtained from *d* or *D* under the same assumptions of overlap indices (Fig. 1.3;

Table 1.1). For example, both $d = 0.50$ and $D = 0.50$ correspond to $U_3 = 0.69$. Following the usual conventions, $U_3 = 0.69$ with a positive d means that 69% of males score above the median female (or, equivalently, that 69% of females score below the median male; Cohen, 1988). The interpretation of U_3 changes slightly when one is dealing with a multivariate distribution. Specifically, U_3 becomes the proportion of males that are more "masculine" or "male-typical" than the median female—or, symmetrically, the proportion of females that are more "feminine" or "female-typical" than the median male.

The *common language effect size* (*CL*; also known as "probability of superiority") is another popular index that translates group differences into probabilities. Specifically, *CL* is the probability that a randomly picked individual from the group with the higher mean will outscore a randomly picked individual from the other group (McGraw & Wong, 1992). By assuming normality and equality of variances/covariances, *CL* can be easily obtained from d or D (Fig. 1.3; Table 1.1). As with U_3, the interpretation of *CL* changes somewhat in a multivariate context, and becomes the probability that a randomly picked male will be more "masculine" or "male-typical" than a randomly picked female (or, symmetrically, the probability that a randomly picked female will be more "feminine" or "female-typical" than a randomly picked male). The original *CL* index can be generalized to discrete distributions (Vargha & Delaney, 2000), and there are procedures to calculate confidence intervals when standard assumptions do not apply (Vargha & Delaney, 2000; Zhou, 2008).

1.2.1.5 Probability of Correct Classification (*PCC*)

The *probability of correct classification* (hereafter *PCC*), *predictive accuracy*, or *hit rate* is the probability that a randomly picked individual will be correctly classified as male or female based on the variable(s) under consideration.[9] The ability to reliably infer the sex of an individual can have considerable practical value and offers an intuitive measure of the degree of statistical separation between two groups. This approach to quantification differs from those reviewed until now in that the probability of success depends (implicitly or explicitly) on the statistical model used to perform the classification task. The problem is greatly simplified when the assumptions of normality and equality of variances/covariances are satisfied. If this is the case, linear discriminant analysis (LDA) approximates the optimal classifier (James et al., 2013), and the *PCC* can be estimated as a simple function of the standardized difference d or D, assuming equal group sizes (Fig. 1.3; Table 1.1; Dunn & Varady, 1966; Hess et al., 2007). For example, both $d = 0.50$ and $D = 0.50$ correspond to $PCC = 0.60$, that is, a 60% probability of correctly classifying a random individual as male or female. Returning to the example of male/female faces discussed earlier, the predictive accuracy of human observers is 0.95 or more; under

[9] This is different from gender diagnosticity (Sect. 1.2.1.2), which is the estimated probability that a *particular* individual is male (or female), regardless of his/her actual sex.

standard assumptions, this would imply a multivariate difference $D \geq 3.30$, a figure very close to the one estimated from face morphology data (about $D = 3.20$ in Hennessy et al., 2005).

If variances/covariances differ between the sexes but normality still applies, the approximately optimal classifier is not LDA but QDA (quadratic discriminant analysis; see James et al., 2013). When distributions are strongly non-normal and patterns of sex differences are characterized by nonlinearity and higher-order interactions, the *PCC* is going to depend on the particular classification model chosen for the analysis. The menu of available methods has been expanding rapidly thanks to advances in machine learning; common options include logistic regression, classification trees, support vector machines (SVMs), and deep neural networks (see Berk, 2016; Efron & Hastie, 2016; James et al., 2013; Skiena, 2017). Sophisticated classification methods can be especially effective in complex datasets with large numbers of variables; it is not a coincidence that many recent applications to sex differences come from neuroscience. To give just a few examples: van Putten et al. (2018) trained a neural network on electroencephalogram signals (EEG) and were able to identify the sex of participants more than 80% of the time. Using regularized logistic regression, Chekroud et al. (2016) achieved 93% accuracy in identifying the sex of adult participants from brain structure. The same accuracy (93%) was reported by Anderson et al. (2018) with SVM and regularized logistic regression, and by Xin et al. (2019) with a neural network. By applying SVM to brain scan data, Joel et al. (2018) obtained 72–80% accuracy in adults, while Sepehrband et al. (2018) achieved 77–83% accuracy in children and adolescents. In all these studies, classification was performed on multivariate data from the whole brain, not on individual brain regions. Interestingly, the sex differentiation score computed by Phillips et al. (2018) from brain structure data (see Sect. 1.2.1.2) yields an expected $PCC = 0.82$ (estimated from $d = 1.80$), which is close to the performance of more complex algorithms.[10]

1.2.1.6 Variance Explained (η^2)

The proportion of variance in the variable of interest that is explained by a categorical predictor (e.g., sex) is usually labeled *eta squared* (η^2; see Lakens, 2013; Olejnik & Algina, 2000). This is a classic effect size but not a very intuitive one; for this reason, it is seldom employed in sex differences research (but see Deaux, 1985). The value of η^2 can be obtained from d or D assuming normality and equality of variances/covariances; for simplicity, the formulas presented in Table 1.1 also assume equal group sizes. As can be seen in Fig. 1.3, $d = 0.50$ and $D = 0.50$

[10]Note that multivariate patterns of sex differences in brain structure are strongly influenced by sex differences in total brain volume. Because different regions show different scaling functions with respect to overall volume, simple linear adjustments do not fully remove the effect of males having larger brains on average. In a recent study that used more sophisticated correction methods, classification accuracy dropped from more than 80% to about 60% (Sanchis-Segura et al., 2020).

correspond to $\eta^2 = 0.06$, or 6% of variance explained by sex. Explaining 50% of the variance requires a male-female difference of two standard deviations. The main problem with indices of variance explained is that values perceived as "small" are easy to underestimate and dismiss as trivial, even when they reflect meaningful or practically important effects (for extended discussion of this point see Abelson, 1985; Breaugh, 2003; Prentice & Miller, 1992; Rosenthal & Rubin, 1979).

1.2.1.7 Variance Ratio (*VR*)

Males and females may differ not only in their mean value on a trait, but also in their *variability* around the mean. When computing most of the indices reviewed in this chapter, unequal variances are treated as a deviation from standard assumptions (Table 1.1); however, systematic differences in variability may be interesting in their own respect, for example because they can have large effects on the relative proportions of males and females at the distribution tails (Sect. 1.2.1.8).

Empirically, males have been found to show larger variance than females in a majority of traits, including most dimensions of personality (except neuroticism; see Del Giudice, 2015), general intelligence (e.g., Arden & Plomin, 2006; Dykiert et al., 2009; Johnson et al., 2008), specific cognitive skills (e.g., Bessudnov & Makarov, 2015; Hyde et al., 2008; Lakin, 2013; Wai et al., 2018), brain size (e.g., Ritchie et al., 2018; Wierenga et al., 2017), and many other bodily and physiological features (see Del Giudice et al., 2018; Lehre et al., 2009). In the human literature, this is known as the "greater male variability hypothesis" (for a historical perspective see Feingold, 1992), but the same general pattern is apparent in most sexually reproducing species (Wyman & Rowe, 2014; Del Giudice et al., 2018). Some of these differences seem to reflect scaling effects: If the variability of a trait increases with its mean level, the sex with the higher mean will also show the larger variance. This is the case for physical traits such as height, body mass, and brain volume. While the variance of these traits is higher in males, the coefficient of variation (i.e., the standard deviation divided by the mean) is very similar in men and women (Del Giudice et al., 2018). However, greater male variance is also found in domains in which average differences are very small or favor females (such as general intelligence and most personality traits).

The standard index for sex differences in variability is the *variance ratio* (*VR*), which by convention is the ratio of the male variance to the female variance. In sex differences research, variance ratios are usually calculated on univariate distributions (confidence intervals on *VR* are discussed in Shaffer, 1992). However, the generalized variance of a multivariate distribution is the determinant of the covariance matrix (Sen Gupta, 2004); a generalized variance ratio can be easily obtained as the ratio of the male and female generalized variances (Table 1.1). Equality of variances corresponds to $VR = 1.00$. In the domains of personality and cognition, values of *VR* estimated from large samples are often smaller than 1.20 and rarely larger than 1.50. For neuroticism and related traits, which tend to be more variable in females, *VR* usually ranges between 0.90 and 1.00 (Del Giudice, 2015; Hyde, 2014;

Lakin, 2013; Lippa, 2009). For comparison, the variance ratio for height is estimated at about $VR = 1.11$ (average across countries; Lippa, 2009).

1.2.1.8 Tail Ratio (*TR*)

The relative proportions of males and females in the region around the mean are often less interesting than their representation at the tails of the distribution. This is typically the case when the outcome of interest depends on competition (e.g., selection of the top-ranking applicants for a job), the crossing of a threshold (e.g., selection requiring a minimum passing score), or other nonlinear effects (e.g., the probability of committing violent crimes may increase more steeply at the upper end of the distribution of aggression). Crucially, small differences between means can have a substantial impact as one moves toward the tails of the distribution; and even if males and females have exactly the same mean on a trait, sex differences in variability can produce marked differences at the extremes (Halpern et al., 2007).

When the tails of the distribution are the focus of interest, summary indices such as mean differences and overlap coefficients are uninformative; researchers may wish to calculate a *tail ratio* (*TR*), that is, the relative proportion of the two sexes in the region above (or below) a certain cutoff. Here I adopt a slight variation of the reference group method proposed by Voracek et al. (2013); the alternative approach by Hedges and Friedman (1993) uses the total distribution of the two groups combined. In the standard version of Voracek et al.'s method, the group with the lower mean serves as the reference group, and the cutoff to identify the tail is placed at z standard deviations from the lower mean (where z can be any value). The choice of cutoff is noted as TR_{zSD}: for example, TR_{2SD} is the tail ratio for a cutoff located $z = 2$ standard deviations above the lower mean; $TR_{2.5SD}$ is the tail ratio for a cutoff located $z = 2.5$ standard deviations above the lower mean; and so on. In the context of sex differences, it is arguably more useful to pick one of the two sexes as the reference group regardless of the ranking of means; in the following I use females as the reference group, following the standard convention for variance ratios. While Voracek et al. (2013) proposed benchmarks for the interpretation of *TR* modeled on those for Cohen's *d*, fixed conventions are even less meaningful in this context and should probably be avoided.

Tail ratios can be estimated from means and variances assuming normality, or from *d* and *D* with the additional assumption of equal variances/covariances (Table 1.1). However, the resulting estimates can be very sensitive to violations of these assumptions (see Sect. 1.3.1), and researchers working with large samples often calculate tail ratios directly from frequency data rather than from summary statistics (e.g., Lakin, 2013; Wai et al., 2018). Figure 1.4 shows how *d* determines the tail ratios above three common cutoffs. With equal variances ($VR = 1$), an effect size $d = 0.50$ corresponds to $TR_{1SD} = 1.94$, $TR_{2SD} = 2.94$, and $TR_{3SD} = 4.60$. In other words, there are almost twice as many males as females in the region one standard deviation above the female mean (TR_{1SD}); almost three times as many in the region two standard deviations above the female mean (TR_{2SD}); and 4.6 times as

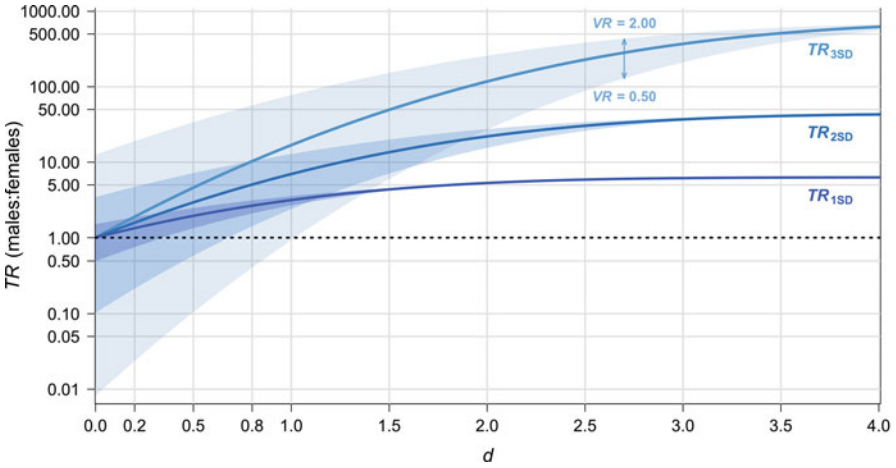

Fig. 1.4 Tail ratios and the effect of unequal variances. The thick lines show the relative proportion of males to females above the cutoffs located at one, two, and three standard deviations from the female mean (TR_{1SD}, TR_{2SD}, and TR_{3SD}) for positive values of *d*. Calculations assume normality, equal group sizes, and equal variances in the two sexes (variance ratio $VR = 1.00$). The shaded areas represent changes in tail ratios when variances are unequal, ranging from $VR = 0.50$ (twice as high in females) to $VR = 2.00$ (twice as high in males). Note that the impact of unequal variances on *TR* is stronger when the difference between means is smaller and/or the cutoff is more extreme

many in the region three standard deviations above the female mean (TR_{3SD}). As the standardized difference increases, *TR* becomes disproportionately larger (note that the vertical axis of Fig. 1.4 is logarithmic). Figure 1.4 also illustrates the major impact of unequal variances, which—depending on how they combine with distribution means—can dramatically amplify sex imbalances in the tails, but also attenuate or even reverse them. While standardized differences and overlap coefficients are robust to minor sex differences in variability, tail ratios can be remarkably sensitive to unequal variances. Specifically, the impact of *VR* is maximized when *d* or *D* values are smaller and/or the chosen cutoff is more extreme (Fig. 1.4).

1.2.2 Other Methods

1.2.2.1 Relative Distribution Methods

A powerful but surprisingly underused approach to group differences employs the statistical concept of a *relative distribution* to compare the distribution of a comparison group to that of a reference group (Handcock & Janssen, 2002; Handcock & Morris, 1998, 1999). A key tool of relative distribution methods is the *relative density plot,* which shows how the ratio of the comparison distribution (e.g., males) to the reference distribution (e.g., females) changes at different levels (quantiles) of the reference distribution. An example of relative density plot is

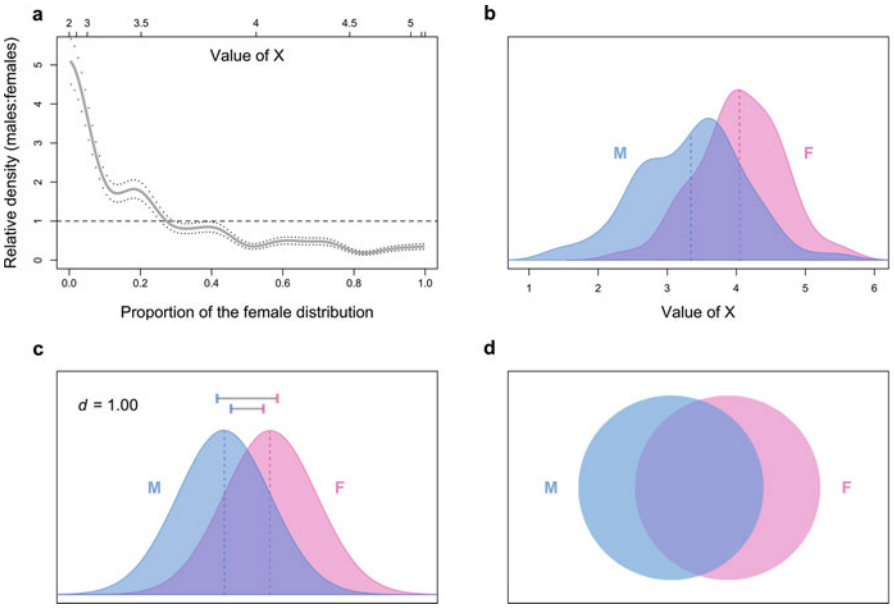

Fig. 1.5 Four visualizations of sex differences/similarities. All plots are based on the same dataset with $d = 1.0$. (**a**) Relative density plot. This plot shows the relative male:female density at different quantiles of the female distribution (bottom axis); the corresponding values of the variable (X) are shown for references on the top axis. Dotted lines represent 95% pointwise confidence intervals. Assuming equal group sizes, a relative density of 1.0 (horizontal dashed line) indicates equal proportions of males and females. Under the same assumption, there are about five time as many males as females with values at the lower extreme of the female distribution (0.0 on the bottom axis; relative density ≈ 5.0). At the median of the female distribution (0.5 on the bottom axis) there are about three times as many females as males (relative density ≈ 0.3), approximately the same proportions found at the upper extreme (1.0 on the bottom axis). (**b**) Overlay density plot of the male and female distributions. This plot shows the shape of the distributions, their overlap, and the location of means (vertical dotted lines). (**c**) Normalized plot of the male and female distributions. This plot shows the standardized mean difference and the corresponding overlap assuming normality and equality of variances (in this case, $OVL = 0.62$ and $OVL_2 = 0.45$). Horizontal bars represent 95% confidence intervals on d; the colors on the bottom bar can be reversed when the interval includes opposite-sign values. (**d**) Venn diagram of the overlap between the male and female distributions. This type of diagram can be used to intuitively communicate the overall size of effects in complex multivariate contexts

shown in Fig. 1.5a (see the figure legend for more details). The relative density function contains all the information about the differences between the male and female distributions, including differences in central tendency (mean or median), differences in variability, and differences in the shape of the two distributions. For this reason, the relative density plot is a remarkably informative display that can be used for high-resolution exploration of the data (for a conceptually similar approach that employs quantile differences instead of relative densities, see Rousselet et al., 2017; Wilcox, 2006).

Besides visual exploration, relative distribution methods also support various types of quantitative inference. Most intriguingly, the relative distribution can be easily decomposed into independent components that separate the effects of location (i.e., differences in means or medians) from those of shape (including, but not limited to, differences in variance). These components of the distribution can be plotted separately to visually examine their characteristics, or quantified and compared using information-theoretic measures (for details and examples see Handcock & Morris, 1998). Despite their many attractive features, relative distribution methods have been largely ignored in sex differences research; the few applications I am aware of—limited to relative density plots—are in Bessudnov and Makarov (2015), Del Giudice (2011), and Del Giudice et al. (2010, 2014).

1.2.2.2 Taxometric Methods

The goal of taxometrics is to use observable indicators to infer the latent structure of a given domain (Beauchaine, 2007; Meehl, 1995; Ruscio et al., 2011, 2013). Specifically, taxometric procedures examine patterns of variation and covariation among indicators to distinguish cases in which differences between individuals are purely dimensional (e.g., a continuum of increasingly severe antisocial behavior) from those in which the data reflect the existence of categories with non-arbitrary boundaries (e.g., psychopaths vs. non-psychopathic individuals)—or, stated otherwise, categories that differ from one another in kind and not just degree (*taxa*). Taxonic and dimensional variation are not mutually exclusive, and often coexist within the same domain (e.g., psychopaths may vary in the severity of their antisocial symptoms; see Ruscio et al., 2013).

Carothers and Reis (2013; Reis & Carothers, 2014) performed a taxometric analysis on various putative indicators of gender, which they distinguished from biological sex: measures of sexuality, mating preferences, empathy, intimacy, and personality (including the Big Five). They found overwhelming support for a dimensional model and concluded that the latent structure of gender—in contrast with that of sex—is not a binary but a continuum. They also argued that average sex differences are "not consistent or big enough to accurately diagnose group membership" (p. 401). However, a simpler interpretation of these findings is that the indicators used in the study were too weak to detect the underlying taxa. As also noted by the authors, taxometric procedures quickly lose sensitivity as group differences on the indicators become smaller than $d = 1.20$ (Beauchaine, 2007; Ruscio et al., 2011); but almost all the effect sizes in the study were below this threshold, and often substantially so. Because the indicators were inadequate to detect taxonic differences, the analysis predictably indicated a dimensional structure. The only set of psychological indicators with adequate effect sizes was a list of preferences for sex-typed activities (e.g., boxing, hair styling, playing golf). Predictably, sex-typed activities showed clear evidence of taxonicity, but this result was not treated as part of the main analysis. Also, the authors' claim that sex differences are too small and inconsistent to infer a person's sex from psychological measures is

unfounded: Personality traits alone can correctly classify males and females with high probability, provided they are measured at the level of narrow traits and aggregated with multivariate methods. For example, $D = 2.71$ (Del Giudice et al., 2012) yields $PCC = 0.91$ using the standard formula.[11] In contrast, the Big Five lack the resolution to accurately differentiate the sexes, and the corresponding effect sizes ($d = 0.19$–0.56 in the study) are too small to regard these traits as valid taxometric indicators. In light of these limitations, the findings by Carothers and Reis (2013) are hard to interpret with any confidence.

Beyond this particular study, it is unclear whether taxometric methods can make a substantive contribution to sex differences research. The purpose of taxometrics is to probe for the existence of taxa that cannot be directly observed, as is often the case with mental disorders (Meehl, 1995). In meaningful applications, one does not know a priori whether the hypothetical taxa exist or not, and there is a genuine possibility that the underlying structure of the data is fully dimensional. But in the case of sex differences, the taxa (males and females) are already known to the investigators, and indicator variables are chosen precisely because they can distinguish between males and females. Given these premises, studies that use sufficiently strong indicators (e.g., sex-typed activities) can be expected to confirm the existence of two sexes, whereas studies that use weak indicators will be uninterpretable because of their lack of sensitivity, as in Carothers and Reis (2013). Either way, the results are going to be uninformative, unless the goal is to look for *additional* taxonic distinctions within each sex (e.g., discrete categories related to sexual orientation; Gangestad et al., 2000; Norris et al., 2015).

1.2.2.3 Internal Consistency Analysis

Internal consistency analysis was introduced by Joel et al. (2015) in a famous study of sex differences in brain structure. The first step of this procedure is to select a subset of variables showing the largest sex differences (e.g., volumes of particular brain regions) and split each of them in three equal-sized categories—the most male-typical third, the most female-typical third, and the middle third. Each participant is then classified based on his/her combination of variables: Participants who fall in the male-typical, female-typical, or intermediate category on all the variables are deemed "internally consistent"; those with at least one male-typical and one female-typical variable are said to show "substantial variability" and are regarded as "mosaics." Joel et al. (2015) found very low proportions of internally consistent individuals (ranging from 0.1% to 10.4%), not only in brain structure but also in personality, attitudes, and preferences for sex-typed activities. Based on these

[11] Of course, this effect size is based on latent variables, and the corresponding *PCC* assumes error-free measurement (Sect. 1.3.3). The point remains valid: in principle, a combination of narrow personality traits can accurately discriminate between males and females. Note that Carothers and Reis' claim concerned the *actual* amount of overlap between the sexes, not the attenuating effects of measurement error.

findings, they claimed that most people are characterized by a mosaic of male and female brain features, a pattern that undermines any attempt to distinguish between "male" and "female" brain types. In later work, Joel and others have argued that extensive brain mosaicism calls into question the use of sex as an independent variable in neuroscience (Joel & Fausto-Sterling, 2016; Hyde et al., 2019).

Unfortunately, the method devised by Joel et al. (2015) is seriously flawed. The threshold for consistency is both arbitrary and exceedingly high: It is easy to show that, in realistic conditions, the method *always* returns a small proportion of "internally consistent" individuals, regardless of the pattern of differences and correlations among variables (Del Giudice et al., 2015, 2016). This remains true even when the variables show unrealistically high levels of consistency (i.e., all correlations among variables equal to 0.90). In light of this, it is not surprising that Joel et al. (2015) found only 1.2% of internally consistent individuals in the domain of sex-typed activities, with the same data that showed clear evidence of taxonicity in Carothers and Reis' (2013) analysis.[12] While "substantially variable" profiles are more sensitive to variations in the data (Del Giudice et al., 2015; Joel et al., 2016), the percentages returned by this method can be quite misleading if taken at face value. The authors have continued to present their findings as evidence that most brains are "gender/sex mosaics" (Joel & Fausto-Sterling, 2016; Hyde et al., 2019). The question they address is without doubt an important one; patterns of consistency/inconsistency among sex-related traits can be both theoretically interesting and practically important. However, their method is designed to show invariably low levels of internal consistency, and I cannot recommend it as a useful analytic tool.

1.2.3 Visualization

There are many possible ways to visualize sex differences/similarities in plots and diagrams; the most appropriate type of display is going to depend on the researchers' aims and their intended audience. Figure 1.5a shows a relative density plot with females as the reference group (Sect. 1.2.2.1). This plot does not depict the original distributions but only their relative differences, and highlights the behavior of the variable in the tail regions. While relative density plots can be very informative, they are not immediately intuitive and require some technical background to interpret. A similar type of plot based on quantile differences instead of relative densities is discussed in Rousselet et al. (2017) and Wilcox (2006). In Fig. 1.5b, the male and female probability densities are overlaid on the same plot (e.g., Ritchie et al., 2018). This straightforward display conveys a lot of information, including the shape of the

[12] To see why, consider a fictional man who hates talk shows and cosmetics and is passionate about boxing and video games (male-typical values), but does not particularly like golf (intermediate). He would be classified as showing an "intermediate" profile of gendered interests. If he happened to dislike golf (female-typical value), he would be classified as a sex/gender mosaic with a "substantially variable" interest profile (see Del Giudice et al., 2015).

two distributions, the difference between means, and the amount of male-female overlap—though it is less effective than the relative density plot in showing differences in the tail regions. Overlay density plots are similar to split violin plots, in which densities are displayed side by side instead of overlaid (e.g., Wai et al., 2018); however, split violin plots make it hard to visualize the overlap between distributions. Both density and relative density plots can be used to visually detect obvious deviations from standard assumptions.

When effect sizes are mapped on normal distributions (with equal or unequal variances), normalized density plots (Fig. 1.5c) offer an intuitive display of standardized differences and overlaps (e.g., Maney, 2016[13]). Plots of actual or normalized distributions can be easily augmented with confidence intervals on *d*, as shown in Fig. 1.5c. Still, this kind of plot is inherently univariate, and can be misleading when one wants to present the results of multivariate analyses. In complex multivariate contexts, the overlap between distributions is usually the most intuitive metric; overlap coefficients can be visualized with Venn diagrams (Fig. 1.5d) in which areas represent proportions of overlap and nonoverlap (e.g., Del Giudice et al., 2012).

1.3 Statistical and Methodological Issues

1.3.1 Assumption Violations

Many of the standard formulas presented in this chapter make the assumptions of normality and equality of variances/covariances in the population. These formulas are useful because they allow investigators to calculate a wide range of indices from commonly reported statistics such as means, standard deviations, correlations, and values of *d* or *D*. Moreover, some non-standard indices (e.g., multivariate overlap between non-normal distributions) may be complicated to obtain even if raw data are available. Still, deviations from normality are quite common: Empirical data are frequently skewed, have heavier tails than expected under a normal distribution, and so on (e.g., Limpert & Stahel, 2011). The size of indices like *d* and *D* is sensitive to both non-normality and the presence of outliers (Wilcox, 2006); moreover, exact formulas for confidence intervals are only accurate when normality can be assumed. Remedies to these distorting effects include bootstrap confidence intervals and robust variants of Cohen's *d* that eliminate the influence of extreme values (e.g., Algina et al., 2005; see Kirby & Gerlanc, 2013). Deviations from normality may also change the amount of overlap between distributions. When this is the case, robust

[13]Note that some of the normalized plots in Maney (2016) show atypically large differences in variance between males and females, up to about $VR = 23$. However, those plots are based on very small samples, and the extreme differences in variability they display are most likely due to sampling error.

nonparametric methods can be used to estimate the *OVL* coefficient in place of the usual formulas (Anderson et al., 2012; Schmid & Schmidt, 2006). As noted in Sect. 1.2.1, when variances/covariances are markedly unequal it is possible to use QDA instead of LDA to estimate the *PCC*; however, both models are quite sensitive to non-normality (Eisenbeis, 1977), which limits the utility of standard formulas when normality assumptions are not met.

The most widely used test of univariate normality is the Shapiro-Wilk test (Garson, 2012; Yap & Sim, 2011). Multivariate normality is harder to assess, and no single method performs well in all conditions (Mecklin & Mundfrom, 2004, 2005). Thus, the recommended approach is to combine multiple tests (which do not always agree with one another) and supplement them with graphical displays (Holgersson, 2006; Korkmaz et al., 2014; see Mecklin & Mundfrom, 2004). Levene's test is the standard procedure for comparing variances, and there are robust versions of the test that are less sensitive to non-normality (Gastwirth et al., 2009). The equality of covariance matrices is usually evaluated with Box's M test. Unfortunately, the M test suffers from a high rate of false positives (i.e., it rejects homogeneity too often) and is very sensitive to departures from multivariate normality; the latter problem can be lessened by using robust variants of the test (Anderson, 2006; O'Brien, 1992). More generally, using significance tests to evaluate assumptions is not without problems. With small samples, many tests have low power to detect violations; but when sample size is large, very small deviations from perfect normality/homogeneity may cause a test to reject the assumption, even if the practical consequences may be negligible.

In sex differences research, the phenomenon of greater male variability (complemented by some instances of greater female variability) implies that the assumption of equal variances is literally false in a majority of cases. If so, it makes little sense to perform significance tests of strict equality: If equality is not expected, a non-significant result may just mean that the test was underpowered. At the same time, sex differences in variance are relatively mild—as noted in Sect. 1.2.1, variance ratios are often lower than 1.20 and rarely higher than 1.50. Large discrepancies between male and female variances typically occur as a consequence of non-normality (e.g., skewed distributions with long tails), the presence of outliers, ceiling/floor effects, and other artifacts. With variance ratios in the usual range and approximately normal distributions, the results of the formulas in Table 1.1 are very close to the actual values even when variances differ between the sexes (with the exception of tail ratios; see below). Because equality of variances cannot be generally assumed, one can test the equality of correlation matrices (which are standardized and do not contain information on variance) instead of that of covariance matrices. This can be done with various significance tests (e.g., Jennrich, 1970; Steiger, 1980; see Revelle, 2018). However, these tests suffer from the usual problems of low sensitivity in small samples and excessive sensitivity in large samples (see above). An alternative that does not rely on significance is to compare sample correlation matrices with Tucker's *congruence coefficient* (φ or *CC*; Abdi, 2007). The *CC* coefficient in an index of matrix congruence that ranges from −1.00–1.00. Lorenzo-Seva and ten Berge (2006) proposed benchmarks for *CC*

based on expert judgments; following their recommendations, values of 0.85 or more indicate fair similarity, while values above 0.95 indicate high similarity. A high value of *CC* implies that there are no major discrepancies between the correlation matrices of males and females. In many applications, this justifies the use of multivariate indices, with the caveat that the resulting values are best regarded as reasonable approximations. Inspection of the correlation matrices (and their difference) may point to specific variables that seem to behave differently in the two sexes. Yet another strategy is to employ structural equation modeling (SEM) to fit a multigroup factor model of the variables (see below), and use model fit indices to evaluate the equivalence of correlations in the two sexes (e.g., Del Giudice et al., 2012).

While most of the standard formulas are robust to minor violations of their assumptions, this is emphatically *not* the case of tail ratios. The formulas used to estimate *TR* from effect sizes or summary statistics are very sensitive to small deviations from the hypothesized distributions, particularly when differences between groups are small and/or cutoffs are extreme (Fig. 1.4). Thus, estimates of *TR* based on standard formulas should be treated with special caution unless the underlying assumptions can be reasonably justified.

1.3.2 Biases in Effect Sizes

When they are calculated from sample data, d and D are not unbiased estimators of the corresponding population parameters but exhibit a certain amount of bias away from zero (i.e., their expected value overestimates the absolute size of the effect). Bias is typically negligible in large samples, but can be substantial in small studies; it transmits to other indices when conversion formulas are used (Table 1.1), and may lead investigators to overestimate the size of sex differences in their data. The bias in d arises from the fact that the pooled sample variance slightly underestimates the population variance, and is only an issue when sample size is very small: It amounts to less than 5% of the absolute value when the total N is $\geq$18, and less than 1% when $N \geq 78$. The bias-corrected variant of Cohen's d is known as d_u or Hedges' g; a simple correction formula is reported in Table 1.1 (see Hedges, 1981; Kelley, 2005). The bias in D is a bigger concern, because random deviations from zero in the univariate effects (caused by sampling error) add up and collectively inflate the value of D. In a previous paper (Del Giudice, 2013), I suggested a simple rule of thumb based on simulations: The bias in D can be kept to acceptable levels (i.e., less than 0.05 in absolute value) by having at least 100 cases for each variable in the analysis (e.g., $N \geq 500$ when calculating D from 5 variables). The rule works as advertised when $D \geq 0.45$, but bias can still be substantial for smaller values of D. A better alternative when N is small relative to the number of variables is to use the correction formula reported in Table 1.1, which yields the small-sample variant D_u (Lachenbruch & Mickey, 1968; Hess et al., 2007).

Capitalization on chance is also an issue with η^2, which tends to systematically overestimate the amount of variance explained. The index ω^2 (*omega squared*) provides a less biased variant of η^2 that can be useful when working with small samples (Lakens, 2013; Olejnik & Algina, 2000). More generally, multivariate methods tend to overfit the sample data, leading to overestimate both the proportion of variance they can explain and the accuracy of their predictions. This is obviously the case when standard formulas are used to estimate *PCC* from inflated values of *D* (see Glick, 1978). However, all kinds of predictive models—from logistic regression to classification trees and SVMs—tend to overfit the sample on which they are trained; to the extent that they do, their performance can be expected to drop when they are applied to a new, different set of data. Reducing overfit to improve out-of-sample predictions and obtain correct estimates of a model's performance is a major concern in the field of machine learning. Common tools employed to this end include cross-validation, regularization, and model selection based on information criteria (see Berk, 2016; Efron & Hastie, 2016; Hooten & Hobbs, 2015; James et al., 2013).

1.3.3 Measurement Error and Other Artifacts

While upward bias increases the apparent size of sex differences, measurement error has the opposite effect. When variables are measured with error, the raw difference between group means remains approximately the same but the standard deviation is inflated by noise; as a consequence, standardized indices like *d* and *D* become proportionally smaller. When measurement is unreliable, this reduction (*attenuation*) can be substantial. In classical test theory, the reliability of a measure is the proportion of variance attributable to the construct being measured ("true score variance," as contrasted with "error variance"). Assuming that sex is measured without error, the true value of *d* is attenuated by the square root of the reliability: $d = 1.00$ becomes 0.95 if the measure has 90% reliability, 0.84 with 70% reliability, and 0.71 with 50% reliability (Schmidt & Hunter, 2014; see also Schmidt & Hunter, 1996). In the case of *D*, measurement error reduces both the univariate differences and the correlations among variables; these effects may either reinforce or oppose one another depending on the correlation structure and the direction of the univariate effects. In the field of sex differences, the large majority of individual studies and meta-analyses fail to correct for attenuation due to measurement error, and as a result yield downward biased estimates of effect sizes. This is also the case of the literature syntheses compiled by Hyde (2005) and Zell et al. (2015).

There are two main approaches to correcting for measurement error. The first and simpler method is to estimate the reliability of measures from sample data, then disattenuate *d* by dividing it by the square root of the reliability coefficient. For example, consider a standardized difference $d = 0.50$ on a variable with reliability 0.77. The square root of 0.77 is 0.88, and the disattenuated *d* is $0.50/0.88 = 0.57$. To calculate *D*, both univariate effect sizes and correlations need to be disattenuated. To

disattenuate a correlation, one divides it by square root of the product of the two reliabilities. For example, consider a correlation $r = 0.30$ between two variables with reliabilities 0.77 and 0.82. The product of these reliabilities is 0.63, its square root is 0.79, and the disattenuated r is $0.30/0.79 = 0.38$. While this method is an improvement over no correction at all, reliability is typically estimated with *Cronbach's alpha* (α), an index with substantial methodological limitations. In realistic conditions, α tends to yield deflated values when applied to unidimensional scales (Dunn et al., 2014; McNeish, 2018; Revelle & Condon, 2018). More worryingly, values of α do not reflect the unidimensionality of a test: If the items measure more than one construct, or tap additional specific factors on top of the general factor they are supposed to measure, α can be substantially inflated (Cortina, 1993; Crutzen & Peters, 2017; Schmitt, 1996). For other ways to estimate reliability and a review of alternative indices, see McNeish (2018), Revelle and Condon (2018), and Zinbarg et al. (2005). Also note that disattenuated effect sizes have larger sampling errors than their attenuated counterparts; this should be taken into account when calculating confidence intervals (see Schmidt & Hunter, 2014).

The second and more sophisticated approach is to use latent variable methods (most commonly SEM) to explicitly model the factor structure of the measures, and obtain estimates of sex differences on latent variables instead of observed scores (e.g., Del Giudice et al., 2012; for a different approach to factor analysis with SEM see Marsh et al., 2014). This applies to both univariate and multivariate differences. If the factor structure is correctly specified, latent variable modeling sidesteps the many problems of α and can achieve nearly error-free estimates of the underlying effects (Brown, 2015; Kline, 2016; Rhemtulla et al., 2018). Typically, SEM estimates of sex differences are notably larger than those obtained with reliability-based disattenuation. In Del Giudice et al. (2012), we examined the effect of different correction methods on the same dataset (15 personality facets in a large United States sample). With uncorrected raw scores, we obtained $D = 1.49$. Disattenuation with α raised the estimate to $D = 1.72$; fitting a multigroup SEM and calculating the effect size from latent mean differences and correlations yielded $D = 2.71$. Similarly, Mac Giolla and Kajonius (2019) calculated D on 30 facets of the Big Five, with no error correction; their average estimate across countries was $D = 1.12$. Of course, the use of SEM raises additional methodological issues, primarily that of measurement invariance between the sexes (or lack thereof; see Brown, 2015; Kline, 2016). Note that while invariance is desirable, the practical impact of statistically significant violations may be small enough to be tolerable or even negligible (especially in large samples; e.g., Schmitt et al., 2011). Nye and Drasgow (2011) developed methods to quantify the effects of measurement non-invariance at the item level and estimate its impact on observed (not latent) group differences. In presence of sizable distortions, it may still be possible to estimate latent differences by fitting a partially invariant model (Guenole & Brown, 2014; Schmitt et al., 2011). As an alternative to SEM, models based on item response theory (IRT) can also be used to estimate sex differences on latent variables (e.g., Liddell & Kruschke, 2018).

Measurement error is not the only artifact researchers should guard against. Floor and ceiling effects can severely distort measurement, and either inflate or deflate sex

differences depending on the direction of the effect, the direction of the artifact (floor vs. ceiling), and the relative variances of males and females (Wilcox, 2006; see also Liddell & Kruschke, 2018). Range restriction is another insidious artifact that occurs in a variety of research contexts: When the participants of a study are (directly or indirectly) selected from the original population on the basis of their personal characteristics, the resulting effect sizes can be substantially biased. There are several methods and formulas that attempt to correct for range restriction, though they are not without limitations (see Schmidt & Hunter, 2014; Johnson et al., 2017).

1.3.4 Meta-Analysis

Meta-analysis plays a prominent role in contemporary research on sex differences and similarities. The main function of meta-analysis is to aggregate evidence across studies, and correct for variation caused by sampling error to obtain accurate, reliable estimates of effect sizes (see Borenstein et al., 2009; Cooper et al., 2009; Schmidt & Hunter, 2014). With enough studies in the meta-analytic dataset one can examine the effect of moderators, both substantive (e.g., age of the participants) and methodological (e.g., different questionnaires or testing procedures). Standard methods of meta-analysis take individual effect sizes at face value; the main exception is the psychometric approach developed by Schmidt and Hunter (2014), which emphasizes the need to correct effect sizes for measurement error, range restriction, and other artifacts before meta-analyzing them.

Meta-analysis is a vast improvement over old-fashioned "vote counting" of significant vs. non-significant results (for an unfortunate example see Ellis et al., 2008), but it is not a panacea. As with primary research, the methodological quality of published meta-analyses is highly variable (Nakagawa et al., 2017 provide useful evaluation guidelines); the tendency to regard the results of meta-analytic studies as "definitive" should be tempered in view of the many levels of judgment involved in their design and execution. While aggregation can effectively deal with sampling error, it does nothing to correct the other artifacts reviewed in this section, which have to be deliberately addressed (see Schmidt & Hunter, 2014). Moreover, meta-analyses may overlook important moderators of a given effect, leading to a distorted picture of its size. This problem is exacerbated when the findings of multiple meta-analyses are aggregated into a "meta-synthesis." For example, Zell et al. (2015) obtained a summary effect size for each meta-analysis included in their synthesis by averaging all the effect sizes reported in the same meta-analysis. At this level of aggregation, the risk of obtaining meaningless results increases dramatically, especially when estimates that pertain to widely different variables and domains are pooled into a single model. Moreover, the magnitude of sex differences in some domains can be drastically underestimated if effect sizes that would be best aggregated with multivariate methods (Sect. 1.2.1) are simply averaged together.

A persistent problem in meta-analysis is the distorting influence of publication and reporting bias. Low statistical power (primarily due to small sample size) and

selective reporting of results can generate large amounts of statistically significant "false positives"; more troubling from the standpoint of meta-analysis, even the true effects in the published literature are likely to be systematically inflated (Ioannidis, 2005, 2008a). For example, a recent study found evidence indicating positive reporting bias in brain imaging studies of sex differences (David et al., 2018). Note that the same statistical and methodological factors can also promote "reverse bias" (the selective non-publication, non-reporting, and deflation of effect sizes) if certain findings go against the social/ideological preferences of the field (Ioannidis, 2005, 2008a; see also Coburn & Vevea, 2015). This is not an unreasonable concern, if one considers that claims of large sex differences in psychology are often denounced as dangerous and socially harmful (e.g., Fine, 2010; Hyde, 2005; Reis & Carothers, 2014). In principle, several methods can be used to detect publication and/or reporting bias in meta-analytic datasets (Jin et al., 2015). Unfortunately, the standard tests are easy to misapply, suffer from high rates of false negatives unless the dataset includes a large number of studies, and may mistake other sources of heterogeneity for evidence of bias (Ioannidis, 2008b; Ioannidis & Trikalinos, 2007; Jin et al., 2015). Thus, common tests of bias can be meaningfully applied only in the relatively few cases in which effect sizes are fairly homogeneous across studies (Ioannidis & Trikalinos, 2007).

In recent years, standard procedures based on the distribution of effect sizes have been joined by *p-curve* and *p-uniform* analyses, two methods that rely on the distribution of significant *p* values in a set of studies to detect selective publication and/or reporting (Simonsohn et al., 2014a, 2015; van Assen et al., 2015). The same methods can be used to estimate the average effect size of a set of studies from their significant *p* values (Simonsohn et al., 2014b; van Assen et al., 2015), thus complementing standard meta-analytic techniques. However, both *p*-curve and *p*-uniform may overestimate the population effect when studies are highly heterogeneous (van Aert et al., 2016). There are also some concerns about the validity of *p*-curve methods in non-experimental research, when changes in significance may depend on the selective inclusion of covariates in the analysis (see Bruns & Ioannidis, 2016).

1.4 Conclusion

In concluding this chapter it may be useful to point out that, important as it is, successful quantification is only the beginning of understanding. Research on sex differences and similarities relies on an exceptionally rich toolkit of methods, ranging from experimental studies to developmental, cross-cultural, and even comparative research across species. Together, these methods can be used to understand how sex differences in various domains vary systematically across contexts, and what are the main factors that reduce or amplify them. At a deeper level, an emphasis on measurement should not blind investigators to the possibility that males and females may differ in *qualitative* rather than purely quantitative ways. For example,

the same traits may be influenced by different causal factors in the two sexes, or predict different patterns of outcomes. If multiple sexually differentiated traits interact with each other in complex patterns, they may give rise to configural or "gestalt" effects that are not well captured by their linear combination (as implicitly assumed by *D* or discriminant analysis). Other nonlinear relations between traits and outcomes (e.g., threshold effects) may turn graded quantitative differences into discrete transitions. In some cases, males and females may possess different psychological specializations that follow qualitatively different rules of operation. No doubt, the study of sex differences and similarities will remain an exciting enterprise for a long time to come, and it is easy to predict that high-quality measurement will play an ever more central role in the future of the field.

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Chapter 2
Prenatal Steroid Hormones and Sex Differences in Juvenile Rhesus Macaque Behavior

Kim Wallen

Abstract Rhesus monkeys (Macaca mulatta) have been the primary primate model for investigating hormonal organization of juvenile sexually dimorphic behavior, primarily rough play and mounting. Large doses of androgens administered to pregnant females for 75 or more days of gestation masculinized the genitalia and juvenile behavior of female offspring. Unlike in rodents, estrogenic metabolites of androgens do not appear to play a role in behavioral sexual differentiation of rhesus monkeys as the nonaromatizable androgen, 5α-dihydrotestosterone, produced comparable behavioral masculinization in this species. Because prenatal androgen treatments masculinized both behavior and genitalia, some argued that the behavioral changes seen in androgenized rhesus monkey females reflect socialized responses to their genital's male-like appearance. By varying the timing of prenatal androgen exposure, the effects of androgens on genitals and behavior were separated. Thirty-five-day androgen treatments in early gestation masculinized female genitalia and mounting in rhesus monkeys, but did not masculinize rough play. By contrast, treatments late in gestation did not masculinize genitalia, but masculinized both rough play and mounting, thus separating genital effects of androgens from behavioral effects. Subsequent work with androgens and antiandrogens identified late gestation as a time when behavioral systems are particularly sensitive to androgens. A study of monkey's preference for human sex-typed toys found sex differences remarkably similar to those reported in children. Since the sex-typed nature of the toys would be unknown to the monkeys, the preference likely reflects a sex-difference in the predisposition for activities facilitated by the toys. Sexually differentiated behavior ultimately reflects both hormonally organized behavioral predispositions and the social experience that converts these predispositions into behavior.

Keywords Aromatization · Androgens · Masculinization · Maternal interest · Monkey · Mounting · Neonatal · Play · Prenatal · Sexual differentiation · Social behavior · Toy preference

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There is great interest in human sex differences and gender development, but experiments to identify causal mechanisms are generally impossible to do in humans. Instead researchers have turned to animal models with the rhesus monkey being the primary nonhuman primate model for investigating behavioral sex differences that may be relevant to humans. Many factors make them a valuable model species. Rhesus monkeys, like humans, have a long developmental life span, live in complex social groups, and exhibit striking sexually differentiated behavioral patterns both during development and in adulthood. Additionally, rhesus monkeys share important biological systems with humans, including a prenatal period of sexual differentiation, making them ideal for investigating basic mechanisms of hormonal effects on sexual differentiation that cannot be experimentally investigated in humans.

Sexual differentiation of behavior has been investigated in few of the many nonhuman primate species. The vast majority of studies use rhesus monkeys. While these studies have elucidated a great deal about sexual differentiation in a nonhuman primate, we know little, if anything, about the extent or the mechanisms of sexual differentiation of behavior in apes, new world primates, or non-Macaque species. However, the range of treatments investigated in rhesus monkeys and the diverse social conditions employed have revealed a number of important relationships that help frame research in other primate species, including humans. Thus this review focuses on hormonal influences on sexual differentiation of behavior in rhesus monkeys. Hormonal mechanisms of sexual differentiation in rhesus monkeys have been investigated in the context of a long history of studies on the role that hormones play in sexual differentiation.

The organizational hypothesis, the notion that androgens or their metabolites alter the developing nervous system during specific developmental periods permanently inducing behavioral characteristics of males and females, has become a central tenet of behavioral neuroendocrinology since the pioneering study of Phoenix et al. (1959). While specific details of hormonally induced organization continue to be debated (Arnold & Breedlove, 1985; Fitch & Denenberg, 1998), there is little doubt that exposure to steroid hormones, particularly androgens, during periods of developmental sensitivity permanently alters the responsivity of individuals to their environment.

Most studies of the organizational effects of steroids on the sexual differentiation of behavior has come from studies of altricial species, such as rats, mice, and hamsters, who are born prior to complete neural differentiation (Wallen & Baum, 2002), guinea pigs and Macaques being the only precocial mammalian species whose sexual differentiation has been extensively studied. Whether the distinction of altricial and precocial mammals (Gaillard et al., 1997) explains differences in the species-specific processes of sexual differentiation remains unresolved. There is little doubt, however, that precocial species differ from the more typically studied altricial species in the timing of sexual differentiation and in the role of estrogenic metabolites of androgens in sexual differentiation (Wallen & Baum, 2002). This is of particular importance for considerations of human sexual differentiation, as the

commonly used altricial rat and mouse models of sexual differentiation may not apply to precocial humans as they appear to use different hormonal mechanisms to produce behavioral sexual differentiation than is the case in precocial species. Thus the results of studies of the precocial rhesus monkey are likely to be more directly relevant to humans.

2.1 Sexually Differentiated Behavior in Rhesus Monkeys

Rhesus monkeys are born with their genitals and internal reproductive anatomy completely differentiated. Unlike altricial species, such as rats, hamsters, and mice, morphological sexual differentiation occurs prenatally in rhesus monkeys as it does in humans. Rhesus monkeys have an approximately 168-day gestation with three approximate 55-day trimesters. In males the testes differentiate in the first trimester between gestation day 38–40 (Resko, 1985). Fetal testes become steroidogenically active around gestation day 40 and secrete androgens throughout gestation with peak levels at gestation days 40–75 (second trimester), then decline with another apparent increase around gestation day 140 (third trimester) (Resko, 1985). Throughout the prenatal period males experience significantly higher levels of testosterone (T) than do females, though there are no apparent differences between the sexes in either 5α-dihydrotestosterone (DHT) or androstenedione (Resko, 1985; Resko & Ellinwood, 1981). The fetal ovaries are apparently quiescent at this time since females show significantly elevated luteinizing hormone (LH) levels in comparison to males and LH levels are suppressed by exogenous T in fetally ovariectomized females (Ellinwood et al., 1982). Thus fetal males are exposed to elevated levels of T from their own testes and females are exposed to lower, but quantifiable, T levels, presumably of maternal origin since the fetal ovary is inactive. It is not known if humans show the same pattern as multiple sampling of prenatal hormones is not possible in humans. From the reproductive anatomical difference between boys and girls it is clear at some point prenatally, likely the second and third trimester, boys experience higher level of androgens than do females.

As is the case in humans, rhesus monkeys have a period of infant and juvenile dependency and development, when behavioral predispositions fully develop. Rhesus monkeys develop more quickly than do humans (e.g., developmentally, a rhesus monkey year equals approximately four human years). Thus, while sharing many important features with humans, rhesus monkeys make a practical and valuable model system for investigating behavioral sexual differentiation.

Rhesus monkeys display several sexually differentiated patterns of juvenile and adult behavior (Lovejoy & Wallen, 1988; Wallen, 1996). The primary sexually differentiated behavioral patterns are higher levels of juvenile mounting and high energy expenditure play (rough play) in males (Goy & Wallen, 1979; Lovejoy & Wallen, 1988), greater interest in infants (Herman et al., 2003), and greater association with adult females (Lovejoy & Wallen, 1988; Wallen, 1996) in juvenile

females. Of these there are analogous human sex differences in play and interest in infants. In addition, infant distress vocalizations, which occur when infants are temporarily rejected or restrained by their mother, are also sexually differentiated in rhesus monkeys (Tomaszycki et al., 2001). Juvenile rhesus monkeys, similar to children, show social sex segregation (Hassett et al., 2010) and human-like sex differences in toy preferences (Hassett et al., 2008). In adult rhesus monkeys, play rarely occurs, but adult males display greater levels of mounting, now accompanied by intromissions and ejaculations, whereas females show increased interest in infants (Maestripieri & Wallen, 1995) and higher levels of sexual initiation (Maestripieri & Wallen, 1995; Wallen et al., 1984).

2.2 Social Influences on Behavioral Sex Differences

Social context and rearing conditions affect the expression of rhesus monkey infant and juvenile behavioral sex differences. A previous review of social influences on sexually differentiated behavior in rhesus monkeys (Wallen, 1996) concluded that some patterns of juvenile behavior differ between males and females almost completely as a result of social context and rearing history. In this regard, some sex differences in rhesus monkeys appear to be the result of socialization as is often invoked in explaining the ontogeny of human sex differences. In contrast, other behaviors are significantly affected by prenatal hormonal conditions and appear to differ between the sexes under all social and rearing conditions studied (Wallen, 1996). The present review focuses on those behavioral patterns where sex differences occur in more than one social environment, or, where the effect of socialization processes has not been investigated. Other behavioral patterns, such as juvenile aggression and submission, suggested to be sexually differentiated (Harlow & Harlow, 1962; Harlow, 1962), are now known to vary with the social environment with sex differences occurring in some environments and not in others (Wallen, 1996). The determining factor appears to be the amount of social interaction juveniles have with each other, with sex differences in juvenile rhesus monkey aggression and submission occurring only in social contexts that severely limit the amount of juvenile social interaction (Wallen, 1996).

2.3 Neonatal Hormonal Secretions and Rhesus Monkey Behavioral Sex Differences

In male rhesus monkeys, testicular activity falls on the day of birth and then increases within 24 hr., remaining at adult-like levels for the first 2–3 months of life (Mann et al., 1993; Mann et al., 1984). There does not appear to be similar neonatal ovarian activation in female rhesus monkeys, although there may be a

gonadal negative feedback suppression of female gonadotropin secretion neonatally as neonatal ovariectomy results in elevated gonadotropins (Plant, 1986). Suppressing male neonatal T secretion appears to influence the timing of puberty (Mann et al., 1993; Mann et al., 1998), but has no striking effects on either juvenile (Wallen et al., 1995) or adult male behavior (Eisler et al., 1993). Neither neonatal castration (Goy & McEwen, 1980; Pomerantz et al., 1986) nor suppression of neonatal T secretion using gonadotropin releasing hormone (GnRH) agonists or antagonists in males have produced evidence that neonatal hormonal secretions are involved in behavioral masculinization or defeminization in males or are involved in normal female sexual differentiation (Nevison et al., 1997; Brown & Dixson, 1999; Wallen et al., 1995; Wallen, 1996). The only behavioral effect of neonatal T was found when males were exposed neonatally to supraphysiological levels of T (Wallen et al., 1995); these males initiated proximity with their mothers significantly less than did either females or males whose neonatal T had been suppressed (Wallen et al., 1995). However, even though supraphysiological T levels appeared to alter juvenile male maternal independence, the effect was limited to supraphysiological levels of T, as suppressing endogenous neonatal T did not significantly alter maternal independence in males in comparison to either normal males or females (Wallen et al., 1995). This finding suggests that some aspects of juvenile social behavior may be sensitive to neonatal hormonal influences, but the effects are not striking or pervasive. It seems more likely that hormonal influences during the neonatal period elaborate predispositions that are hormonally organized prenatally. In this regard rhesus monkeys, like humans, are quite different from altricial mammals, where sex differences in adult behavior develop following elevated neonatal androgens (Corbier et al., 1992). Human male's testes, like those of monkey males, secrete nearly adult levels of T for 3–5 months neonatally (Forest, 1979; Forest & Cathiard, 1975), and this elevated T secretion is not evident in boys with congenital hypogonadotropic hypogonadism (Bouvattier et al., 2011). It is not known, however, whether the failure to experience a neonatal rise in T has any behavioral effects on human males because this condition also results in failure of increased prenatal T, resulting in extensive lack of genital masculinization by the time birth occurs (Bouvattier et al., 2011). Thus, it would not be possible to attribute any behavioral differences solely to differences in neonatal T.

2.4 Sex Differences in Maternal Treatment of Infants

Sex differences in juvenile and adult behavior could result from differential maternal treatment of male and female infants, resulting in differential developmental patterns. While the notion that sex differences in rhesus monkey social behavior stem from differences in maternal socialization is attractive, there are few data to support this notion. Rhesus monkey mothers have not been found to react differently to males and females in regard to time spent grooming, restraining, or interacting with infants of each sex (Lovejoy & Wallen, 1988; Wallen, 1996). There are, however,

two patterns of maternal behavior that may be differentially expressed to male and female infants. Goy and colleagues reported that mothers inspect the genitals of their male offspring more frequently than they do those of female offspring (Goy et al., 1988). The original report was obtained from 4–6 monkey mother-infant groups in relatively sparse surroundings that limited activities; thus the behavior might have reflected a response to limited activities available in the social environment. However, this maternal difference was also seen in larger (20–125 monkeys), more socially complex groups housed in outdoor compounds offering many behavioral opportunities (Wallen et al., 1995). In this latter case, males had either suppressed, typical, or supraphysiological neonatal T levels and maternal inspection of their male offspring's genitals was proportional to penis size (Wallen et al., 1995) and may thus reflect that the male's penis presents the opportunity for maternal manipulation not seen in females.

The only other maternal behavior expressed differentially to male and female infants is maternal responsiveness to infant distress vocalizations. Mothers more reliably retrieved male infants when the males performed distress vocalizations (Tomaszycki et al., 2001). Given that greater inspection of male infant genitals seems to be the only consistent maternal sex difference in infant treatment, it seems unlikely that juvenile behavioral sex differences described in the following sections stem from differential maternal socialization. It is more likely that they result from behavioral predispositions that reflect hormonal modulation of nervous system development.

2.5 Prenatal Hormonal Influences on Behavioral Sex Differences

Prenatal hormonal influences on behavioral differentiation have been investigated primarily by exposing genetic female fetuses to supraphysiological levels of prenatal androgens, by injecting their mothers with 5–25 mg/day of either esterified testosterone (testosterone enanthate, propionate, or cypionate) or dihydrotestosterone (dihydrotestosterone propionate) (Goy & McEwen, 1980). Altering male's prenatal hormonal environment is considerably more difficult because the hormones they are exposed to come from the secretions of their own testes, which would have to be suppressed to alter the prenatal hormonal environment, whereas in females the hormones can be exogenously administered and researchers don't have to regulate the activity of the female's ovaries. One study of Japanese macaques, a species closely related to rhesus monkeys, employed abdominally implanted silastic packets containing crystalline testosterone, which produced maternal T levels (~75 ng/ml) comparable to those produced by injections (Eaton et al., 1990). Exogenous androgen treatments typically resulted in supraphysiological maternal androgen levels, but only 1/8th to 1/10th to the elevated maternal androgens reached the fetus resulting in fetal androgen levels within the normal fetal-male range (Resko et al., 1987). Thus a

T treatment that produces 75–125 ng/ml of T in the mother will produce levels within the normal fetal range for males, but levels 10–20-fold higher than normal in fetal females (Resko et al., 1980; Resko et al., 1987). If treatment is started early enough in gestation, these amounts will completely masculinize female genitalia. The behavioral effects of such treatments are thought to reveal the processes involved in normal masculine sexual differentiation. This conclusion is based on the assumption that the undifferentiated fetus is essentially female regardless of its actual genetic constituency and that in XY individuals masculine characteristics are imposed upon essentially female primordia. By varying the timing of the prenatal treatment the effects of androgens on genital anatomy can be separated from some of their effects on sexually differentiated behavior (Goy et al., 1988). In general, androgen treatments starting around 35 days of gestation (end of the first trimester) and continuing through gestation day 75 masculinize both reproductive anatomy and juvenile mounting, but not rough play (Table 2.1).

Treatments starting after gestation day 100 (end of the second trimester) have no detectable effect on female reproductive anatomy, but masculinize juvenile mounting and rough play (Goy et al., 1988). These androgen treatments have not been reported to have any effect on male offspring, possibly because the serum androgen levels in male fetuses of treated mothers do not differ from the endogenous levels produced by fetal testes (Resko et al., 1987).

My laboratory has prenatally administered lower testosterone doses than used in previous monkey studies of prenatal hormonal influences on behavioral and anatomical sexual differentiation. These lower T doses model the effects of accidental androgen exposure. In addition there were treatment groups that received the antiandrogen flutamide to investigate the effect of blocking androgen receptors on sexual differentiation in male and female monkeys (Herman et al., 2000). Treatments were done on pregnant time-mated females (Zehr et al., 2000) living as members of 65–125-member social groups containing multiple adult males and females and their offspring. Table 2.2 presents the acronyms and treatments for each of the subject groups used in this study. Pregnant females received either testosterone enanthate (20 mg/week, intramuscular (IM) in oil vehicle) which should masculinize behavior or flutamide (30 mg/kg twice daily in dimethlyl sulfoxide (DMSO) vehicle) which could block any masculinization from the small amount of endogenous T that females are exposed to from their mothers, or vehicle (twice daily DMSO). The timing of treatments was varied such that about half of the subjects' mothers received 30- or 35-day-long hormonal treatments starting on either gestation day 35 or 40 through gestation day 70 (early treatments) or on gestation day 110 or 115 through gestation day 145 (late treatments). Thus the duration of treatment was the same for both early and late treatments. Only the time in gestation varied between the treatment groups. All treatments were administered within the pregnant female's social group and infants were delivered within the social group and mothers and offspring remained in the group for the duration of the longitudinal study.

Testosterone treatment produced maternal T levels ranging from 2.4 ng/ml to 21.7 ng/ml at the treatment nadir (Herman et al., 2000), which was substantially lower than reported in previous monkey studies (Resko et al., 1987). Females

Table 2.1 Summary of effects of prenatal hormonal manipulations in relation to dosage and gestational timing on anatomical and behavioral endpoints in male and female rhesus monkeys in studies where the subjects were not reared in socially restricted conditions

Prenatal treatment [references]	Sex	Genital anatomy	Rough play	Juvenile Mount
Early flutamide 35 or 40 days (Herman et al., 2000; Wallen, 2005)	♀	↑ Female-like	↔	↔
	♂	↓ Masculinized	Not different from control ♀ and ♂	Not different from control ♀ and ♂
Early testosterone 35 or 40 days (~3 mg/day) (Herman et al., 2000; Wallen, 2005)	♀	↔	Not different from control ♀ and ♂	↔
	♂	↔	Not different from control ♀ and ♂	↔
Late Flutamide 35 or 40 days (Herman et al., 2000; Wallen, 2005)	♀	↔	Not different from control ♀ and ♂	↔
	♂	↓ Penis length	↔	↑ mounts
Late testosterone 35 or 40 days (~3 mg/day) (Herman et al., 2000; Wallen, 2005)	♀	↔	↔	↔
	♂	↑ Penis length (not significant)	↑ Rough play	↔
Early testosterone 25 days (10 mg/day) (Goy et al., 1988; Goy, 1981)	♀	Masculinized	↔	↑ Mounts
Late testosterone 25 days (10 mg/day) (Goy et al., 1988; Goy, 1981)	♀	↔	↑ Rough play	↑ Mounts
> 50 days TP or DHTP (10 mg/day) (Goy, 1970; Goy, 1981; Goy & Phoenix, 1972)	♀	Masculinized	↑ Rough play	↑ Mounts
DESDP >100 days (Goy & Deputte, 1996)	♀	↔	↑ Rough play	> Control ♀ < Control ♂
	♂	↔	↔	↔
DESDP 25 days late gestation (Goy & Deputte, 1996)	♀	↔	↔	↔

Key: ♀ = female, ♂ = male, ↔ = no effect (Does not differ from same-sex control), ↑ = increased, ↓ = decreased
Not different from control ♀ and ♂ = subject values in between ♀ and ♂controls
DHTP 5α-dihydrotestosterone propionate, *TP* testosterone propionate, *DESDP* diethylstilbestrol dipropionate
(Wallen, 2005, copyright Elsevier, used with permission granted, Nov. 8, 2019)

Table 2.2 Abbreviations and factors for treatment groups in a study of the effects of prenatal hormone treatment and timing during pregnancy in group-living male and female rhesus monkeys

Group abbreviation	Timing of treatment	Type of treatment	Sex of subject
VCM	Early or late	Vehicle	**M**ale
VCF	Early or late	Vehicle	**F**emale
EAF	**E**arly GD[a] 35 or 40 until GD 75	**A**ndrogen (20 mg testosterone enanthate/week	**F**emale
LAF	**L**ate GD 110 or 115 until GD 150	**A**ndrogen (20 mg testosterone enanthate per week)	**F**emale
EFF	**E**arly GD1 35 or 40 until GD 75	**F**lutamide (30 mg/kg twice daily)	**F**emale
LFF	**L**ate GD 110 or 115 until GD 150	**F**lutamide (30 mg/kg twice daily)	**F**emale
EAM	**E**arly GD[a] 35 or 40 until GD 75	**A**ndrogen (20 mg testosterone enanthate/week	**M**ale
LAM	**L**ate GD 110 or 115 until GD 150	**A**ndrogen (20 mg testosterone enanthate per week)	**M**ale
EFM	**E**arly GD1 35 or 40 until GD 75	**F**lutamide (30 mg/kg twice daily)	**M**ale
LFM	**L**ate GD 110 or 115 until GD 150	**F**lutamide (30 mg/kg twice daily)	**M**ale

[a]*GD* gestation day

exposed to these levels of testosterone early in gestation (early androgen females or EAF) showed little evidence of genital masculinization, except for increased anogenital distance. In addition, their neonatal gonadotropin secretion was altered, suggesting that significant androgen had reached the fetus, but at levels below those necessary to masculinize genitalia (Herman et al., 2000). Females exposed to testosterone late in gestation (LAF) and females exposed to flutamide early (EFF) or late (LFF) in gestation showed no clear effects of treatment on genital anatomy or neonatal neuroendocrine function (Herman et al., 2000). Males exposed to flutamide early in gestation (EFM) had significantly less masculinized penises and, in one case, had a penis with a urethral meatus separate from the penile shaft as is typical of females. Thus, EFM penises were both smaller and less typically masculine than those of control males. Males exposed to flutamide late in gestation (LFM) had male-typical genitals, but their penises were significantly smaller than those of control males. Androgen treatment either early (EAM) or late (LAM) in gestation had no measurable effect on male genital anatomy, likely reflecting that the T dose was very small and didn't likely add to the endogenous levels from male's testes. The finding that flutamide treatment reduced penis masculinization either extensively (EFM) or in terms of penile size demonstrates that the penis remains sensitive to androgens after the prenatal period when the genital tubercle differentiates into the penis.

The range of prenatal treatments and the differing social conditions under which rhesus monkeys have been studied allow some generalizations about the role that prenatal androgens play in sexual differentiation of behavior. The sections that

follow are organized around specific behavioral endpoints. The specific nature of the behavioral sex difference is first described and then the effects of alterations in the prenatal hormonal environment are discussed. Although much work remains to be done to fully articulate the role that prenatal androgens play in behavioral differentiation, it is apparent that their effects are pronounced and that androgens are critical for masculinization of behavior, whether the endpoint is one requiring concurrent hormonal activation, like adult copulatory behavior, or a pattern not needing hormonal activation, like juvenile rough play.

2.5.1 Sex Differences in Juvenile Social Behavior

The finding of Phoenix et al. (1959) that prenatal hormones altered adult responsiveness to gonadal hormonal activation of adult sexual behavior led some to suggest that steroid hormones primarily organized sensitivity to hormonal activation (Whalen, 1968). While this applies to adult sexual behavior requiring hormonal activation in adulthood, the existence of sexually differentiated behavior that does not require hormonal activation for its expression provides the opportunity to distinguish the organization of behavioral patterns from the organization of sensitivity to hormonal activation. The demonstration by Harlow (1962) of sexually differentiated infant and juvenile behavior in monkeys provided an excellent behavioral system for investigating the effects of prenatal hormones on the organization of behavior. While several of the sex differences described by Harlow (1962), "rigidity," "threatening," and "withdrawal," are only seen in socially impoverished environments (Wallen, 1996), two patterns in particular, rough play and juvenile foot-clasp mounting as shown in Fig. 2.1, are important behavioral endpoints for demonstrating the effects of prenatal hormone manipulations.

Rough play (also called rough and tumble play, Fig. 2.1) is a high energy expenditure whole body play with grasping and tumbling that is exhibited more frequently by males than females in peer groups (Harlow & Harlow, 1962; Harlow, 1962; Goy, 1970), mother-peer groups (Wallen et al., 1977; Goy & Wallen, 1979; Wallen et al., 1981), and in large social groups (Lovejoy & Wallen, 1988; Wallen et al., 1995).

Juvenile rhesus monkey males display a variety of mounting postures, but of primary importance is the double foot-clasp mount (Fig. 2.1b) typical of the mating posture of adult male macaques (Altmann, 1962). This mount is displayed more by males than females (Lovejoy & Wallen, 1988; Wallen et al., 1995; Harlow, 1962; Goy, 1970; Harlow, 1965), but is only displayed with any appreciable frequency when males are reared with substantial opportunities for continuous social interaction with peers (Wallen et al., 1977; Wallen, 1996; Goy & Wallen, 1979; Wallen et al., 1981). In more socially limited contexts, foot-clasp mounting is almost never displayed (Harlow & Lauersdorf, 1974; Wallen et al., 1981; Harlow, 1965). Instead, in these socially restricted environments males will display mounts not oriented to the partner's pelvic region, will not display the double foot-clasp, and will often

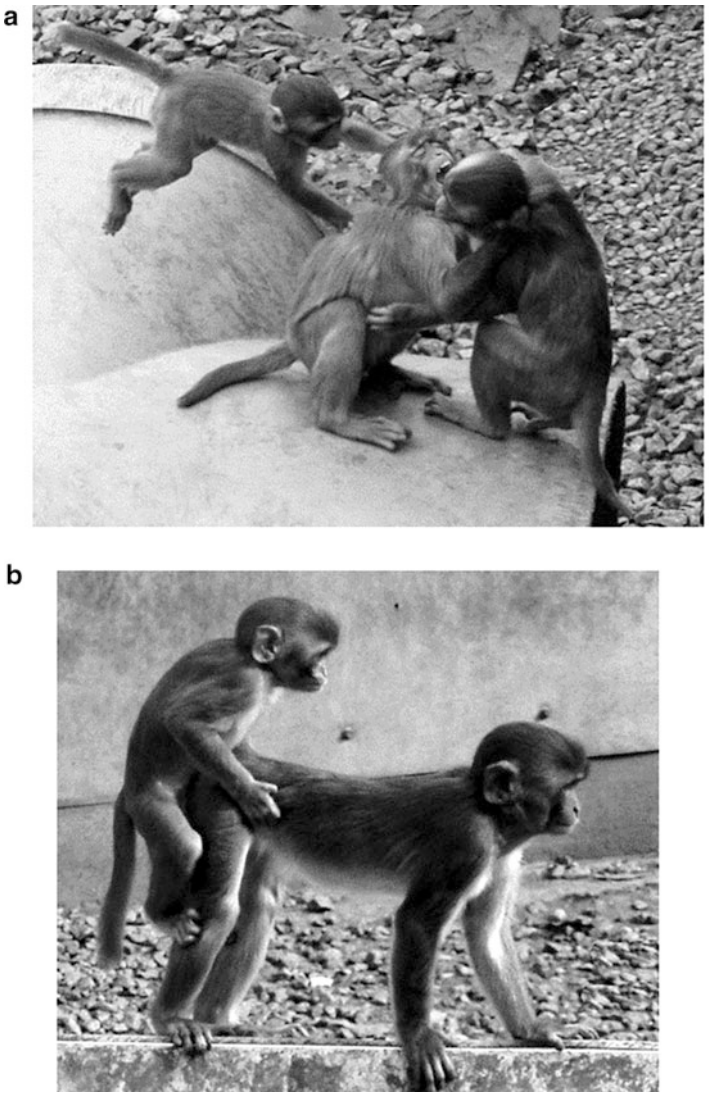

Fig. 2.1 (**a**) Rough play in yearling rhesus monkeys. The two male rhesus monkeys at the right engage in wrestling play, characterized by grappling and whole body involvement. Play may involve more than two animals as the infant on the left is about to demonstrate. (**b**) Foot-clasp mounting by an infant male to a yearling rhesus monkey. This mount is a highly cooperative behavior that is of the same form as that used by adult males during copulation. (Wallen, 2005, copyright Elsevier, used with permission granted by Elsevier, Nov. 8, 2019)

show mounts oriented to the partner's head or side (Wallen et al., 1977; Goy & Wallen, 1979). Unlike rough play, in which high frequencies occur under rearing conditions not conducive to developing adult social competence, the regular juvenile

display of foot-clasp mounting indicates juvenile socialization that predicts adult competency (Goy & Wallen, 1979; Wallen, 1996).

2.5.1.1 Studies of Effects of Exogenous Prenatal Steroid Administration on Rough Play and Mounting in Genetic Females

Early studies of the role of hormones on the development and expression of rough play and foot-clasp mounting demonstrated that their juvenile expression was not dependent upon the presence of male gonadal function as neonatally castrated males displayed these behaviors at levels indistinguishable from gonadally intact males (Goy, 1970). In contrast to the lack of effect of postnatal androgenic influences, these behaviors were significantly increased in genetic females whose mothers had been treated with either testosterone or 5α-dihydrotestosterone, a nonaromatizable androgen, during much of gestation (Goy, 1970; Goy, 1981; Goy & McEwen, 1980; Goy & Resko, 1972). Japanese macaque females whose mothers received testosterone from approximately gestation day 40 to 100, of the 160-day gestation, showed increased mounting, but not rough play compared to control females (Eaton et al., 1990). The androgen levels in this study were lower than those employed by Goy and colleagues in the rhesus monkey, as the female Japanese macaque offspring exposed to androgen in utero did not have extensive genital masculinization. These results suggest that lower levels of prenatal androgen are required to masculinize mounting than are required to masculinize rough play. Further evidence that play and mounting have different sensitivities to androgens came from a study in which androgen exposure was limited to a 25-day period during gestation, but varied the gestational timing of the 25-day treatment (Goy et al., 1988; See Table 2.1 for a summary of findings).

Exposing genetic females to 10 mg of testosterone propionate (TP) injected daily to their mothers on gestation days 40–64 extensively masculinized their genitalia, producing a fully formed penis, scrotum, and no vaginal opening. Behaviorally, these genitally masculinized females mounted at higher frequencies than did control females and did not differ from control males. However, these early androgenized females, like Eaton's Japanese macaques exposed to lower levels of T, did not show increased frequencies of rough play (Goy et al., 1988). By contrast, the same dose of T administered from gestation days 115–139, produced no detectable masculinization of the female's genital anatomy, but significantly elevated both mounting and rough play compared to control females, and the elevated rough play was over the levels displayed by early androgen-treated females (Goy et al., 1988). Thus, the timing of androgen exposure separated its effects on genital anatomy from its effects on behavior. This study also suggested that late gestation is a period of particular sensitivity of the developing nervous system to prenatal androgens. This might be expected since the time course of genital differentiation differs markedly from that of neural differentiation. While genital differentiation is completed by approximately gestation day 75, cortical neurons have not completely proliferated in some areas of the macaque brain until after gestation day 100 (Rakic, 1988). In addition,

synaptogenesis of these neurons, which begins after prenatal gonadal differentiation, continues through the first two postnatal months (Bourgeois et al., 1994; Granger et al., 1995). Evidence that synaptogenesis can be influenced by androgens (Matsumoto, 1991) provides support for the latter part of gestation being a period of particular sensitivity to androgens for behavioral differentiation. Studies in humans show a pattern of prenatal and postnatal synaptogenesis similar to that seen in rhesus monkeys (Huttenlocher & Dabholkar, 1997). The timing in humans and monkeys is also similar, when considered in relation to the longer human gestation.

Both aromatizable and nonaromatizable androgens masculinize juvenile behavior. Because estrogen levels in females are typically higher than in males, estrogens have been thought to produce feminization. There is, however, little evidence in support of this view (Fitch & Denenberg, 1998). There is some evidence suggesting that estrogens can masculinize rhesus monkey juvenile behavior (Table 2.1). Goy and Deputte (1996) treated pregnant females for more than 100 days of gestation with 100ug per day of the synthetic estrogen, diethylstilbestrol dipropionate (DESDP), a dose 33 times that shown to masculinize and defeminize aspects of the behavior of genetic female guinea pigs (Hines et al., 1987). Females experiencing long DESDP treatment had female-typical genitalia, but displayed increased juvenile mounting and rough and tumble play. Another group of females received shorter DESDP treatments timed similarly to the late gestation androgen treatments described above. These short-term treated DESDP females showed no evidence of behavioral masculinization, in contrast to the significant masculinization produced by short TP treatments late in gestation. DESDP females were only studied for their first year of life while still in the presence of their mothers when the full expression of juvenile sex differences has yet to be realized (Goy & Wallen, 1979). Thus, it is hard from these data to determine whether the masculinization produced by long-term treatments with large amounts of DESDP reflect an involvement of estrogens in masculinization, or a pharmacological effect of this synthetic compound. Clearly, the DESDP treatment had the capacity to influence sexual differentiation, but the short-term nature of the study period in this single report prevents reaching any definitive conclusions about the role that estrogens play in the sexual differentiation of juvenile behavior in rhesus monkeys.

DESDP is probably the only estrogenic hormone that can be used to investigate the role of estrogens in sexual differentiation, because, unlike estradiol, DESDP doesn't induce abortion when administered to pregnant females. That estrogens typically induce abortion in primates, including humans, accounts for why there has been so little work with prenatal estrogens in primates. Because in altricial rodents sexual differentiation occurs mostly after birth means that abortion is not an issue in rodent studies. Whether or not estrogens or estrogenic metabolites play any role in the normal course of juvenile behavioral differentiation in primates as it does in some rodent species (Wallen & Baum, 2002) remains an open question.

2.5.1.2 Effects of Altering Endogenous or Exogenous Androgens on Rough Play and Mounting in Males and Females

The hypothesis that late gestation is a period of increased sensitivity to the organizing actions of androgens on sexually differentiated behavior was investigated in an omnibus study that use lower doses of exogenous testosterone than employed in the studies of the previous section, and by interfering with the actions of endogenous androgens using the antiandrogen flutamide (Herman et al., 2000). This is the first study to attempt to alter endogenous androgen actions in monkeys. This manipulation potentially allows studies of hormonal influences on sexual differentiation to reveal normative mechanisms of masculinization.

Subjects were the offspring of mothers receiving vehicle, flutamide, or testosterone enanthate early or late in gestation as shown in Table 2.1. The treatments and observation procedures have been previously described (Herman et al., 2000; Herman et al., 2003; Tomaszycki et al., 2001). Early flutamide treatment of males (EFM) prevented full masculinization of the male's penis, whereas late flutamide treatment resulted in a fully formed, but significantly smaller penis. Early flutamide treatment in females (EFF) modified their genitals in a more female-typical direction suggesting that females are exposed to some level of endogenous androgens. None of the TE treatments significantly affected genital anatomy in either male or female offspring, although males exposed to androgen late in gestation (LAM) had the longest penises of any male group (Herman et al., 2000). The results from the study described above have been previously reported (Wallen, 2005, 2009, 2017) and are briefly recapitulated here. The study results are presented for each of the first 2 years of life. The years are presented separately because rhesus monkeys interact extensively with their mothers during the first year of life, but spend substantial time away from their mother during the second year of life and beyond. Thus treating the 2 years separately reflects developmental changes that occur in the 2 years.

First year of life: Behavioral data were collected as previously described for the first 6 months of the first year of life (Herman et al., 2000; Herman et al., 2003; Tomaszycki et al., 2001).

During the first 6 months of life infants spend much of their time with their mothers. When the data on rough play are characterized by whether they are within 1 m or less from their mother juveniles display low incidence of rough play and there is no statistically significant sex difference. By contrast, when play is measured when infants are more than 1 m from their mothers, a significant sex difference in rough play is seen. This may reflect that males spend more time away from their mothers than do females.

Behavioral data were analyzed using a one-way analysis of variance (anova) with treatment group (Table 2.2) as the factor followed by multiple Bonferroni post hoc comparisons. Rough play differed significantly across the 10 treatment groups with all male groups displaying significantly higher rates of rough play than did any of the female groups (see Table 2.2 for group descriptions). Although there was an overall main effect of prenatal treatment group ($F(9, 52) = 6.36$, $p < 0.001$) on rough play

rates, female rough play was not increased by treatment with prenatal testosterone (EAF and LAF groups) compared to play rates of control females. The only suggestion of a prenatal hormonal effect in females was that late-treated females (LAF and LFF subjects, Table 2.2) played at frequencies not significantly different from either control males or control females. In males, both early and late androgen-treated males displayed higher rates of rough play than did any female group with the exception of the LFF subjects who did not differ significantly from control males. Contrary to predictions, administration of flutamide to males late in gestation (LFM, Table 2.2) did not significantly decrease rates of rough play. Although early flutamide treatment of males (EFM, Table 2.2) produced the lowest rates of male rough play, EFM subjects did not differ significantly from any other treatment group. Thus their play was not significantly more masculinized than that of females nor significantly less masculinized than that of the other males, an unexpected finding.

Foot-clasp mounting is very infrequent during the first 6 months of life, so the measure presented here includes all properly oriented mounts (penis in correct juxtaposition to the rear of the animal being mounted), not just mounts with foot-clasps. There was an overall treatment effect $F(9, 52) = 2.92$, $p = 0.007$ reflecting, surprisingly, that late flutamide-treated males (LFM, Table 2.2) mounted more than did either control males or any of the female groups. Thus contrary to our hypothesis that flutamide late in gestation would block juvenile behavioral masculinization, it paradoxically seems to have hypermasculinized these males, an effect not evident in EFM subjects who, as with rough play, did not differ significantly from any other group. There was no evidence that prenatal androgen exposure affected female mounting rates.

These findings of sex differences in the first year of life are consistent with findings in studies under more limited social conditions (Wallen, 1996). The effects of testosterone treatments differed from previous studies principally because we used T doses that did not affect genital masculinization. The flutamide treatment was unique and reduced genital masculinization in males, but paradoxically produced increased masculinization of behavior when given late in gestation. Infant monkeys spend substantial time with their mother during the first year of life resulting in low frequencies of both mounting and rough play, possibly making it less likely to identify hormonal influences on these behaviors. This is not the case for the second year of life where juvenile monkeys spend much of their day completely independent of their mother.

Second year of life: Behavioral data were collected as previously described (Wallen, 2005) for 13–15 weeks starting on the subject's first calendar birthday, which is thought to developmentally represent 4 years in human time. Data were analyzed as previously described (Herman et al., 2000; Herman et al., 2003; Tomaszycki et al., 2001). Data were collapsed across all weeks of observation to provide a total occurrence of the specific behavior.

Rough play varied with prenatal treatment ($F(9, 48) = 6.91$, $p < 0.001$) with control males playing more than did control females (Fig. 2.2a). Among the female treatment groups, only EAF subjects displayed significantly less rough play than did control males with the other female treatment groups differing significantly from

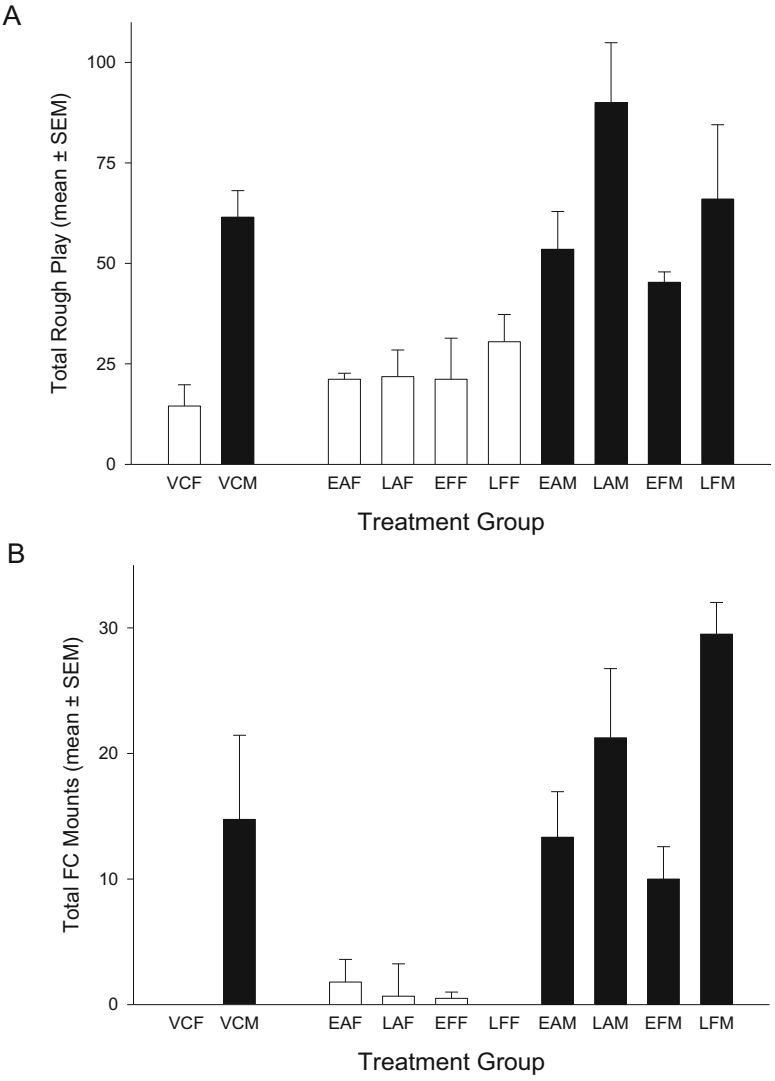

Fig. 2.2 Rough play (**a**) and mounting (**b**) displayed by control and prenatally treated rhesus monkeys during the second year of life. Abbreviations: *VCF* vehicle-treated control female, *VCM* vehicle-treated control male, *EAF* early-treated androgen female, *LAF* late-treated androgen female, *EFF* early-treated flutamide female, *LFF* late-treated flutamide female, *EAM* early-treated androgen male, *LAM* late-treated androgen male, *EFM* early-treated flutamide male, *LFM* late-treated flutamide male (see text for details of treatments). (Wallen, 2005, copyright Elsevier, used with permission granted by Elsevier, Nov. 8, 2019)

either control males or females (Fig. 2.2a). Thus prenatal testosterone treatments to females, except EAF, increased rough play sufficiently such that females were neither completely masculine nor feminine in their pattern of play. Surprisingly,

late flutamide treatment had the most pronounced masculinizing effect on female rough play, although this was not significantly different from any other female or male group. In addition to control males, males receiving prenatal hormonal treatments late in gestation, regardless of whether the treatment was T or flutamide, were the only male treatment groups to differ from control females. In addition, LAM subjects differed significantly from all prenatally treated female groups (Fig. 2.2a). LFM subjects differed significantly from EAF subjects in addition to control females, making them the most fully behaviorally masculinized of the male treatment groups after LAM subjects. In contrast to the LAM and LFM subjects, early male treatment groups (EAM and EFM, Table 2.2) did not differ significantly from any other group in their rough play. Thus, like the late flutamide females, these groups of males were neither fully masculine nor feminine in their play patterns, suggesting that these early prenatal treatments, both androgen and flutamide, had partially blocked full masculinization.

Foot-clasp mounting also varied with prenatal treatment. Control males displayed significantly more mounts than did control females (Fig. 2.2b) and more than any female treatment groups (Fig. 2.2b). None of the female treatment groups differed significantly from the control females (Fig. 2.2b); thus unlike the case of rough play, there was no evidence that prenatal androgen or flutamide treatment had any impact on the occurrence of juvenile mounting by females. By contrast, manipulating androgens in males significantly affected their mounting behavior. Late treatments, either with T or flutamide, produced elevated levels of mounting (Fig. 2.2b). Males receiving flutamide late in gestation (LFM) showed the highest level of mounting of any group in the study and differed significantly from all groups except the late androgen-treated males (LAM, (Fig. 2.2b). In contrast, flutamide treatment given early in gestation (EFM) produced males whose mounting did not differ significantly from any group, male or female. Late androgen-treated males (LAM) mounted at higher frequencies than any of the female groups, but not more frequently than any other male treatment group. Males receiving androgens early in gestation (EAM) were similar to late-treated males (LAM), differing only in that they did not mount more frequently than did EAF and mounted less frequently than did late-treated flutamide males (LFM, Fig. 2.2b).

These results are surprising and support several conclusions. First, juvenile male mounting is particularly sensitive to hormonal manipulations during late gestation. In fact, the only effects of either androgen or antiandrogen treatment were in late gestation treatments, suggesting that this time in gestation is when the developing nervous system underlying behavior is organized by steroid exposure. Second, paradoxically, both flutamide and exogenous T had similar effects when administered late in gestation, with both significantly augmenting mounting. It is unlikely that this reflects that masculinization does not involve the activation of androgen receptors (AR), but instead that flutamide has complex effects in males with an intact hypothalamic, pituitary, testicular (HPT) axis that may, paradoxically, increase testosterone levels by blocking testicular negative feedback. Last, differentiation of mounting is somewhat sensitive to hormonal variation early in gestation as well, with early flutamide treatment producing males (EFM) with the poorest mounting

performance. These males also had the least masculinized genitals raising the possibility that the lower mounting displayed by EFM subjects reflected reduced sensory feedback from their less completely masculinized penile structure.

The effects that we produced using prenatal flutamide treatments are paradoxical and contradictory if one assumes that flutamide works consistently as an antiandrogen and in the same manner on both neural and peripheral organ systems. There are several possible explanations for these findings. One possibility is that flutamide simply doesn't enter the brain in sufficient amounts to occupy a significant proportion of brain androgen receptors. No in vivo studies have been done that administer flutamide peripherally (e.g., not directly administered into the brain) and measure brain levels of flutamide compared to peripheral levels. Since flutamide is a relatively weak AR ligand (Singh et al., 2000), any decreased neural flutamide concentration could markedly reduce its antiandrogenic behavioral effects. Probably more critically, flutamide treatment can suppress LH negative feedback resulting in increased LH secretion (Grattan et al., 1996; Sodersten et al., 1975; Veldhuis et al., 1992). This increase in LH potentially increases endogenous androgens making a neural flutamide antiandrogen blockade even less effective.

In a study of intact male rats (Sodersten et al., 1975), peripherally administered flutamide produced no measurable reduction of male sexual behavior. Flutamide treatment of intact males markedly increased LH and T, reflecting suppressed negative feedback. These same males, however, had inhibited prostatic growth demonstrating a peripheral effect of flutamide. Castrated males, who produce no endogenous T, treated with flutamide and T showed reduced ejaculations, but no change in intromissions or mounts, suggesting that flutamide was not having a clear effect on the brain. By contrast, prostate growth in these T-treated castrated rats was completely inhibited by concurrent flutamide treatment (Sodersten et al., 1975). Taken together, these results suggest that flutamide can block androgenic effects on androgen-sensitive peripheral structures without blocking centrally mediated androgen-sensitive behaviors.

One study of pregnant rats administered flutamide found it blocked the masculinization of the corpus callosum in male offspring (Fitch et al., 1991). There is, however, scant additional evidence that peripherally administered flutamide has significant effects on brain structure and function. Thus one possible explanation for the behavioral masculinization effects that we found with peripherally administered flutamide is that flutamide effectively blocks testicular negative feedback, resulting in either increased steroid secretion in pregnant females, such as the increased T secretion we found in our flutamide-treated mothers (Herman et al., 2000), or produces an increased secretion of testicular T in fetal male offspring of flutamide-treated mothers. In this regard, it may be significant that neonatally, LFM subjects had significantly higher T levels than any other group during the first 2 weeks postnatally (Herman et al., 2000). Whether this reflects alteration in testicular sensitivity to gonadotropins (LFM subjects did not have elevated LH when their neonatal T was elevated), or some remaining effect of the late flutamide treatment on hypothalamic-pituitary-gonadal function (HPG), remains to be seen.

Flutamide did cross the placenta as shown by its blocking full masculinization of male genitalia in the EFM group. However, behavioral masculinization was not blocked, and in fact was enhanced in some cases, a finding incompatible with significant levels of flutamide entering the developing brain.

An alternative possibility is that flutamide interferes with testicular negative feedback elevating androgens, but that estrogenic metabolites from aromatization of these elevated androgens produce increased behavioral masculinization. Given that prenatal DHT (which cannot be aromatized to an estrogen) both masculinizes and defeminizes the sexual behavior of adult female rhesus monkey (Thornton et al., 2009) and given the moderate effects of the synthetic estrogen DESDP on juvenile behavioral masculinization, aromatization of T seems an unlikely explanation for our findings. It cannot, however, be ruled out at this time. It is apparent from our results that the administration of flutamide to animals with an intact HPG axis does not produce results consistent with flutamide acting on the brain and having a pure antiandrogenic mode of action. In some ways, this should not be surprising given that one of the earliest studies of flutamide in intact male rats reported no antiandrogenic effect on male sexual behavior (Sodersten et al., 1975).

2.5.1.3 Sex Differences in Juvenile Interest in Infants

As seen in adults, juvenile and prepubertal females exhibit much greater interest in infants than do juvenile and prepubertal males in several primate species (Herman et al., 2003), including humans (Feldman et al., 1977; Maestripieri & Pelka, 2002). Most of the studies of prenatal hormone manipulations were done in social contexts precluding measurement of interest in infants and thus we know nothing about the effect that long T or DHT treatments may have had on this endpoint. In contrast, subjects in Herman et al. (2003) were reared in complex social groups, where access to infants was a typical aspect of the environment. Subjects were those previously described for the studies of juvenile mounting and rough play described above. A variety of measures of infant interest were collected during approximately 10 hrs/yr. of 15 min focal observations of social behavior for each of the first 3 years of life on each subject: Behavioral measures included touching, holding, playing with infants, and kidnapping infants (Herman et al., 2003). Sex differences in interactions with infants are striking, with effect sizes (Cohen's d) ranging from 1.3 (frequency of kidnapping in yearling subjects) to 5.1 (frequency of touching infants in yearling subjects). These are among the largest behavioral sex differences reported in rhesus monkeys, or any other species for that matter. Together, 14 measures differed significantly between males and females, but few of these measures were affected by prenatal treatment to females and none affected males.

Surprisingly, females receiving flutamide late in gestation (LFF) showed masculine patterns of infant interest on five of the 14 measures, very much like what we found for mounting behavior in LFM. To maximize the power of our multiple measures we calculated an index of infant interest that used the deviations from the control males and females across all measure differing significantly between

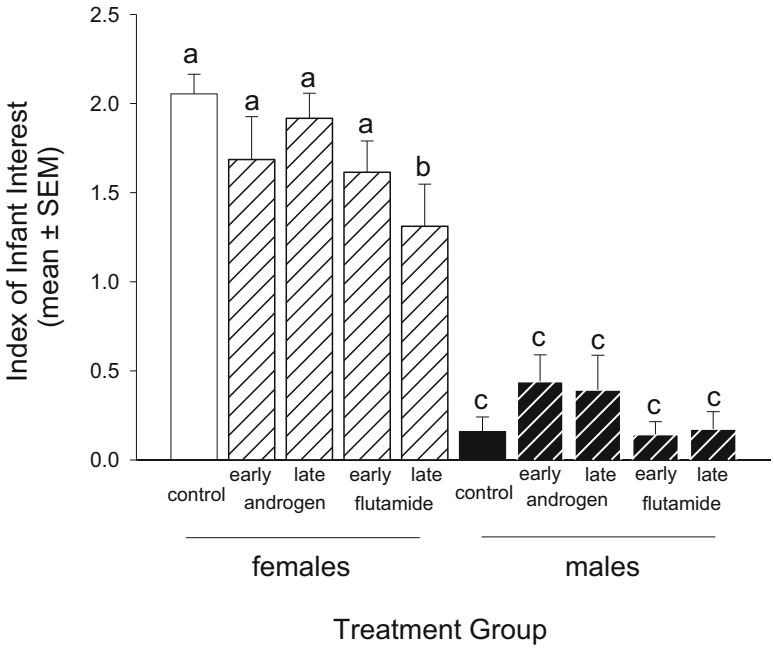

Fig. 2.3 Index of interest in infants for control male and female rhesus monkeys and males and females receiving testosterone or flutamide treatments early and late in gestation. Bars with differing superscripts differ significantly. (Herman et al., 2003, copyright Elsevier, used with permission granted by Elsevier, Nov. 11, 2019)

males and females (Herman et al., 2003). Figure 2.3 illustrates the effect of prenatal treatment on this measure of infant interest. Males differed significantly from all female groups, but the LFF group differed significantly from all other female and male groups, suggesting that they showed less interest in infants than did control or EFF females, but more interest in infants than did males (Herman et al., 2003). This supports juvenile interest in infants reflecting prenatal hormonal action late in gestation, but suggests that our treatments were near the threshold for effectiveness in altering interest in infants. It is important to point out that the effect of late gestation flutamide was consistent with androgen defeminization of interest in infants. This may reflect that flutamide treatment increased maternal T and thus may have elevated T in the fetus. That the action of this maternal T that got to the fetus was apparently not blocked in the fetus by the flutamide treatment is consistent with insufficient flutamide entering the brain to block the effects of elevated maternal T.

Juvenile interest in infants is of particular interest because of the magnitude of the sex difference and that it occurs at a time when the gonads are quiescent, arguing that it is the expression of an underlying behavioral predisposition not requiring hormonal activation. Particularly intriguing is that interest in infants in post-pubertal reproductive females, unlike in juvenile females, appears to be activated by ovarian

hormones under our social conditions (Maestripieri & Zehr, 1998; Maestripieri & Wallen, 1995). Those hormones do not modulate infant interest before puberty, but do after puberty as is also seen in male mounting. Juvenile mounting, like juvenile interest in infants, requires no hormonal activation, whereas adult copulatory mounting does (Wallen, 2001). The mechanism by which a behavior occurs prior to puberty without hormonal activation and then comes under hormonal activational control post-pubertally has not been investigated. It is likely, however, that understanding the mechanism of this transition will be important to developing a general understanding of hormonal modulation of behavior.

2.5.1.4 Juvenile Sex Differences in Preferences for Human Toys

A striking sex difference among children is preference for stereotypical masculine and feminine toys (Berenbaum & Hines, 1992). This sex difference has often been presented as evidence of the social construction of human sex differences and has been thought to reflect parental endorsement of sex-typed toys and encouragement of boys and girls to play with different toys (Martin & Little, 1990). An alternative view is that toy preferences reflect activity preferences and that the sex difference in toy preferences reflects that boys and girls have different activity preferences. If this is the case and if monkeys share this same sex difference in activity preferences, they possibly could show similar preferences for human sex-typed toys as do boys and girls. This notion was first explored by Melissa Hines and Gerianne Alexander (Alexander & Hines, 2002) who measured play times for male and female vervet monkeys with sex-typed human toys. Monkeys were given, in randomized serial presentation, either a stereotypical male toy (truck or ball), a stereotypical female toy (doll or cooking pan), or a gender-neutral toy (picture book or furry dog), and how long they played with the toy was recorded. The gender-neutral toys showed no sex differences, but male vervets played more with stereotypical male toys than did female vervets, though males did not differ in play with the male and female toys. Female vervets played more with the stereotypically female toys than did male vervets and females also played more with the female toys than they did with male toys. Because these play times were collected with only a single toy in the cage, this study didn't directly test preference although it likely reflects interest in the toy type as the monkey could choose to not play with the toy if uninterested. These results provide some support for the notion that vervet monkeys express a sexually differentiated interest in human toys that is similar to those expressed by boys and girls. The differences between these results in vervets and those in children could reflect that toys in the vervet study were presented serially whereas in human studies children have access to multiple toys and thus can clearly demonstrate a preference for a sex-typed toy.

We followed Alexander and Hines' study with a toy-preference study in group-living rhesus monkeys (Hassett et al., 2008) in which members of a social group of monkeys had access to both a wheeled toy (cars, trucks, a wagon, shopping cart) and a plush toy (dolls, stuffed animals) and were free to interact with whichever toy they

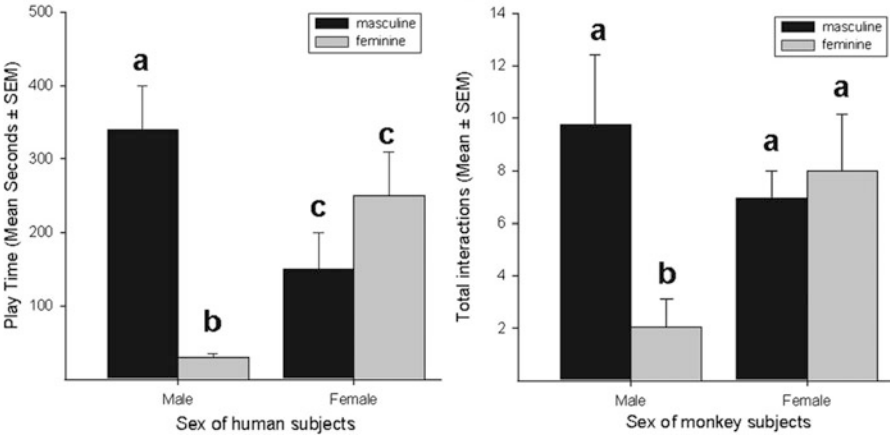

Fig. 2.4 Sex differences in interaction with sex-typed toys in children (left side, adapted from Berenbaum & Hines, 1992) and juvenile rhesus monkeys (right side, adapted from Hassett et al., 2008). Children's toys consisted of an array of stereotypical boy's and girl's toys. The monkey's toys were either wheeled toys (masculine) or plush toys (feminine). Monkeys had access to either toy in their social group. Superscripts that differ within a figure indicate significant differences. Bars with the same superscript do not differ significantly. Both boys and male monkeys show a strong preference for masculine toys and interact little with feminine toys. By contrast, girls and female monkeys show a weak and nonsignificant preference for feminine toys. Girls show less interest in masculine toys and more interest in feminine toys than do boys. In monkeys, females show more interest in feminine toys than do male monkeys, but do not differ from male monkeys in interacting with masculine toys. (Hassett et al., 2008, copyright Elsevier, used with permission granted by Elsevier, Nov. 8, 2019)

preferred. These two categories of toys were selected because they loosely divided the toys in masculine and feminine toys, but also because they facilitated very different interactions with the toys. There was clear evidence of sex differences in toy preference with male monkeys strongly preferring the wheeled toys and females showing a moderate preference for the plush toys (Fig. 2.4). These sex differences in rhesus monkey toy interactions largely duplicated the sex differences seen in children in a study by Berenbaum and Hines (1992). The striking differences in both species are that males show a very pronounced preference for the male-typical toys, but females, while preferring, to some extent, female-typical toys don't show a statistically significant preference for either toy type. In other words, both boys (Berenbaum & Hines, 1992; Meyer-Bahlburg et al., 2004) and juvenile male monkeys (Hassett et al., 2008) show very stereotyped toy preferences, whereas girls and juvenile monkeys are much less pronounced in their toy preferences. The similarity in response by children and juvenile monkeys is striking because the toys in the two studies were different. Because monkey toy preferences could not have been socialized (the toys were novel to the monkeys), these results could support the notion that the sex difference in toy preferences reflects that boy's and girl's toys promote different activities (wheeled toys promote manipulation and large motor movements, whereas plush toys promote protosocial interaction) that appeal differently to males

or females instead of reflecting a preference for a "boy's" or "girl's" toys per se, distinctions not available to monkeys. We know that prenatal androgens promote different activities in male and female juvenile monkeys, but whether such prenatal androgen exposure predisposes males to prefer the different activities that toys promote remains to be investigated.

2.6 Conclusion

Prenatal exposure to supraphysiological levels of exogenous androgen (either testosterone or 5α-dihydrotestosterone) during the second or last third of gestation masculinizes juvenile mounting and rough play behavior of genetic rhesus monkey females. Importantly, only treatments during the second third (second trimester) of gestation masculinize both female genitalia and mounting behavior, whereas treatments in the last third of gestation (third trimester) don't masculinize genitalia, but have the biggest effect on behavior masculinizing both mounting and rough play. Thus, genital and behavioral masculinization are separable processes and masculinization of behavior does not require genital masculinization. Similarly, blocking endogenous androgen in genetic males during the second third of gestation significantly reduced genital masculinization, but did not prevent masculinization of behavior, again demonstrating the independence of genital and behavioral masculinization. Whether flutamide blockade failed to prevent masculinization of behavior because it did not reach the brain in sufficient quantities or because estrogenic metabolites, which would not have been blocked by flutamide, are important for male masculinization remains to be resolved.

Across studies, it does appear, however, that estrogens are not critical to male sexual differentiation, although there are still too many gaps in the data to be completely confident of this conclusion. However, it is apparent that the nonaromatizable androgen, DHT, both masculinized and defeminized the behavior of genetic females when administered prenatally. Thus, it seems likely that sexual differentiation in the precocial rhesus monkey is more similar to the precocial guinea pig than it is to the other altricial laboratory animals (Wallen & Baum, 2002). In both rhesus monkeys and guinea pigs, prenatal DHT masculinizes female sexual behavior, whereas in altricial species like the rat, DHT does not masculinize female behavior unless estrogen is also given (Wallen & Baum, 2002). In contrast to the guinea pig, where prenatal DHT does not defeminize genetic females (Goldfoot & van der Werff ten Bosch, 1975), prenatal DHT treatment defeminized female proceptive behavior in rhesus monkeys (Pomerantz et al., 1985). Whether this reflects a true developmental species difference or a difference between the hormonal influences on receptivity in the guinea pig and proceptivity used in rhesus monkeys remains to be resolved. Taken together, it seems unlikely that estrogenic metabolites of testosterone are the active agents stimulating behavioral sexual differentiation in rhesus monkeys.

The hormonal manipulations that are possible in rhesus monkeys, but not in humans, can guide us to understanding the likelihood that similar processes operate in humans. Specifically, monkey studies can control the amount and timing of hormonal manipulations in ways impossible on humans. What findings there are in humans come primarily from natural variations in hormones and from two clinical conditions: Congenital Adrenal Hyperplasia (CAH), in which female fetuses are exposed to elevated prenatal androgens (though at levels lower than those experienced by genetic males) and exhibit male-typical behavior in certain aspects of development, and Complete Androgen Insensitivity (CAIS), in which genetic males lack androgen receptors and thus their endogenous androgens cannot influence their sexual development resulting in nearly complete feminized genitals and female-typical behavior. Thus, it does seem likely that humans would show similar responses to exogenous androgens during gestation as those found in monkeys.

It is apparent from these studies that the latter part of gestation is an important period for prenatal hormones to affect brain organization in rhesus monkeys. Consistently across studies using high levels of testosterone, or our studies using lower dosages and antiandrogen treatment, behavioral effects late in gestation were more pronounced than those seen in early gestation. Thus, it seems that this period of significant synaptogenesis (Bourgeois et al., 1994; Granger et al., 1995) is also an important period for behavioral differentiation.

The effects of prenatal hormones on behavioral differentiation are profound and significantly determine developmental trajectories in both male and female rhesus monkeys. The consistent findings of effects on mounting and rough play across different social contexts suggest that these behaviors are particularly sensitive to prenatal hormonal influences. However, it is important to remember that social context also significantly affects sexually differentiated behavior. Other patterns of behavior, such as threatening behavior, are sexually differentiated in some social conditions but not others, and prenatal hormones do not consistently affect the development of this behavior (Wallen, 1996). Similarly, prenatal androgens appear to have little effect upon adult copulatory behavior of females reared under restrictive social conditions (Phoenix et al., 1959; Phoenix et al., 1983), but profoundly alter female copulatory behavior when reared under less restrictive conditions (Pomerantz et al., 1985; Pomerantz et al., 1986; Thornton & Goy, 1986). This effect of social context on steroid action likely reflects that socially restrictive conditions suppress the development and expression of sex-specific behavioral predispositions. This behavioral suppression is large enough that steroid modulation of these sexually dimorphic behaviors is difficult or impossible to see. The suppressive effect of restrictive social environments likely reflects that social restriction alters social interactions whether or not they require hormones. Thus, the effect of prenatal hormonal manipulations reflects an interaction between the specific hormonal manipulation, its timing in gestation, and the social history of the animal. Ultimately, sexually differentiated behavior reflects both the hormonally organized predisposition to engage in a behavior and the social experience and current social context to convert that predisposition into behavioral expression.

Are these findings relevant to humans? While one cannot extrapolate directly from nonhuman primates to humans, these results raise issues relevant to humans. The most important of these is the finding that late gestation exposure to elevated prenatal androgen fully masculinizes aspects of female juvenile behavior without detectable genital masculinization. If similar processes pertain to humans, it is possible that there are conditions where genetic females are psychologically, but not genitally, masculinized. Similarly, in genetic males, interfering with androgen function late in gestation could reduce or block psychological masculinization without modifying male genitalia. Such late-gestation psychological effects could be one basis for human transgenderism, where there is psychological cross-gender identification and behavioral expression without genital modification.

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Spotlight Feature: The Implications of Social Environment for Sex Differences in Brain and Behavior

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Naked mole-rats (*Heterocephalus glaber)* do not fit the traditional framework of mammalian sexual development in that most individuals remain pre-pubertal for the duration of their [extraordinarily long] lives (>28 years) (Buffenstein, 2005; Jarvis, 1981). Native to East Africa, naked mole-rats are small eusocial rodents, living in underground colonies of up to 300 individuals (Jarvis, 1981). Eusociality refers to their rigid social hierarchy where breeding is restricted to one dominant female (the queen) and 1–3 males. All other colony members are socially subordinate and reproductively suppressed. These "subordinates" are remarkably sexually monomorphic for adults of a sexually reproducing species, failing to show many of the sex differences in behavior, gross morphology, endocrinology, and neural morphology (Holmes et al., 2009) that are highly conserved in mammals. For example, subordinates of both sexes participate equally in both prosocial and agonistic interactions (Lacey & Sherman, 1991; Mooney et al., 2015). Male and female subordinates are of similar body size and weight (Dengler-Crish & Catania, 2007; Peroulakis et al., 2002) and, unlike other rodents, there is no sex difference in anogenital distance, with possible male feminization of the genitalia such that the external penis resembles a clitoris in shape and size (Jarvis, 1981; Peroulakis et al., 2002; Seney et al., 2009) (Fig. 2.5). Furthermore, the perineal muscles used in copulation are sexually monomorphic in subordinate naked mole-rats despite showing dimorphism in most mammalian species (Peroulakis et al., 2002). Finally, no sex differences are seen in circulating gonadal steroid hormones in subordinates (Clarke & Faulkes, 1998; Faulkes, Abbott, & Jarvis, 1990; Swift-Gallant et al., 2015; Zhou et al., 2013), and we failed to find sex differences in regional brain volume, cell number, or cell size in reproductively relevant brain regions known to be sexually differentiated in other mammals (e.g., medial amygdala) (Holmes et al., 2007).

Crucially, subordinate naked mole-rats are neither asexual nor sterile. They can become reproductive if removed from the suppressive influence of the queen, showing the endocrine and behavioral transitions characterized as mammalian puberty. We often see these changes occurring in both males and females. For example, RFamide-related peptide-3 immunoreactivity (the mammalian ortholog of gonadotropin inhibitory hormone) is lower in breeders than subordinates, regardless of sex, in the dorsomedial and arcuate nuclei of the hypothalamus (Peragine et al., 2017). This protein is thought to be a main player contributing to reproductive suppression in subordinates. Similarly, breeders of both sexes have larger regional volumes of the medial amygdala, bed nucleus of the stria terminalis, and paraventricular nucleus of the hypothalamus when compared to subordinates.

Fig. 2.5 Naked mole-rats show reduced sexual dimorphism compared to other mammals. (**a**) Breeders (BRE), particularly queens, are typically larger and heavier than subordinates (SUB). Subordinates are not sexually dimorphic in overall body size (**a**) or external genitalia (**b** and **c**). The genital mound enlarges in queens and she also develops a perforate vagina (**b**). The animals pictured here are all young to middle-aged adults ranging between 5 and10 years of age. Their weights are as follows: BRE female = 53.2 g, BRE male = 44.0 g, SUB female = 34.9 g, SUB male = 36.3 g

Thus, for some variables, social/pubertal status is a better predictor than sex. However, for other variables, the release from pubertal suppression seems to trigger the emergence of sex differences. Indeed, sex differences in behavior emerge post-puberty as both males and females begin to display sex-typical reproductive behaviors (e.g., mounting in males and lordosis in females). Urinary progesterone increases in females within days of removal from the colony and the vagina becomes perforate (Faulkes, Abbott, Jarvis, & Sherriff, 1990). As the female begins to breed, she will become longer as her vertebral column lengthens with each litter born (Dengler-Crish & Catania, 2007). Alternatively, the male endocrine transition is marked by an increase in urinary testosterone and, over time, breeding males often decrease in size. This emergence of sex differences extends to the nervous system where differences in gene and protein expression have been reported (Faykoo-Martinez et al., 2018; Holmes et al., 2008; Swift-Gallant et al., 2015; Zhou et al.,

2013). For example, female breeders have higher expression of estrogen receptor alpha and progesterone receptor mRNA and higher numbers of kisspeptin immunoreactive cells relative to male breeders and subordinates of both sexes (Swift-Gallant et al., 2015; Zhou et al., 2013), and these sex differences are all directly related to ovulation in female mammals. Not all emergent sex differences are in keeping with mammalian "norms," however. For example, the breeding female is socially dominant and the most aggressive individual in the colony (Clarke & Faulkes, 2001; Reeve, 1992), pushing and shoving other colony members. This is key as it reveals species-specific patterns of sex differences in brain and behavior as well as at least some dissociation between sex- and gender-typical variables.

All of this is consistent with the idea that sex is "less important" than social/pubertal status for sculpting brain and behavior in this species. More recently, however, we discovered that molecular sex differences exist in the brains of subordinates. Specifically, stress-related genes have higher expression in socially relevant brain regions (e.g., nucleus accumbens) in males compared to females (Faykoo-Martinez et al., 2018), suggesting that reproductive suppression is controlled, at least in part, in a sex-specific way. Thus, on the one hand, socially mediated pubertal suppression might prevent or delay the emergence of sex differences but, on the other, sex differences in mechanism might be critical for allowing pubertal suppression to exist in both sexes. That is to say, sex-specific mechanisms underlying reproductive suppression may serve to compensate for sex chromosomal gene expression, ultimately bringing males and females closer together on many variables (De Vries, 2004).

Studying diverse species like the naked mole-rat allows us to better understand the complex interplay between an organism's biological sex and sociosexual environment. From an evolutionary perspective, we learn about how species-specific social organization and reproductive strategy is associated with the type and magnitude of sex differences present in a species (e.g., sexual selection). From an organismal perspective, we learn about how social cues influence the development and maintenance of sex differences across the life span, which is hugely important for understanding individual differences in, and plasticity of, sex and gender variables. Employing both perspectives is necessary for understanding the causal relationship(s) between sex differences in brain and sex differences in behavior and can challenge how we think about sex and gender in both human and non-human animals.

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Chapter 3
Biological Approaches to Studying Gender Development

Vickie Pasterski and Dimitris Bibonas

Abstract The origins of sex differences in human behavior have been extensively studied from various theoretical perspectives, and a growing body of evidence has suggested that organization of the brain, and subsequent sex-typed behaviors, are influenced by exposure to sex hormones and the expression of specific genes during early development. Methodological advances in the study of biological bases of sex differences have shed light on mechanisms that influence sex development across the life span, though many questions remain. This chapter provides a general overview of biological approaches to the study of sex differences, with summaries of findings to date and future directions. The emphasis of the chapter is on hormones because that has been the major focus of biological approaches to sex development for decades. The chapter also touches on genetics toward the end given some important emerging work disentangling hormonal effects from genetic effects.

Keywords Androgens · Brain function · Brain structure · Complete androgen insensitivity syndrome · Congenital adrenal hyperplasia · Gender identity · Gender role · Sexual differentiation · Sex determination · Sexual orientation

The nature versus nurture debate regarding influences on human behavior is increasingly replaced by a more integrative perspective that incorporates relative influences of biological, environmental (e.g., endocrinological), social, and cognitive factors. Nevertheless, the scientific process relies on systematic and incremental investigation of individual factors (e.g., biological or environment) that contribute to an overall and integrated understanding of human behavior. The origins of sex differences in human behavior have been extensively studied from various theoretical perspectives, and a growing body of evidence has suggested that organization of the

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brain and subsequent sex-typed behaviors are influenced by exposure to sex hormones and the expression of specific genes during early development. From this perspective, differences in brain structure and organization are already present as early as birth. Methodological advances in the study of biological bases of sex differences have shed light on mechanisms that influence sex development across the life span, though many questions remain. The aim of the current chapter is to provide a general overview of biological approaches to the study of sex differences, with summaries of findings to date and future directions. Here, we focus mainly on hormones because that has been the major focus for decades, and we touch on genetics toward the end given some important emerging work disentangling hormonal effects from genetic effects. Note that many topics in this chapter are considered in greater depth elsewhere in this volume.

3.1 Sex Differences in Human Behavior

Sex differences in human behavior can be observed starting in infancy (Jadva et al., 2010), and they often grow larger across early and middle childhood (Pasterski et al., 2011b) before becoming less pronounced in adulthood (Hyde, 2005). In childhood, the differences are readily seen in gender role behavior, gender identity, and cognitive abilities, while in adolescence and adulthood differences are primarily seen in gender identity, sexual orientation, and cognitive abilities, though differences have also been shown in personality, emotion processing, and vulnerability to psychiatric disorders (Bao & Swaab, 2011; Chapman et al., 2006; Feingold, 1994; Hines, 2010; Schirmer et al., 2004).

Gender role behavior in childhood primarily refers to play style, toy choices, and playmate preferences. For example, boys tend to engage more in highly active and rough-and-tumble play, compared with girls; boys tend to prefer toys such as cars and truck and weapons, compared with girls, while girls tend to play more with toys such as dolls, doll accessories, and dishes, compared with boys; and both boys and girls tend to prefer same-sex playmates. Core gender identity across the life span refers to identification as male, female, both or neither, and sexual orientation, which emerges at puberty, refers to sexual attractions to males, females, both, or neither (Zucker, 2005).

With respect to the relative size of the sex difference in these domains, it can be helpful to think of the differences in terms of standard deviation units (d) (Cohen, 1988). The sex difference in height, which is $d = 2$, is a useful frame of reference (Hines, 2020). Of the three primary domains of sex differences, core gender identity shows the biggest effect, with reports ranging from $d = 11.0$ to 13.2 (Deogracias et al., 2007; Hines, 2004). Sexual orientation shows the next biggest sex difference with effects ranging between $d = 6.0$ and 7.0 (Hines et al., 2004; Meyer-Bahlburg et al., 2006). The sex differences in gender role behavior in childhood vary slightly depending on the behavior. For example, in a study of play style and playmate preferences, effects ranged between $d = 0.7$ (preference for masculine preschool

games) and 5.6 (playmate preferences) (Zucker, 2005). While there are strong correlations between these categories (Hines et al., 2004), they have been shown to vary independently (Hines, 2010).

Sex differences in cognitive function in adolescents and adults tend to be fewer and smaller. For example, meta-analytic studies have shown negligible differences in basic cognitive functions such as vocabulary (Hyde & Linn, 1988) and mathematics skills (Hyde et al., 1990) that were previously believed to differ between males and females. By contrast, some measures of spatial skills continue to show a sex difference favoring males, $d = 0.3$ to 0.9 for mental rotations and $d = 1.1$ to 2.0 for targeting (Collaer et al., 2009; Hines et al., 2003b; Peters et al., 2006; Voyer et al., 1995; but see also Estes & Felker, 2012).

3.2 Sex Determination and Differentiation of Primary Sex Characteristics

Sex determination in human fetal development starts with conception and the establishment of genetic sex (see Fig. 3.1; Hughes, 2001). In typically developing humans, each cell nucleus contains 22 pairs of autosomes and one pair of sex chromosomes, resulting in the karyotype 46,XX in females and 46,XY in males. In XY male fetuses, the Y chromosome contains the sex-specific *Sry* gene, or sex determining region on the Y chromosome, which directs a bipotential gonad to develop as a testis. In the absence, or dysfunction, of *Sry*, development of the gonad proceeds along a default pathway as an ovary.

In the XY male fetuses, sex differentiation is then directed by sex hormones produced by the testes, starting around week 7 of gestation. The production of testosterone by Leydig cells in the testes directs the development of Wolffian ducts into male-typical internal reproductive structures such as the epididymis, the vas deferens, and the seminal vesicles, while anti-Müllerian hormone produced by Sertoli cells in testes causes regression of the female-typical Müllerian ducts (internal reproductive structures). Conversion of testosterone to dihydrotestosterone directs the development of male external genitalia, i.e., penis and scrotum. In a pattern similar to that of gonadal development, the absence of male-typical sex hormones results in fetal development following the female-typical pathway of internal and external genital development, by default. That is, Müllerian ducts become the uterus, fallopian tubes, and part of the vagina, and the Wolffian ducts regress, and external structures become labia and clitoris.

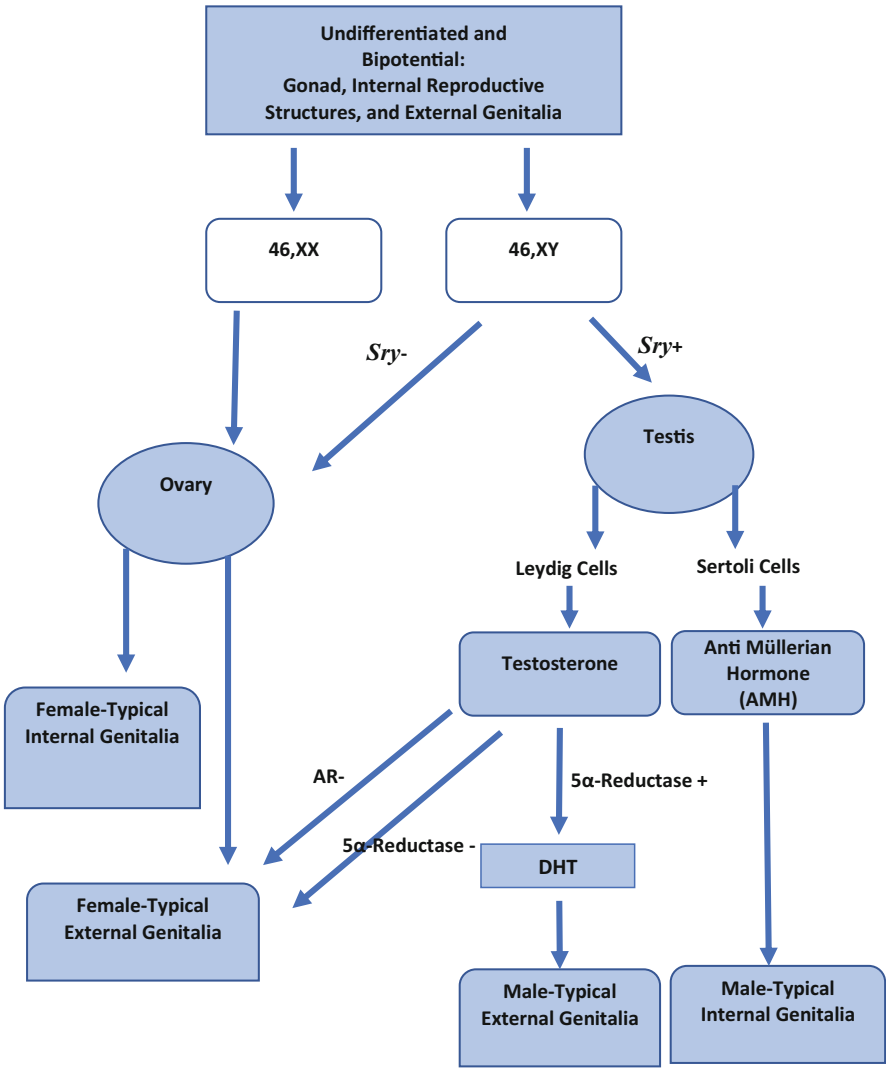

Fig. 3.1 General schematic of sex determination and differentiation. AR, androgen receptor; DHT, dihydrotestosterone; *Sry*, sex determining region of the Y chromosome

3.3 Hormone Influences in Sex Differences

Given the crucial role of male sex hormones in the development of the reproductive system, noted in both human and non-human mammals, researchers have questioned whether there might be similar factors at play in the development of male-typical neurobehavioral patterns (Balthazart, 2020). Due to ethical considerations, purely experimental approaches have only been used with non-humans, while in humans,

studies have relied on alternative methods. The primary source of knowledge about hormone influences in humans comes from clinical studies of conditions in which fetal and perinatal hormone exposure is variable due to naturally occurring factors. Other approaches include studies of outcomes in cases where hormone treatments were given to pregnant women to avoid miscarriage, studies using measures of hormones found in amniotic fluid or maternal blood during pregnancy as predictors of later outcomes, or the use of assumed biomarkers of hormone exposure (e.g., digit length ratio, otoacoustic emissions).

3.3.1 Animal Studies of Biological Influences on Sex-Typed Behavior

In the early to middle twentieth century, outcomes from experimental studies in rats (Pfeiffer, 1936; Wilson et al., 1941) began to show that female rats exposed to testicular hormones during development would fail to ovulate in adulthood in addition to showing an increased tendency toward male-typical copulatory behaviors (i.e., mounting) and decreased female-typical copulatory behaviors (i.e., lordosis), compared with unexposed females. By the 1950s, researchers had realized that the pituitary function was under neural control, which led to support of the hypothesis that gonadal steroids act directly on the brain (Barraclough & Gorski, 1961; Phoenix et al., 1959). Furthermore, Phoenix et al. (1959) proposed two distinct modes of hormone action on the brain: *organizational* and *activational.* That is, sex steroids present in early development *organize* neural pathways responsible for reproductive behavior and these organizational changes are permanent. Later, circulating levels of hormones/steroids act on the differentiated pathways to *activate* behaviors or functions previously organized.

Since the early twentieth century, thousands of studies have manipulated hormones during early development in non-human mammals, linking them to later neurobehavioral structural and functional changes. Using experimental techniques such as castration and hormone replacement during critical periods of development, researchers have been able to show separation of the early and permanent organizational effects of hormones on brain and behavior from effects that occur later and are more transient. Many species have been studied, ranging from rodents to non-human primates, and similar patterns of results have been found. For example, female rhesus monkeys treated with testosterone during early development later show masculinized patterns of behavior, including increased male-typical rough-and-tumble play and reduced female-typical sexual behavior (Goy & McEwen, 1980).

Experimental methods aimed at elucidating structural effects on brain development have used similar methods of hormone manipulation and have found sexually dimorphic effects. In rodents, for example, brain structures thought to be connected to sexual behavior, such as the sexually dimorphic nucleus of the preoptic area (SDN-POA) and the bed nucleus of the stria terminalis (BNST), are changed as a

function of hormone exposure (McCarthy et al., 2009). Although caution is warranted when generalizing findings from studies of animals to human development, three basic principles have emerged from the extant animal literature: (1) A female phenotype will develop in the absence of testosterone, i.e., estrogens do not directly effect a female-typical development; (2) The masculinizing effects of testosterone are exerted in a dose-response, or linear, relationship—greater exposure results in stronger effects; and (3) Neurobehavioral sexual differentiation is multidimensional, i.e., complex patterns of development result in sex differences in brain structures and behavior that do not interrelate in a uniform manner (Hines, 2011).

More recent research has expanded on what may be considered a linear model of sex differentiation, noting interaction effects of environment and previously unrecognized genetic inputs that change how hormones act on brain and behavior (McCarthy & Arnold, 2011). Epigenetic contributions to hormonally mediated sexual differentiation of the brain (McCarthy & Nugent, 2013) are briefly discussed at the end of this chapter.

3.3.2 Studies of Hormone Influences in Humans

Due to ethical considerations, experimental manipulations of hormones for research purposes are not possible in humans. Because there are only a handful of behaviors evident in non-human species that might map onto humans, potential effects of early hormone exposure on sexually dimorphic human behavior have been left open to question. In this case, research has relied on alternatives to experimental methods. Approaches include studies of individuals exposed to atypical levels of sex hormones due to a disorder/difference of sex development, studies of individuals exposed to androgenic progestins prescribed during pregnancy, studies including measures of sex hormones in amniotic fluid, maternal blood, saliva, or urine, and studies linking markers of androgen exposure to sex dimorphic structure, function, or behavior.

Disorders/Differences of sex development (DSD) is the umbrella term for conditions in which the chromosomal, gonadal, or anatomical sex development is atypical (Houk et al., 2006). Though this umbrella encompasses a wide range of conditions, there are two that have been studied relatively frequently with the aim of elucidating factors responsible for the development of normative sex differences. These are congenital adrenal hyperplasia (CAH) and complete androgen insensitivity syndrome (CAIS). In the first case, we can assess effects of increased exposure of fetal androgens on later sex-typed behavior in 46,XX individuals, while in the case of CAIS we see outcomes in 46,XY individuals for whom androgen action has been cancelled.

3.3.2.1 Congenital Adrenal Hyperplasia (CAH)

CAH refers to a group of autosomal recessive conditions characterized by enzymatic deficiency and impairment in the adrenal steroid biosynthesis pathway (see for review Pasterski & Hughes, 2017). CAH affects 1/10000 to 1/15000 live births, with the most common enzyme defect, 21-hydroxylase deficiency (90% of cases), resulting in chronically elevated adrenocorticotropic hormone (ACTH), and overproduction of cortisol precursors that are peripherally converted to testosterone. The result for 46,XX individuals (CAH affects males and females with equal frequency) is exposure to high levels of testosterone and virilization of the external genitalia. There is a dose-response relationship resulting in variable degrees of enlargement of the clitoris, fusion of the labial folds, and rostral migration of the urethral/vaginal perineal orifice. Virilization of the external genitalia ranges from mildly ambiguous to completely male in appearance. The Prader scale is often used to classify the degree of virilization (Prader & Gurtner, 1955), which, in turn, may serve as an indication of degree of androgen exposure.

Studies of girls with CAH have consistently shown increases in male-typical behavior, and decreases in female-typical behavior, across the three domains of sex differences discussed at the beginning of the chapter (Berenbaum et al., 2004; Dittmann et al., 1990; Ehrhardt & Meyer-Bahlburg, 1981; Hines, 2004). For example, compared to unaffected sisters, girls with CAH are more likely to play with boys' toys and to play less with girls' toys (Pasterski et al., 2005), they more often prefer boys as playmates (Pasterski et al., 2011a, 2011b), and they engage in more rough-and-tumble aggressive play (Pasterski et al., 2007). Furthermore, it appears that the degree of masculinization of these behaviors depends, to some extent, on the degree of testosterone exposure. A study looking at outcomes as a function of CAH severity (increased severity increases testosterone exposure) found that girls with the more severe enzyme deficiency showed greater increases in male-typical behavior (Nordenström et al., 2002). It has been suggested in the 1970s that girls with CAH may be treated differently by parents due to their virilized appearance. Pasterski et al. (2005) found that not only did parents not encourage masculine behavior among daughters with CAH, but they encouraged female-typical behavior significantly more often. In this case, social influences cannot explain the masculine behavior of girls exposed to atypically high levels of prenatal androgens.

It appears that prenatal exposure to male-typical levels of testosterone also influences gender identity to some degree. Note that historic conceptualizations of gender identity and components that contribute to what one might consider a cross-gender identity have changed over time. Previous versions of the Diagnostic and Statistical Manual for Mental Disorders (DSM; American Psychiatric Association, 2013), for example, have considered gender role behavior as a core manifestation of gender identity. However, with growing societal acceptance of "gender-nonconforming" behavior, core identity is considered as fundamentally separate from gender expression (American Psychiatric Association, 2013). With this in mind, a study assessing the degree to which girls with CAH may wish to change

gender, compared with unaffected sisters, examined gender role expression as independent from cross-gender ideation. Specifically, Pasterski et al. (2015) found that girls with CAH showed increased cross-gender ideation as well as increased male-typical toy and playmate preferences.

As mentioned earlier, sexual orientation shows a very large sex difference. As one might expect, there appear to be influences of fetal androgens in this domain as well. Studies of women with CAH report decreased heterosexual orientation compared with other women (Hines et al., 2004), and degree of prenatal testosterone exposure may be correlated with this behavioral outcome (Meyer-Bahlburg et al., 2008). In sum, studies of 46,XX individuals with CAH elucidates effects of early androgen exposure and findings are in line with models suggesting that male-typical hormones, at least in part, drive male-typical neurobehavioral development. Although effects of genes cannot be ruled out and may be worthwhile exploring in future work, individuals with CAH do not appear to show genetic disruptions beyond 21OHD enzyme deficiency (Pasterski & Hughes, 2017).

3.3.2.2 Complete Androgen Insensitivity Syndrome (CAIS)

As shown in Fig. 3.1, sexual differentiation of the male phenotype in a 46,XY zygote will only occur when *Sry* directs the bipotential gonad to develop as a testis, which then produces testosterone, and its metabolites. However, a mutation in the androgen receptor (AR) can result in partial or full resistance of the sex hormone in candidate tissues. Full androgen resistance is the primary feature of CAIS (Hughes et al., 2012). The typical presentation for CAIS is primary amenorrhea in adolescence or inguinal swellings in an infant or toddler. Outward physical appearance, including genitalia, is completely female in appearance, though the presence of Anti Müllerian Hormone (AMH) causes regression of the Müllerian duct, resulting in a blind-ending vagina and absent uterus. With respect to secondary sex characteristics, axillary hair is sparse, though breast development occurs spontaneously as testosterone is converted to estradiol by aromatase (Tadokoro-Cuccaro & Hughes, 2014). Note that the female-typical outward appearance may cause delays in discovering CAIS.

Behaviorally, girls and women with CAIS generally do not differ from comparison groups of females, in line with the hypothesized role for the absence of androgen effects in the development of sexually dimorphic behavior. Studies of childhood gender role generally rely on recalled behavior as most individuals with CAIS are not aware of the disorder and have not come to medical attention until late adolescence. Nevertheless, these reports suggest they do show increased female-typical, or decreased male-typical, behavior, compared to genetic males despite the presence of a Y chromosome, testes, and testosterone (Hines et al., 2003a). In addition, most reports suggest female-typical gender identity and sexual attractions to men (Hines et al., 2003a; Wisniewski et al., 2000). More recent reports, however, have suggested that psychosexual development in CAIS is not as straightforward as previously thought, with examples of identities other than female and greater variability in sexual attractions (Brunner et al., 2016; T'Sjoen et al., 2011).

In addition to behavioral outcomes, magnetic resonance imaging (MRI) studies in women with CAIS have informed the respective roles of sex chromosomes versus hormones in brain structure and function. For example, a study of brain responses to sexually arousing stimuli showed that women with CAIS did not differ from control women. Control men in this study showed greater activation of the amygdala, compared with control women and women with CAIS, suggesting that the Y chromosome is not engaged in this aspect of sexual response (Hamann et al., 2004; Hamann et al., 2014).

3.3.2.3 Hormones Measured in Normative Development

Although studies of individuals with CAH and CAIS have shed light on factors that contribute to sexually dimorphic neurobehavioral development, questions still remain as to effects of natural variation of sex hormones in typically developing populations. It is possible that factors associated with having either of these conditions may contribute to study findings. Some have suggested, for example, that girls with CAH are more masculine in their behavior, at least in part, because they have a virilized appearance and parents may treat them differently to their unaffected daughters (Quadagno et al., 1977). Indeed, a more recent study found that parents' reported encouragement of everyday toy play in girls with CAH was correlated with their actual patterns of play, i.e., parents encouraged more male-typical play in the daughters with CAH compared with unaffected daughters (Wong et al., 2013). However, observational evidence suggests that parents encouraged their daughters with CAH to play more with female-typical toys in the laboratory when both male and female-typical toys are available. Such conflicting evidence makes it difficult to generalize studies of girls with CAH to typically developing populations.

In this case, researchers have aimed to collect measures of hormone exposure during pregnancy in typically developing children, using amniotic fluid or maternal blood samples, and link them to later behaviors. Unfortunately, studies employing these methods have produced conflicting results. Two studies relating testosterone on amniotic fluid to maternal reports of toy choices or observed toy choices found no effects (Knickmeyer et al., 2005; van de Beek et al., 2009). Meanwhile, a study measuring testosterone in a maternal blood sample (Hines et al., 2002) and another using amniotic fluid (Auyeung et al., 2009) both found effects of fetal testosterone exposure. The first study found a linear relationship between testosterone and gender role behavior in preschool girls, and the second found a relationship between testosterone and reported sex-typed play for both boys and girls. More research is needed to resolve these inconsistencies.

3.3.2.4 Markers of Hormone Exposure

Given the challenges of obtaining direct measures of early hormonal exposure (Constantinescu & Hines, 2012), attempts have been made to identify and use

biomarkers of such exposure, the most common of which is second-to-fourth digit ratio (2D:4D). As of 2019, the number of studies looking at direct links between 2D:4D and later life outcomes exceeded 1400 (Leslie, 2019). Studies from a wide range of disciplines (e.g., psychology, sociology, economics, marketing) have commonly used 2D:4D as a marker of fetal hormone exposure to investigate biological origins of various behaviors. Digit ratio (2D:4D) has consistently been shown to be sexually dimorphic, with males showing lower ratios than females on average. In fact, enough studies have been conducted linking 2D:4D to single constructs to warrant meta-analysis (e.g., Grimbos et al., 2010). This is a lot considering that the measure was established as a potential proxy of fetal androgen exposure only 7 years earlier (Manning et al., 2003). Unfortunately, there has been no clear or consistent evidence directly linking sexual dimorphism in 2D:4D to fetal androgen exposure. Manning et al. (2003) reported that 2D:4D covaried meaningfully with a polymorphic repeat (CAG) sequence in the gene coding for androgen receptors in men. However, two subsequent studies with larger sample sizes failed to find the effect (Hampson & Sankar, 2012; Hurd et al., 2011). The initial finding has not been replicated. Despite genuine findings of 2D:4D correlating with a plethora of human behaviors, interpretation of the behavior as it relates to fetal androgen exposure is not warranted. In fact, a study looking at 2D:4D in women with CAIS found that while proband-control comparisons varied in a pattern consistent with a hormonal influences interpretation, closer inspection of the data suggested that non-androgenic factors are likely also needed to establish the male-typical phenotype (Van Hemmen et al., 2017).

A second candidate proxy of fetal androgen exposure that has been linked to sexually dimorphic behavior is otoacoustic emissions (OAEs). OAEs are sounds produced by the cochlea, which can be measured in the inner ear canal (Kemp, 1986, 2002). Spontaneous OAEs are more frequent and stronger in women than in men, and OAEs evoked by click stimuli have larger amplitudes in women, compared with men (Snihur & Hampson, 2011). Although "masculinized" patterns of OAEs have been linked to non-heterosexual attractions in women (Breedlove, 2017), evidence for the usefulness of OAEs as a proxy for androgen exposure is limited. It has been suggested that OAEs might also be affected by circulating hormones (Snihur & Hampson, 2011).

Other biomarkers include anogenital distance (AGD) (for a review, see Thankamony et al., 2016). A clear and large sex difference in AGD has been found in both rodents and humans beginning in pregnancy. AGD may reflect variations in prenatal androgen exposure in healthy children as shorter AGD at birth is associated with reduced masculine play behavior in preschool boys. Several studies also provide evidence linking shorter AGD with lower fertility, semen quality, and testosterone levels. More direct support for AGD as a biomarker of androgen exposure comes from studies showing correlations with prenatal testosterone levels in humans and rats (Callegari et al., 1987; Welsh et al., 2008; Yeh et al., 2002). The larger and more consistent sex difference in AGD suggest it may be a better reflection of the early hormone environment than other biomarkers such as

2D:4D (Wong & Hines, 2016). However, the sensitive nature of measuring AGD may limit its popularity as a measure used in human studies.

3.4 Genetic Approaches to Studying Sex Differences

"Direct genetic effects" with respect to sexually dimorphic neurobehavioral development refers to effects that arise from the expression of X and Y genes within non-gonadal cells. That is, much of what is known about direct genetic effects comes from mouse models in which it has been possible to separate out effects of gonadal sex from chromosomal sex—two characteristics that nearly always correlate in an individual animal. The four core genotypes (FCG) mouse model was developed specifically for this purpose (Arnold & Chen, 2009). Without in-depth discussion of the model, suffice it to say that, and limitations notwithstanding, evidence for direct genetic effects on neurobehavioral development has been established (Ngun et al., 2011). Researchers are able to compare mice with the same gonadal type, but different sex chromosomes and pairs of mice with different sex chromosomes, but same gonadal type (see Fig. 3.2).

The FCG model has been instrumental in showing direct genetic effects in brain structure and behavior. For example, the lateral septum, which is involved in stress-related behaviors, had nucleus that is denser in men than in women. Gatewood et al. (2006) have shown that lateral vasopressin fiber was greater in XY mice with and without testes compared to XX mice with and without testes. In addition, differences

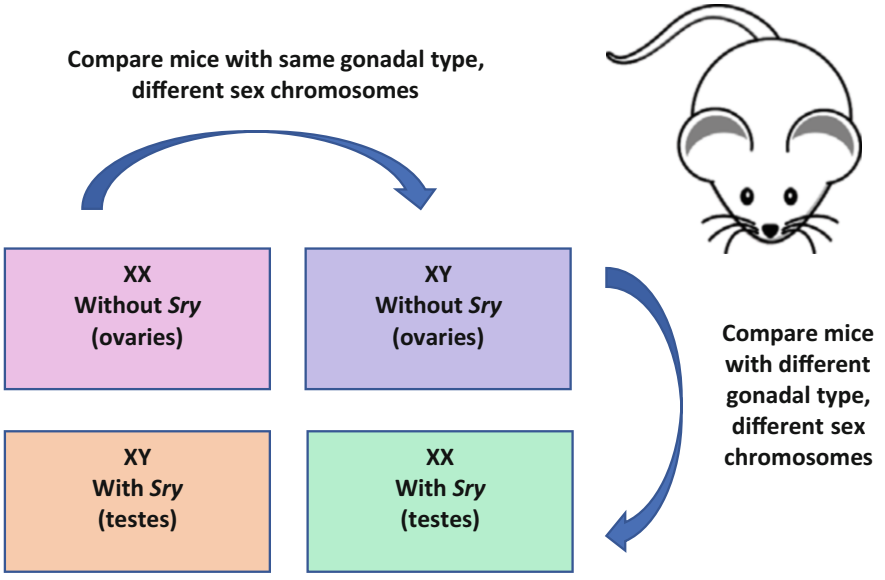

Fig. 3.2 Comparison of four core genotypes mouse model

in addiction behavior have been found to develop as a function of direct genetic effects (Quinn et al., 2007), and, although gonadal hormones have been shown to play a role in aggression (Pasterski et al., 2007), a study employing the FCG model showed an interaction between hormones and genes (Gatewood et al., 2006). In their study, XX females were slower to display aggressive behavior (on initial encounter) compared with mice in all three other groups.

As with studies investigating neurobehavioral effects of hormones, studies looking at sex chromosome effects have studied women with CAIS. Earlier in this chapter, it was noted that most studies of CAIS have found female-typical behavior profiles with respect to gender role, gender identity, and sexual orientation (Hines et al., 2003a; Wisniewski et al., 2000). However, it was also noted that two more recent studies have found conflicting patterns (Brunner et al., 2016; T'Sjoen et al., 2011). Though further studies are warranted, such findings might suggest a role for sex chromosomes in the behaviors that show diversion from the pattern expected for a hormonal influences interpretation.

3.5 Conclusions

While it is widely accepted that neurobehavioral sex differences in humans arise out of complex interactions between biology, environment, and social and cognitive influences, there is great value in establishing relative contributions in each domain. Biology sets the parameters on which other factors may act. In the current chapter, we have reviewed various approaches to the study of biological influences on sex differences in neurobehavioral development. Though the prevailing theory since the early twentieth century has put sex hormones at the fore as a primary influence, more recent studies have provided evidence for the role of direct genetic effects. Limitations for such studies are many, however, as experimental manipulation in humans is considered unethical, and most complex behaviors are either not evident in animal models or are not easily generalizable to humans. Nevertheless, with technological advances and continued efforts using tried and true paradigms, we continue to advance our knowledge of biological influences on sex differences with the benefits including the intrinsic value of knowledge and, potentially, improved sex-specific healthcare.

Spotlight Feature: The Neurobiology of Gender Dysphoria

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Genetic, in vivo magnetic resonance imaging (MRI) and *postmortem* brain studies have been focused on transgender people who fulfill the description of transsexuals in DSM-5 (Guillamon et al., 2016). Research shows there are genetic bases influencing transgender identity. In both transmen (TM) and transwomen (TW), concordance is higher between monozygotic than dizygotic twins (Heylens et al., 2012). Since the pioneering *postmortem* studies of Swaab on the brain of TW (Zhou et al., 1995), the endocrine bases of transsexuality have been examined from a focus on the sexual differentiation of the brain. This has prompted studies on polymorphisms of the androgen (AR) and estrogen (ERα and ERβ) receptors as well as the aromatase enzyme, all of which contribute to cerebral sexual differentiation. Henningsson et al. (2005) were the first to report that TW differed from cis-men with respect to the mean length of the Cytosine-Adenine repeat in intron 5 of the ERβ gene. Hare et al. (2009) found that a Cytosine-Adenine-Guanine length repeat had a significant association with TW. However, Ujike et al. (2009), in a Japanese population, reported no significant difference in allelic or genotypic distribution of the above-referred genes for either TM or TW. In TW, gender dysphoria (i.e., distress related to an incongruence between experienced gender identity and birth-assigned sex) may have an oligemic component with several genes involved in sex hormone signaling contribution (Foreman et al., 2019). In a recent large study of 2300 cis and trans subjects controlling for early onset of gender dysphoria and sexual orientation, it was shown that TW gender development involves an AR polymorphism accompanied by an ERβ polymorphism (Fernández et al., 2018). An inverse allele interaction between AR and ERβ is characteristic of the TW population: When either of these polymorphisms is short, the other is long. ERα and ERβ polymorphisms are also associated with gender dysphoria in the TM population although no interaction has been observed between these polymorphisms.

A landmark in the study of trans people was the *postmortem* neurohistological study showing that hormonally treated TW have a feminine (lesser volume and neurons) central part of the bed nucleus of the stria terminalis (BSTc) (Zhou et al., 1995). In rodents, this nucleus is sexually dimorphic (Guillamon et al., 1988), contains AR and ERs (Simerly et al., 1990), and is involved in male sexual behavior (Emery & Sachs, 1976; Claro et al., 1995). The Dutch group, led by Swaab, reported that the volume of the BSTc is larger in cis-men than in cis-women and that TW present a female-sized BSTc and hypothesized that gender identity develops as a result of an interaction between the developing brain and sex hormones (Zhou et al., 1995).

In vivo MRI studies can be classified as structural (sMRI), examining features such as the size, shape, and microstructure of brain regions, or functional (fMRI), examining brain activation in response to stimuli or when at rest. For all, the main methodological problem they may present is the use of non-homogeneous groups of trans and cis people, this being because neither transmen nor transwomen are homogeneous groups with respect to age of gender dysphoria onset and sexual orientation (Blanchard, 1989a, 1989b). It is sometimes quite difficult to achieve a homogenous group design because of the relatively low prevalence of trans people in the population.

Results from sMRI studies in Table 3.1 indicate that, with respect to the main brain parameters, TW and TM show the normative characteristics of their assigned sex at birth. However, when the volume or the thickness of the cortex, the volume of subcortical structures or the white matter microstructure of the main brain bundles are specifically studied, the TW brain is a blend of masculine, feminine, and demasculinized morphological traits just as the TM brain is a mixture of feminine, masculine, and defeminized traits (Rametti et al., 2011a; Guillamon et al., 2016; Kreukels & Guillamon, 2016). It is important to underscore that in TW and TM, structural changes are observed in regions like the insula, parietal lobe, precuneus, and visual cortex (Savic & Arver, 2011; Zubiaurre-Elorza et al., 2013) that are related to body perception. Functional connectivity studies (Table 3.2) suggest that TM and TW each have their own phenotypic circuitry that differs from cis males and females.

To explain gender dysphoria and gender identity, three complementary hypotheses/theories have emerged from brain studies:

Brain feminization of transwomen. Because the volume of their BSTc is in a feminine range, it was hypothesized that gender identity would develop as a result of an interaction between the developing brain and sex hormones. Hence, TW would experience a process of feminization (Zhou et al., 1995). This hypothesis was the first to focus attention on a differential sexual differentiation of the brain associated with TW. The mechanisms responsible for feelings of gender incongruence in trans people would depend on their prenatal exposure to sex hormones and could lead to atypical sexual differentiation of the brain, with the body and genitals developing in the direction of one sex, while the brain and gender developed in the direction of the other sex (Swaab & Garcia-Falgueras, 2009).

Cortical neurodevelopmental theory. This theory is based on sMRI and resting state functional MRI. This theory considers that (a) there is substantial work showing that the cerebral cortex experiences a life-long thinning process that depends on testosterone and the testosterone receptor (Raznahan et al., 2010), (b) normatively, cis-females show thicker cortex than cis-males, (c) cis-females, TM, and TW present thicker cortex than cis-males, but this occurs in different regions, and (d) these differences give a distinct structural cortical phenotype to each of the four groups. Consequently, it was proposed that cis-females, TM, and TW present a slower cortical thinning process than cis-males. Each of the four groups follows different developmental timings in different regions during cortical development (Zubiaurre-Elorza et al., 2013; Guillamon et al., 2016). Functionally, TM, TW, and cis women

Table 3.1 The brain phenotype of transwomen and transmen before cross-sex-hormone treatment

Morphological trait	Normative sex differences	Phenotype	References
TW: Intracranial volume, adults and adolescents	M > F	M	Rametti et al. (2011b), Hoekzema et al. (2015), Savic and Arver (2011)
TW: Volume: Gray matter; white matter; cerebrospinal fluid	M > F	M	Rametti et al. (2011a), Hoekzema et al. (2015)
TW: Volume cortex, adults	F > M	F&TW > TM&M	Simon et al. (2013)
TW: Volume cortex, adolescents	F > M	Differs from M and F in some regions	Hoekzema et al. (2015)
TW: Volume cortex	F > M	TW > M and F	Savic and Arver (2011)
TW: Cortical thickness, adults Putamen volume	F > M M > F	F > M M	Zubiaurre-Elorza et al. (2013)
TW: Cortex: Volume putamen	F > M M > F	M F	Luders et al. (2009)*
TW: Cortex: Cortical thickness	F > M	F	Luders et al. (2012)*
TW: White matter microstructure: Mean Diffusivity (MD)	M > F	TW > M	Kranz et al. (2014)*
TW: Fractional Anisotropy (FA) of white matter microstructure, adults	M > F	Demasculinized FA	Rametti et al. (2011a)
TM: Cortex: volume	F > M	F > M and M > F depending on regions	Simon et al. (2013)
TM: Cortex: volume	F > M	M	Hoekzema et al. (2015)
TM: Cortex: cortical thickness	F > M	F	Zubiaurre-Elorza et al. (2013)
TM: White matter microstructure	M > F	M or Defeminized	Rametti et al. (2011b)
TM: Cortex: cortical thickness	F > M	TM > F & M	Manzouri et al. (2017)

TW: transwomen; **TM**: transmen; **F**: cisgender female; **M**: cisgender male; * mixed samples with regard to onset of gender dysphoria and/or sexual attraction

have decreased connectivity compared with cis men in superior parietal regions, as part of the salience and executive networks (Uribe et al., 2020).

Body perception disconnection theory. Studies using different methodologies based on functional resting state data have referred to the parietal lobe as a key structure in the own-self body perception processes in TM (Burke et al., 2017; Feusner et al., 2017; Manzouri et al., 2017; Manzouri & Savic, 2018). When comparing intrinsic connectivity in networks involved in self-referential processes

Table 3.2 Brain connectivity profiles in transwomen and transmen

Findings	References
TW compared to cis men and women: decreased hemispheric connectivity ratio in subcortical/limbic regions. **TM** decreased intra-hemispheric connectivity between the right subcortical/limbic and right frontal and temporal lobes compared to cis-men and women.	Hahn et al. (2015)
TM show decreased regional cerebral blood flow in cingulate cortex but increased right insula flow with respect to cis females.	Nawata et al. (2010)
TM & TW combined sample shows greater centrality in parietal lobes and somatosensory cortex.	Lin et al. (2014)
TM functional connectivity more like cis-females than cis-males.	Santarnecchi et al. (2012)
TW & TM: Combining TW and TM samples using rsMRI and graph theory: changes in components (insula, parietal lobe, somatosensory cortex) of body representation circuitry.	Lin et al. (2014)
TW: TW exhibit unique rsMRI patterns in an empathy-related network.	Spies et al. (2016)
TM displayed weaker functional connections from the pregenual anterior cingulate to the insular cortex and the temporoparietal junction compared with both control groups.	Manzouri et al. (2017)
TM: rsMRI to study intrinsic connectivity networks involved in self-referential processes and one's own body perception-default mode network and salience network—and visual networks. Results suggest dysconnectivity within networks involved in one's own body perception in the context of self.	Feusner et al. (2017)
TM & TW & cis Women: Transmen, transwomen, and cisgender women had decreased connectivity compared with cisgender men in superior parietal regions, as part of the salience network and the executive control. Interaction between networks is a keystone in building a gendered self.	Uribe et al. (2020)

TW: transwomen; **TM**: transmen; **rsMRI**: resting state functional MRI

and their own body perception and visual processing, TM compared with cis-males and females showed decreased connectivity in several networks (default mode, salience, and visual) related to body perception. This suggests dysconnectivity within networks involved in one's own body perception in the context of self (Feusner et al., 2017).

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Spotlight Feature: Hormonal Treatment Effects on Adolescent Brain Development

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Since their introduction during the 1990s at the gender identity clinic in Amsterdam, puberty suppression by means of Gonadotropin Releasing Hormone analogs (GnRHa), followed by gender-affirming hormone treatment (estradiol and androgen-blocking medication in birth-assigned boys, testosterone in birth-assigned girls), have become standard treatments for adolescents with gender dysphoria (GD; i.e., distress related to incongruence between experienced gender identity and birth-

assigned sex; Hembree et al., 2017). GnRHa, which should only be given to youth who have been found eligible after careful diagnostic assessment and who have reached at least Tanner stage 2 (i.e., minimal pubertal development), suppress any further development of the secondary sex characteristics that forms a major source of distress for adolescents with GD. Thereby, GnRHa treatment importantly contributes to improvements in adolescents'—still developing—emotional and social functioning, and more generally their mental health and well-being (Costa et al., 2015). Another advantage of delaying puberty in adolescents with GD is that it provides them with additional time to reflect upon the far-reaching decision of undergoing gender-affirming hormone treatment and, potentially, later surgery as well.

However, a major concern has been that puberty suppression could interfere with significant developmental brain changes, particularly within the prefrontal cortex, that underlie adolescence-specific changes in behavior (e.g., in cognitive control and flexibility, social cognition, working memory, emotion regulation; Juraska & Willing, 2017). More specifically, the rise in pubertal sex hormone levels has been associated with (sex-specific) cortical maturation, and both pubertal stage and timing of pubertal onset have been found to impact brain development significantly (Herting & Sowell, 2017; Juraska & Willing, 2017). Therefore, long-term delay of puberty with GnRHa, and thus prevention of exposure to sex hormones during the early adolescent years, might negatively affect the cognitive and social-emotional development of youth with GD. Indeed, evidence from animal models suggested sex-specific adverse effects of GnRHa on stress-processing, mood and cognition (in females), and locomotion, social behavior (Anacker et al., 2020), and spatial memory (Hough et al., 2017; in males). Furthermore, studies in girls with idiopathic central precocious puberty (reviewed in Hayes, 2017) have suggested deleterious effects of GnRHa treatment on general intelligence and persistent (even after treatment discontinuation) reduction of spatial memory performance. But, although in recent years brain imaging studies have started to accumulate evidence on the shorter term effects of gender-affirming hormone treatments on transgender individuals' brain functions and structure, knowledge regarding the longer term effects of these treatments on brain and cognition remains very limited, and systematic, prospective studies of puberty suppression in youth with GD are currently lacking. In fact, a recent report, using an expert consensus method, identified the prioritized need for research on the long-term effects of puberty suppression on brain development and on cognitive and social-emotional maturation during the critical transition period of early adolescence (Chen et al., 2020).

One functional magnetic resonance imaging (fMRI) study, including participants with GD ages 14–16 years, aimed to test whether GnRHa treatment might have any adverse effects on adolescents' executive functions and associated brain activations using an fMRI version of the so-called Tower of London task (Staphorsius et al., 2015). Findings suggested no differences between adolescents receiving GnRHa and treatment-naïve adolescents with GD in task performance. However, because of the relatively small sample sizes of transgender boys (female birth-assigned sex, $n = 12$) and transgender girls (male birth-assigned sex, $n = 8$) receiving GnRHa as well as

the cross-sectional study design, caution is warranted in drawing any conclusions on the effects of puberty suppressants on cognition and behavior.

In a prospective case study of an 11-year-old transgender girl (male birth-assigned sex), cognitive capacity and changes in diffusion measures of white matter microstructure (indexing myelination, axonal diameter, and white matter integrity, all of which contribute to efficient information transfer) were assessed before initiation of GnRHa treatment and during two follow-up measurements at ages 13 and 14 years, respectively (Schneider et al., 2017). In line with prior studies (Hayes, 2017; Hough et al., 2017; Anacker et al., 2020), performance intelligence quotient and memory deteriorated with treatment, and typical, testosterone-dependent white matter maturation (increase in diffusion parameters) was not observed, suggesting inhibiting effects of GnRHa on neurodevelopment. However, these findings require replication in larger samples and should be compared to the effects of hormone (mainly estradiol) suppression with GnRHa on brain development in birth-assigned females.

In another study, using the same participant samples as in the study by Staphorsius et al. (2015), regional brain volumes of adolescents with and without GD were compared (Hoekzema et al., 2015). It was found that hypothalamus volumes in a sample of 37 transgender girls (male birth-assigned sex) of varying treatment status ($n = 11$ were treatment-naïve, $n = 14$ received GnRHa, $n = 12$ received gender-affirming hormone treatment) tended to be sex-atypical, thus smaller than in cisgender boys. However, given the heterogenous total sample and the small sample sizes of adolescents who had received treatment, it is unclear whether the observed effects on brain structure may be ascribed to the suppression of endogenous hormones, to the addition of estradiol, or being treatment-naïve (i.e., differences could be related to the experience of GD per se).

As of yet, two longitudinal studies, in the same adolescent participant samples, investigated testosterone treatment effects on spatial cognition (Burke et al., 2016) and functional amygdala lateralization (Beking et al., 2020) in youth who experience GD. In the study by Burke et al. (2016), during the first fMRI session, a group of 21 transgender boys (female birth-assigned sex, mean age 16 years) was receiving GnRHa and was compared to groups of treatment-naïve, age-matched cisgender boys ($n = 20$) and cisgender girls ($n = 21$). Brain activation patterns of the transgender boys, during an fMRI mental rotation task, were comparable to those of the cisgender boys, but differed significantly from those of the cisgender girls, thus suggesting sex-atypical spatial functioning prior to initiation of gender-affirming hormone treatment. During a follow-up session, after an average 10 months of testosterone treatment, they showed significantly increased activation during mental rotation (in superior parietal, superior frontal cortex) relative to the previous session, similar to the cisgender boys, and significantly different from the cisgender girls, who showed no changes between sessions.

In another task-fMRI study (Beking et al., 2020), using the same participant samples, the effects of testosterone treatment on changes in functional amygdala lateralization were investigated. The two hemispheres of the brain are well-known to differ in structure and function between cisgender males and females, which is

thought to develop under the influence of testosterone. In line with the hypothesis, the lateralization index (relative activation differences of individuals' right and left amygdalae) in transgender boys shifted towards the right amygdala after testosterone treatment. In addition, the cumulative dose of testosterone treatment correlated significantly with amygdala lateralization after treatment although there were no significant differences between the groups. However, because the transgender boys had received GnRHa treatment during the first fMRI sessions, both studies lacked a baseline (treatment-naïve) control condition. Therefore, possible advantageous effects of suppressing estrogens (which are known to have detrimental effects on mental rotation performance) in the transgender boys (female birth-assigned sex) versus the cisgender girls cannot be ruled out. Nevertheless, together with other findings from hormone administration studies (Heany et al., 2016), these data highlight the influence of testosterone on the human brain.

To conclude, the existing literature suggests long-term adverse effects of GnRHa on adolescent cognitive development, but evidence is too limited to allow definitive conclusions. In addition, it remains an open question whether the window of sex hormone-sensitive brain reorganization might be closed by the time adolescents with GD start using gender-affirmative hormones. Future follow-up studies of existing samples of GD youth and new longitudinal studies that consider typical brain developmental trajectories as well as include a pre-pubertal baseline condition are highly recommended.

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Chapter 4
Social Influences on Gender Development: Theory and Context

Emily F. Coyle and Megan Fulcher

Abstract The social environment has long been recognized as an important context for human development in general and gender development in particular. Children's environments are replete with cues about gender appropriateness and models of gendered behavior. Children receive direct and indirect feedback about their gendered behavior such as the reward of social approval by peers or parents. As a result, gender role differences appear early, especially in domains where the environment is strongly gender-differentiated such as in the realm of play or children's media. From early in life, boys and girls show gender-differentiated preferences for color, toys, and same-gender peers. In this chapter we review classic and contemporary theories of gender development with a focus on Social Cognitive Theory (Bussey & Bandura, 1999) and a newer developmental model of persuasion (Buijzen et al., 2010). We then discuss environmental contexts in which social influences operate to produce gender role development, including parents, peers, school, toys and play, and children's media.

Keywords Social Cognitive Theory · Developmental Persuasion Model · Gender development · Gender socialization

The distinct social influences on girls' versus boys' development have been described as producing "distinctive cultures that develop within girls' and boys' groups as the children grow older" (Maccoby, 1998, p. 78). Indeed, there are no shortage of ways in which the environment may differ for girls versus boys, including the models available to them, reinforcement they receive for gender-typed behavior, and direct instruction they receive about the nature of gender and

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gender-appropriate behavior. Mothers keep their daughters physically closer while allowing sons greater independence to explore the environment (Lindahl & Heimann, 2002). Peer groups provide different environments, given children's tendency to segregate by gender and same-gender peer groups' tendency to play in gender-typed ways (Maccoby & Jacklin, 1974; Martin et al., 2005; Martin et al., 2012). Teachers may organize classrooms by gender, asking children to line up alternately by gender, for example, a practice that increases children's gender stereotyping (Hilliard & Liben, 2010). The gendered environment children see reflected in their storybooks (Gooden & Gooden, 2001; Hamilton et al., 2006) and in their toys (e.g., Auster & Mansbach, 2012) is often strongly gender-stereotyped. The predominant social theoretical umbrella for understanding the operation of these influences is Social Cognitive Theory (Bussey & Bandura, 1999). We begin the chapter with an explanation of the tenets of this theory. We also consider a contemporary application in a developmental model of media persuasion (Buijzen et al., 2010). The remainder of the chapter is dedicated to domain-specific examples of social influence on gender development, including factors from parents, peers, school, and toys/media.

4.1 Theoretical Roots of Social Influence on Gender Development

There are numerous social theoretical approaches to gender development. Classic approaches include Social Learning Theory (Bandura, 1977) and Bioecological Theory (Bronfenbrenner, 1977; Bronfenbrenner & Morris, 2006), among others. Such approaches emphasize the role of the environment, actors in that environment, and responses to individual behavior as important shapers of human development. Although these approaches can and have been applied to understand gender development in particular, one of the first theories to explicitly describe gender role development was Social Cognitive Theory (SCT; Bussey & Bandura, 1999).

4.1.1 Social Cognitive Theory

Social Cognitive Theory (Bussey & Bandura, 1999) is one classic explanation for the mechanism behind social influences on gender development. Triadic reciprocal causation, that is, the transactional influences among individual thinking and self-regulation, gendered patterns of behavior, and environmental factors, is the primary mechanism operating to produce differences in gender role, behavior, and cognition, according to SCT. The environment is not a monolith but is rather situation-dependent and dynamic. There are three environmental structures posited to operate within SCT: the imposed environment, the selected environment, and the

constructed environment. The imposed environment refers to influences outside of the individual's own agency, such as parenting style, school, or neighborhood. The selected environment refers to the influences the individual chooses to engage, with peers and leisure activities being classic examples of selected environments. The constructed environment is rooted in cognitive symbolism such as how an individual thinks about their interactions within a selected environment (e.g., children thinking that engaging in gender-typed play with a same-gender peer is more enjoyable).

SCT of course borrows from behaviorism in that modeling, reinforcement, and punishment are primary shapers of gendered behavior and self-efficacy, which is a person's belief in their ability to complete tasks and achieve goals in specific domains (Bussey & Bandura, 1999). Boys and men are more likely to model other boys and men, whereas girls and women are more likely to model other girls and women. Different models result in the gender-differentiated reproduction of behavior and self-efficacy for gender-differentiated tasks. Enactive experience elicits social feedback (i.e., reinforcement, punishment, or no feedback). Bussey and Bandura argue that given the strong social norms in most cultures prescribing gendered behavior, boys and girls often receive distinctly different feedback for the same behavior. A boy wearing a dress, for example, might be teased (punishment) whereas a girl in the same dress might be praised (reinforcement). Enactive experience is, in and of itself, practice with a particular behavior, which can boost self-efficacy in the associated domain. Direct tuition, instruction in gendered behavior, also has origins in culture-specific social norms for gendered behavior. Importantly, these routes of influence operate throughout the life span. Even before the ability to label one's own gender, we receive gender-differentiated feedback (Lindahl & Heimann, 2002; Lindsey & Mize, 2001). Gender-reveal parties, for example, are occasions to contribute to the imposed environment (e.g., in the form of feminine or masculine clothes and toys) before an infant is even born (Halim et al., 2018; Kane, 2006). Later in life, traditionally gendered career choices have been linked to gender differences in perceived self-efficacy for occupational skills (Bandura et al., 2001), perhaps ultimately contributing to a largely gender-differentiated workforce (Fulcher & Coyle, 2011).

Though at its core a theory about social influences, SCT sees socialization as cognitively demanding, requiring attention to potential influences on gender development, symbolic encoding and cognitive organization of gender-linked information, production or reproduction of gendered behavior, and synthesis of any feedback. As such, an individual's self-regulatory capacity determines which environments and which routes of influence operate to produce gender differentiation (Bussey & Bandura, 1999). While family, peer, and school environments are often-cited examples of influential environments, just as we consider in this chapter, Bandura and Bussey (2004) clarify that SCT posits the robust influence of a wide range of environments. In this chapter, we explore media and toys as additional contexts for gender development.

4.1.2 Developmental Persuasion Model

To understand the influence on self-regulatory behaviors in SCT of media in particular, and of persuasive messaging more generally, it is helpful to consider Buijzen et al.'s (2010) triple-process model of persuasion in tandem with aspects of SCT. According to this model, media and other persuasive messaging are influential via three levels of processing: No attention (automatic-persuasion processing), low-moderate attention (heuristic-persuasion processing), and high attention (systematic-persuasion processing).

Automatic-persuasion processing happens without much cognitive elaboration on a message and is driven primarily by affect (Buijzen et al., 2010). This route is especially influential for young children who, given their cognitive processing limitations, may be unable to think especially deeply about a message or even consciously process some messages at all. Environments that promote positive affect operate in this way (e.g., play) and may be prominent routes of influence especially in early childhood. Heuristic-persuasion processing happens with directed but low cognitive effort to elaborate on messaging. Cognition is guided by heuristic cues, such as attractiveness or predictability. For example, an attractive, gender-conforming character might be a more influential model than a less traditionally conforming or less attractive character. Systematic-persuasion processing involves a high degree of cognitive elaboration, something that becomes more possible with age and cognitive development but is beyond the capabilities of young children. For example, an older child might recognize that a toy advertisement is targeting girls (e.g., with a toy that has strongly feminine cues in terms of color, model, and mode of play). Between 10 and 12 years old, children are better able to recognize the persuasive intent of messaging (Rozendaal et al., 2011). Yet, because it is effortful, even those older children, adolescents, and adults capable of this processing may be unlikely to engage in it unless motivated to do so. Therefore, the superficial automatic and heuristic cues in our environment may be the predominant routes of influence. In the following sections, we explore particular contexts in which gender development is facilitated by various social influences, including family, peer, school, play, and media. Where possible, we connect to tenets of the developmental persuasion model although empirical tests of this model with respect to gender development are currently limited and therefore most of our connections are theoretical in nature and should be empirically validated.

4.2 Social Contextual Factors Influencing Gender Development

4.2.1 Family

Parents play an important part in their children's gender role development both as teachers and as models, and are likely persuasive at every level (automatic, heuristic, systematic). From infancy, and perhaps before birth, parents treat their sons and daughters differently (Kane, 2006; Sweeney & Bradbard, 1988). In fact, American parents report wanting a child of each gender because they believe that raising boys and girls will bring different rewards (Nugent, 2013). One of parents' first tasks, to name their child, is a task that relies on and signals the gender of the child (Lieberson et al., 2000), permitting infants who look remarkably similar to be treated according to their gender. Like names, children's dress indicates children's gender, and parents choose and buy clothes throughout childhood; by toddlerhood, gender-typed clothing is more closely tied with children's own gender labeling than parents' attitudes (Halim et al., 2018). Clothing in particular may elicit heuristic processing about gender-appropriate appearance.

Although it is clear that children's own behaviors and characteristics have an impact on parenting behaviors (Ayoub et al., 2019), classic studies indicate that mere knowledge of an infant's gender impacts cognition about and behavior toward that infant (Rubin et al., 1974; Seavey et al., 1975). When infant gender labels were randomly assigned, adults treated them differently and stereotypically. In such *Baby X* experiments, no real gendered infant behaviors were eliciting differences in adult behaviors (Seavey et al., 1975). Parents of newborns also respond to children's gender. Newborn boys are perceived by parents as more alert, more coordinated, and bigger than are newborn daughters even when the infants did not differ by length, weight, or Apgar scores at birth (Rubin et al., 1974). Parents continue to rely on gender when responding to their infant including interpreting crying (a primary infant behavior) differently in sons and daughters (Teichner et al., 1997). Mothers underestimate daughters' motor development in infancy while they overestimate sons' (Mondschein et al., 2000), and play more physically with sons than with daughters (Lindsey & Mize, 2001). Conversely, they talk to and cuddle daughters more than they do sons (Leaper et al., 1998; Mascaro et al., 2017). These differences in experiences extend into toddlerhood, where daughters are kept close to parents (Lindahl & Heimann, 2002), particularly mothers. However, sons are encouraged to play more independently and are given toys that encourage large motor skill and spatial relation skills (Leaper & Gleason, 1996). Such differences in parental perceptions can produce different developmental environments, an automatic cue, in which girls build efficacy for relationship skills while boys do so for physical and independent tasks.

Although studies of general parenting practices (e.g., Endendijk et al., 2016) show few gender differences, looking at more subtle differences can show that parents indeed differentiate their behaviors, and thus gender socialize their older

children (Mesman & Groenevald, 2018). When examining national state accountability test data from elementary to middle school, the gender gap in math scores seems to have disappeared (Reardon et al., 2018). However, boys are perceived as smarter in math and sciences while girls are perceived as hard-working and well-behaved students (Bhanot & Jovanovic, 2009). Parents encourage boys' extracurricular activities that are usually narrowly focused on athletics or on science and math (Wigfield et al., 2002).

Fathers are particularly concerned with their children's gender role development and report more concern about sons' adherence to gender roles than daughters' (Kollmayer et al., 2018; Langlois & Downs, 1980). Fathers will engage in masculine play with both daughters and sons, but will only engage in feminine play with daughters (Fagot & Hagan, 1991; Leaper, 2000). Fathers also give direct information to sons about gendered attitudes and behaviors (Caldera et al., 1989; Kane, 2006), potentially eliciting sons' heuristic or even systematic processing of these gendered messages. When presented with feminine toys, sons report knowing that these are toys with which their fathers would not like them to play (Freeman, 2007; Raag & Rackliff, 1998).

The toys that are provided at home influence children's play preferences in the wider world (Boe & Woods, 2018). Parents still provide physical environments, including toys that differ by child gender (MacPhee & Prendergast, 2019; Sutfin et al., 2008). Boys are more likely to have toy vehicles, athletic games, and action figures while girls are more likely to have baby dolls, fashion dolls, and kitchen sets (Blakemore & Centers, 2005). Although egalitarian parents find cross-gender-typed toys more desirable for their children than do traditional parents (Weisgram & Bruun, 2018), many parents play differently with sons (e.g., more physical play) versus daughters (e.g., more pretend play). Children then use parent play as template for peer play. Those who pretend with parents also pretend with peers, and those who play physically with parents also play physically with peers (Lindsey & Mize, 2001). These different interactions with peers give boys and girls practice and efficacy-building experiences to further differentiate the set of skills and competencies they bring to adulthood.

Adults hold and adhere to beliefs about how men and women should behave, and these beliefs influence their parenting behaviors and their expectations for their children's behaviors. Interestingly, for most parents, becoming a parent is associated with increasingly traditional gender-role stereotypes and behaviors (Endendijk et al., 2018). Thus, many parents arrive at parenthood with more traditional notions about gender, which are associated with more gendered behavior by children. Men's reported masculinity is associated with less instrumental and expressive parenting and more harsh parenting (Petts et al., 2018); such harsh parenting is directed more often at sons, which in turn is associated with sons' own aggressive behaviors (Endendijk et al., 2017). Parents' reported stereotypes are also associated with children's cognitive and educational outcomes. Parental math self-concepts and beliefs are associated with 5-year-old girls' own math self-concept, and kindergarteners' belief that only boys do math (del Rio et al., 2019). Similarly, parents' endorsement of the stereotype favoring girls in reading was associated with boys'

lower competence beliefs and intrinsic value beliefs (Muntoni & Retelsdorf, 2019). Parents' attitudes continue to influence children's ideas as they plan their future work (Farkas & Leaper, 2016).

Children's vision of their future work and family roles are not only influenced by parental attitudes. Importantly, children use their parents' behaviors in the home and at work as a template for their own future selves (Fulcher & Coyle, 2011; Fulcher et al., 2008), a heuristic cue for gendered division of labor. Heterosexual couples still specialize family labor according to parental gender, with mothers responsible for more child and house care and fathers responsible for earning money outside the home (Mannino & Deutsch, 2007; Solomon et al., 2005; Tichenor, 2005). This heteronormative family ideal known as the breadwinner/caregiver model (Christiansen & Palkovitz, 2001) does not come to perfect fruition in most families, as most mothers work and provide needed income (Pew Research Center, 2013). However, the ideal persists and impacts parents' behaviors at home. Most mothers are primarily responsible for the physical and managerial care for children, and fathers' childcare behaviors are often framed as "helping" (Meteyer & Perry-Jenkins, 2010). However, fathers' more regular involvement in children's physical care has been shown to have several benefits to children's and men's well-being and adjustment (Bronte-Tinkew et al., 2008; Schindler, 2010). Fathers are more likely to spend time caring for sons than for daughters (Manlove & Vernon-Feagans, 2002), and sons seem to benefit more from father involvement than do daughters (Bronte-Tinkew et al., 2008). As parents enact these gender-differentiated caregiver roles, children come to see women as more competent caregivers (Sinno & Killen, 2009) and to model behaviors associated with the breadwinner/caregiver ideal. Girls are involved in more domestic and doll play (Leaper & Gleason, 1996) and later more responsible for household chores than are boys (Crouter et al., 2001).

Children begin to envision their future work and family life by preschool (Fulcher et al., 2008), and these visions are typically gendered as children understand gender divisions in the workforce (Liben & Bigler, 2002; Liben et al., 2001). Children whose parents adhere to the more traditional breadwinner/caregiver ideal report more traditional gendered behaviors and vision of their future selves (Fulcher et al., 2008). Conversely, daughters whose mothers contribute to family finances are more likely to think about future careers and to envision a future that includes working. Sons whose mothers work have visions of the future that include increased childcare responsibilities (Riggio & Desrochers, 2006). When mothers view their family role as financial provider, their daughters reported less traditional gender role attitudes than do daughters of mothers who consider themselves primary caregivers (Helms-Erikson et al., 2000). Thus, heterosexual parents who break from the breadwinner/caregiver ideal have children who are also able to envision a future with family roles less restricted by gender (Deutsch, 2001).

Parents foster gender differences in emotions and communication by talking more about emotions with daughters than with sons. This begins in infancy where mothers talk and play differently with sons and daughters (Clearfield & Nelson, 2006). When they do talk about emotions, both mothers and fathers talk differently to sons and daughters about emotional events (Fivush et al., 2000). Parents discuss interpersonal

emotional situations and feelings of sadness more with girls, and autonomous emotional situations with boys. Parents read emotional stories by gendering angry characters as boys, and sad or happy characters as girls. Mothers talk more about emotions than do fathers with both sons and daughters (van der Pol et al., 2015). As parents build different efficacies for emotional tasks, they are highlighting that girls need to be prepared to emotionally manage and nurture relationships, a key component of the breadwinner/caregiver model.

However, some parents are able to construct family roles outside of the breadwinner/caregiver model. For example, adopted preschool children of lesbian mothers have less stereotyped play than those of heterosexual mothers (Goldberg et al., 2012). This difference can be explained by the higher likelihood of egalitarian division of labor and more nontraditional gender role attitudes (Fulcher et al., 2008; Sutfin et al., 2008). Similarly, heterosexual parents with nontraditional behaviors and attitudes also have children whose vision of the future is less tied to gender roles (Fulcher et al., 2008). Furthermore, black mothers give stronger encouragement of independence to their daughters than do white mothers. This building of efficacy and role modeling helps to explain black girls' higher self-esteem and sense of control than that of white girls (Ridolfo et al., 2013). These alternative behaviors in the family show that parents can work to help children loosen their adherence to gender roles.

4.2.2 Peers

Outside of the family, peers operate as a strong influence in many aspects of child development. In fact, some have suggested peers may be even more influential on development than are parents (Harris, 1995, 2009). Peers serve both as models of behavior and as the source of reward and reinforcement for gender-typed behavior (Bandura, 2001). Social approval operates as an automatic persuasive process (e.g., the approval of others feels good and is motivating, while the disapproval of others may be uncomfortable and demotivating). Peer influence operates at three levels: Interactions, relationships, and groups (Rubin et al., 2006). Interaction-level influences are those between two individuals in the context of a single interaction whereas relationship-level influences refer to what characterizes the bond between those individuals. Group-level influences refer to what is happening at the level of a collection of individuals that has influence at the level of a single individual. At all three of these levels, peers have the potential to be a powerful influence on gender development.

Beginning early in life, a child's peer group is generally same-gender, and play with same-gender peers tends to be gender-typed in nature (Maccoby & Jacklin, 1974; Martin et al., 2005; Martin et al., 2012). On average, boys play in larger groups whereas girls play in dyads or triads (e.g., Fabes et al., 2003). Boys' play tends to be rougher, more active, and more competitive, whereas girls' play tends to be more cooperative (Maccoby, 1990). Activity choices in same-gender groups tend to be

gender-stereotyped, especially among groups of boys (Fabes et al., 2003). In fact, peer experiences for girls versus for boys have been said to be so gender-differentiated that boys and girls experience fundamentally different cultures in childhood (Maccoby, 1998). Indeed, the tendency to self-segregate by gender persists across the life span (Mehta & Strough, 2009). The proclivity to associate with same-gender peers may be a product of homophily, the greater similarity (e.g., in traits, interests, skills) among female members of all-female peer groups and among male members of all-male peer groups. Perhaps as a result, same-gender interactions produce and reinforce gendered behavior, whereas interactions in mixed-gender dyads tend to be less gender-typed (e.g., Goble et al., 2012). Gender-segregated activity can therefore be strongly self-perpetuating, producing increasing similarity over time in behavior, interaction styles, preferences, and communication, among other similarities (Mehta & Strough, 2009), via automatic and heuristic processing.

Evidence for the transactional relationship between gendered behavior and gender-segregated peer affiliation can be found in the work by Martin et al. (2005). The researchers observed preschoolers' interactions at play and in the classroom over 1 year, using a state-space grid approach based on dynamic systems principles to model interactions over time. Same-gender peer interaction states were more common than mixed-gender states, meaning most interaction occurred with same-gender groups. Additionally, children who engaged in more same-gender play showed an increase in preference for play with same-gender peers, such that that same-gender play became increasingly common for these children (Martin et al., 2005). At the level of the group, Martin et al. (2012) used a similar approach to model group influence on children's peer play interactions. As expected, they found children played with same-gender peers more often, and with peers with similar activity preferences. Importantly, they found the play preferences of the group were powerful in shaping a child's activities and interactions (Martin et al., 2012).

As children have more practice in gender-typed modes of play, they may come to prefer it. At the same time, preference for gender-typed play likely leads children to affiliate with same-gender peers, an automatic persuasive process. It is challenging to disentangle which influence is more powerful, peer gender versus peer play style. Research by Alexander and Hines (1994) found that while children preferred same-gender peers playing in traditional gender-typed ways, their preference for peers when play was cross-gendered was more complex. Boys preferred girls playing in masculine ways than boys playing in feminine ways. For girls, this pattern replicated for older girls (6–8-year-olds; preference for boys playing in feminine ways over girls playing in masculine ways) but was reversed for younger girls (4–5-year-olds; preference for girls over boys, regardless of play style). The self-regulatory aspect of SCT may be an important moderator for children's selection of peers on the basis of gender versus play style. Children who perceived themselves as more similar to same-gender peers were more likely to affiliate with same-gender peers than other-gender peers in observed free play (Martin et al., 2011). Interestingly, this was regardless of play style for girls but not for boys. For boys, engaging in rough and tumble play was positively associated with play with other boys (that is, boys play with boys in this style), in addition to boys' perception of similarity to other boys.

For girls, perceived similarity to girls was the only significant predictor of affiliation with girls. Perceived similarity to same-gender peers likely operates as a heuristic cue in children's processing of associated gender-linked information.

In addition to the direct socializing forces of interaction with same-gender peers, peers operate indirectly to produce gendered behavior. Children may be motivated to appear gender-typical to peers and therefore to present in a gender-typed manner in the presence of peers. Boys appear especially likely to play in gender-stereotyped ways in the presence of their peers as compared to when they play alone, perhaps a result of their more rigid gender stereotype as compared to girls (Banerjee & Lintern, 2000). Gender-typical self-presentation is rewarded by peers and adults alike (e.g., Coyle et al., 2016). Moreover, children may police one another's gendered behavior, punishing children whose behaviors are perceived to be gender transgressive or nonconforming (e.g., Blakemore, 2003; Smetana, 1986). In this way, the peer group may act both indirectly, as a motivator to behave in gender-typed ways, and directly, to reinforce gender-typed behavior when it occurs, perhaps perpetuating a mostly automatic persuasive process of the "gender-segregation cycle" (Brown & Stone, 2018, p. 128).

4.2.3 School

In middle childhood, boys and girls spend a great deal of their day at school, and along with academic lessons, they learn about gender from teachers who both serve as models and teach gender via differential treatment and expectations of boys versus girls. These are both potential heuristic persuasive cues about gendered behavior. Before elementary school, preschool is an opportunity for children to build the social and emotional skills needed to be a student. However, preschool teachers bring different expectations of, and strategies for, boys versus girls (Gansen, 2019). Teachers expect girls to be more polite and responsive to teachers' requests, punishing girls when they are not; yet, teachers offer boys support and reminders for the same types of behavior. Boys are expected to be physical and aggressive and are offered more alternative solutions and muted responses from teachers than are girls when behaving aggressively (Gansen, 2019). The message to girls is that they should remain quiet and in tune with teachers, while boys learn it is natural for them to conflict with peers and need help following school rules. Punishments also differ for boys and girls, with boys being given opportunities to release energy (e.g., push-ups, running) while girls are asked to clean (Gansen, 2019). This differential treatment may reinforce the different behaviors and roles children observe in parents at home. Preschool teachers encourage gender-typed play with groups of students, such that groups of girls are more likely to be encouraged to participate in feminine play while groups of boys (and mixed-gender groups) are encouraged to participate in masculine play (Granger et al., 2017). Girls are much more likely to play with feminine domestic toys than are boys even when those boys were playing with girls. Girls receive more practice and rewards for emulating the caregiver role.

In fact, teachers often cast children's friendships in a heteronormative lens. Boys and girls who show affection are referred to as "boyfriend/girlfriend" by teachers (Gansen, 2017). Teachers talk about children's "crushes" and allow boys with crushes to kiss girls without consent (Gansen, 2017). At the same time, preschool teachers support heterosexual scripts by more carefully monitoring girls' displays of their bodies. Girls were punished both when showing their body and when commenting on boys' body displays. Boys were not punished for showing their body or for making body jokes (Gansen, 2017). Additionally, preschool teachers show more control over girls' bodies than boys' bodies (Martin, 1998). Girls learn that access to their body is not under their control, yet should it be revealed to others, they will be held responsible.

In classrooms where gender is a more salient heuristic cue, such as when teachers refer to children by gender and use gender as an organizational category, children increase gender-stereotyping, report less positive ratings of other-gender peers, and decrease their play with other-gender peers (Hilliard & Liben, 2010). When children segregate their play, they can come to think of themselves as different in many domains. Thus, boys and girls can enter elementary school feeling efficacies and preferences for different tasks.

As children enter formal schooling, the gendered curriculum continues, with teachers' expectations and reactions to children's behaviors differing on the basis of child gender. Boys are seen as in need of help and support, and as needing more behavioral interventions than are girls. Thus, teachers give more attention to boys, leaving girls who are trained to be quiet to figure things out on their own (Myhill & Jones, 2006). Teachers have lower expectations for male students who they often believe to be underachievers, indicating that they are not doing well because they are not trying. In fact, high school teachers perceive boys who give less effort as more popular and more intelligent (Heyder & Kessels, 2017). Conversely teachers believe girls are good students who try, so their failure indicates a lack of ability. Boys and girls receive different messages about their successes and failures. As boys are encouraged to try harder, they continue to pursue challenging classes while girls who are encouraged to accept their limitations may not.

One area where differences in boys' and girls' educational experiences are clear is in science, technology, and engineering and math (STEM) classes. Both parents and teachers report that boys are better at and more interested in math and science. Combining this with messages girls receive about success and failure makes it difficult for girls to build efficacy for STEM skills. Girls' preschool science interests foster positive self-concepts and higher science achievement scores in elementary school (Leibham et al., 2013). Thus, it is important to build girls' efficacy for difficult math and science tasks early. However, parents report sons have more early science interest and offer more science experiences for sons than for daughters. For older children, boys receive informal science experiences regardless of science interest (Alexander et al., 2012). The mere exposure to enjoyable science experiences may be an automatic persuasive cue to boys but not to girls that science is desirable and gender-appropriate.

One common way to build girls' efficacy for and interest in science is to offer female role models. Although this intervention seems to fit nicely with SCT, empirical evidence paints a more complicated picture and it is helpful to draw on the developmental persuasion model here to understand potential moderating variables. Teachers may serve as role models for math success, but female teachers' math anxiety negatively impacts female students' performance (Beilock et al., 2010). Interestingly, interacting with STEM role model, more feminine appearance of the model may demotivate girls in STEM possibly because achieving both femininity and success in STEM may not feel attainable to girls (Betz & Sekaquaptewa, 2012). Additionally, female scientists who use confusing jargon or boring presentations also do not work to increase girls' interest in STEM, instead creating a cognitive gap such that girls believed women could be scientists but that they themselves could not (Bamberger, 2014). In contrast, a letter from a female role model that recognizes the obstacles helped young women scientists persist (Herrmann et al., 2016). Each of these intervention examples incorporates important persuasive cues. Seeing teachers with anxiety may make math seem less enjoyable to girls (automatic). Similarly, scientists using confusing jargon may make STEM seem less enjoyable. Feminine STEM models may be demotivating if the two identities seem to be in conflict (heuristic). Models recognizing obstacles to success may elicit deeper systematic processing, leading to greater STEM persistence.

STEM areas vary in success of attracting women to the field. Women sometimes report they do not feel a sense of belonging in more segregated STEM domains (e.g., computer science). Girls who are good at math are often also good at reading, and will choose subjects in reading over math if they do not perceive a sense of belonging in STEM (Breda & Napp, 2019). Simply changing the décor in a computer classroom so that it does not reflect stereotypes about computer science made women feel more comfortable (Cheryan, Meltzoff, & Kim, 2011a). Women with non-stereotypical models (regardless of gender) believed they could be more successful in computer science than those that interacted with a stereotypic model (Cheryan et al., 2012; Cheryan, Siy, et al., 2011b). Women's concerns about pursuing STEM occupations are realistic, given that bias against women in these fields continues. Male students' applications for junior science jobs were reviewed more favorably by both male and female scientists than were female students' applications. Scientists reported more career mentoring to the male student (Moss-Racusin et al., 2012). Conversely, for tenure-track academic positions women held an advantage in hiring (Williams & Ceci, 2015). This may be beneficial for women with a Ph.D., but without early science experiences and career mentoring, some women will not get to the tenure track job search. Interventions to encourage girls' and women's interest in science should continue, but in order to be successful, these interventions need to be paired with less-biased classroom and career structures.

Another intervention implemented to reduce the gender gap in academic domains is single-sex schools and classrooms. By removing students of the other gender, it is thought that gender-based biases and comparisons would not occur, leaving all children to learn free of gendered expectations. Yet, large-scale meta-analyses of gender composition of schools found no academic benefit of single sex schooling,

and any differences found were due to pre-existing group differences (Pahlke et al., 2014; Signorella & Hayes, 2013). When appropriate control groups were used (e.g., wait list, magnet schools), no academic benefits emerged for single-sex schools (Hayes et al., 2011; Pennington et al., 2018). Instead, there is evidence that single-sex schools promote gender stereotyping (Halpern et al., 2011), perhaps via automatic (e.g., enjoying time with exclusively same-gender peers or anxiety about interacting with the other gender), systematic processing (e.g., noticing that gender is an important societal organizing tool) and heuristic processes (e.g., abundance of same-gender models and gender-typical behavior). Students in single-sex schools show heightened gender salience, more mixed-gender anxiety, and fewer cross-gender friendships (Wong et al., 2018). Even during school activities where the focus is on only one gender, there is not always the need to segregate by gender (e.g., to mitigate body dissatisfaction) because a coeducational setting can be as impactful on students (Dunstan et al., 2017).

In coeducational environments, cognitive benefits emerge for both boys and girls. When assigned to coeducational classrooms, girls scored higher on exams and were more likely to enroll in physics than those in single sex classes, while boys in coeducational classes were more likely to enroll in biology, now a female-dominated STEM discipline, than boys in single sex classrooms (Park, 2018). Of course, being coeducational does not guarantee that boys and girls work together harmoniously in the classroom as there are varying levels of gender integration within classrooms (Fabes et al., 2018). Teachers and interventionists need to pay attention when boys and girls work together on hands-on science learning, as girls may let boys take the lead (Weiselmann et al., 2020). Consistently offering coeducational groups with leadership roles for both boys and girls can promote science efficacy in all students.

School can also be used as a forum to discuss and build efficacy for responding to gender stereotypes and discrimination. School-based interventions can change how children, particularly girls, respond to peers' sexist remarks (Lamb et al., 2009). Lessons about gender discrimination increases awareness for all students, and for girls, increases the desire to combat discrimination their later continued perception of discrimination (Pahlke et al., 2010). When boys and girls work together with teachers who treat all children similarly, school can be an ideal place for students to build efficacy for social and cognitive skills.

4.2.4 Toys and Media

In addition to formal classroom learning, informal learning via toys and media is a particularly rich medium for gender socialization. Play is a primary activity for children (Hofferth & Sandberg, 2001) and a context that facilitates learning (Bandura, 1978). Play may be a particularly influential medium for automatic information processing given that play is enjoyable. Even if older children may be able to recognize marketing cues that serve to mark toys as for a particular gender, they may be likely to still respond to such cues (Rozendaal et al., 2011).

Extrapolating from a gender-neutral example, research shows preschool children who read an interactive story about a rabbit eating carrots felt more positively about and consumed more carrots than did children who read a different story, presumably because storytelling is enjoyable and the positive feelings children felt while reading the story transferred to their attitude about carrots (de Droog et al., 2014). Similarly, we might expect that books or play with messaging about gender are influential at this automatic level. Toys and media can be models of gendered behavior, promote practicing gendered skills, and in some cases directly instruct about gender norms. Toys in the USA are marketed by gender more now than ever before in history (Sweet, 2014). Different toys are marketed to girls versus to boys: Dolls, domestic toys, and fashion accessories are typically marketed to girls while action figures, weapons, building toys, and vehicles are typically marketed to boys (e.g., Auster & Mansbach, 2012). One strong marker for gender in children's toys is color. Toys marketed to girls are typically pink, purple, and shades of pastel whereas toys marketed to boys are often red, black, or non-pastel shades of other colors (Auster & Mansbach, 2012). Girls show a preference for pink while boys show an avoidance of pink (LoBue & DeLoache, 2011) and a preference for blue (Wong & Hines, 2015b) by 2–3 years old.

In addition to color, explicit labeling is another marker of gender-appropriateness of toys. Martin et al. (1995) asked preschool children to rate their own and their peers' interest in a novel toy. When the toys were labeled as explicitly "for girls" or "for boys," children showed a strong difference in their ratings, preferring toys labeled as for their own gender and being least interested in toys labeled for the other gender, regardless of the attractiveness of the toy. Girls were especially susceptible to this effect, rating own-gender-labeled toys even higher than boys did. Drawing on the developmental persuasion model discussed earlier in this chapter, labeling may elicit heuristic processing. Color and label work together to cue gender-appropriateness to children. Research by Weisgram et al. (2014) found that girls rated novel toys highly if they were labeled as "for girls" (regardless of color) or if they were pink (regardless of label). Wong and Hines (2015a) found a similar effect for boys in their observation of toddlers' play. Boys played longer with the masculine toy (train) than the feminine toy (doll), and with blue toys (regardless of object) than with pink toys.

Given how strongly toys are marked with information about gender, it is perhaps not surprising that beginning as early as the first 2 years of life, boys and girls show preferences for different toys (Caldera et al., 1989; Martin et al., 1995; Serbin et al., 2001; see Zosuls & Ruble, 2018 for a recent review). Girls are more likely than boys to prefer and to play with domestic toys, dolls, stuffed animals, and fashion accessories (Cherney & London, 2006). Boys are more likely than girls to prefer and to play with transportation toys, construction and building toys, toy guns, and sports-related toys (Cherney & London, 2006; Jirout & Newcombe, 2015).

Such gender-differentiated toys can teach different skills, contributing to gender differences in behavior, interest, and self-efficacy. Feminine toys are particularly encouraging of nurturance and domestic skills (Blakemore & Centers, 2005). Research by Li and Wong (2016) found that for Chinese children, play with

feminine toys predicted comforting skills—even more strongly than comforting skills predicted frequency of play with feminine toys. Masculine toys appear particularly encouraging of aggression, active play, competition, and construction (Blakemore & Centers, 2005; Miller, 1987). Boys are more likely to have and to play with LEGO than are girls (Fulcher & Hayes, 2018). Play with construction toys such as LEGO has been associated with better math performance in elementary school (Wolfgang et al., 2003) and stronger spatial skill in adulthood (Doyle et al., 2012).

Even when boys and girls are given the same toy, they may not play with it in the same way, thus practicing and honing different skills despite using a toy that might afford development of parallel skills. Coyle and Liben (2018) gave children a mechanical engineering toy that varied by gender marketing. Children either received GoldieBlox, marketed to girls (pink, female character), or BobbyBlox (identical but masculine in color and character). In children's free play with the toys, girls were more likely to use the associated storybook as a guide to their building whereas boys were more likely to build freely and not in relation to the book. Interestingly, boys' and girls' play was relatively more similar in same-gender conditions (i.e., less use of the storybook). The storybook included direction on how to build a belt-drive, the engineering concept targeted by the toy. Thus, when children used the storybook more (i.e., in the other-gender condition, girls with BobbyBlox and boys with GoldieBlox), learning was greatest. That is, boys learned more playing with GoldieBlox whereas girls learned more playing with BobbyBlox (Coyle & Liben, 2018). In Fulcher and Hayes' (2018) study of children's play with LEGO, they found that boys built more masculine objects than did girls during a period of free building. Play with a same-gender toy may reinforce playing in gender-typed ways, perhaps because children are already familiar with own-gender toys and their associated modes of play.

In addition to the particular skills children develop in play, toys can act as models of gender-typed behavior or qualities. One ubiquitous model of traditional femininity is Barbie. Sherman and Zurbriggen (2014) gave girls either Barbie or Mrs. Potato Head for 5 min of play before asking them about their career cognitions. Girls who played with Mrs. Potato Head perceived a greater number of careers to be personally attainable than did girls who played with Barbie. In Coyle and Liben's (2016) research, girls played a computer game about jobs featuring either Barbie or a Playmobil doll ("Jane"). Although neither condition increased girls' interest in masculine, feminine, or novel jobs, play with Barbie increased interest in other feminine toys. This effect was especially strong for girls who paid a lot of attention to gender (i.e., highly gender salient). In both of these studies, Barbie appears to operate as a model of stereotypic femininity (i.e., domesticity and feminine play), to the exclusion of less feminine attributes (i.e., career involvement). Yet, other research shows characters that model counterstereotypes may change children's behavior. Green et al. (2004) exposed a sample of preschoolers selected for their high degree of gender-typed play to books that carried a counterstereotypic message. In these books, a main character played with a culturally cross-gender toy and received encouragement from own-gender peers, parents, and teachers. Girls who

heard the counterstereotypic books played more with masculine toys than did girls who heard a neutral book that contained no gender information. These findings suggest that the books were an effective tool for changing girls' gender-typed toy play. Interestingly, no such change was observed among the boys in the study, who continued to play predominantly with masculine toys regardless of the books they were read.

In addition to toys, children's media (e.g., books, television, and movies) is also highly gender-stereotyped. Male characters are approximately twice as prevalent in both children's books (e.g., Hamilton et al., 2006) and movies (e.g., Smith et al., 2010), especially among lead characters or protagonists. Boys therefore have many more models in the media they consume than do girls. Even as female representation in children's media has somewhat increased over historical time (previously male representation was almost 10 times female representation), the gender roles portrayed in children's books and movies are largely consistent with stereotypic gender roles, especially for female characters (Gooden & Gooden, 2001; Hamilton et al., 2006; Smith et al., 2010). It is perhaps not surprising that similar stereotypes pervade media aimed at adult audiences (Collins, 2011). Adults and children alike see myriad models of traditional gender roles in a range of media.

On average, children under 8 years old spend more than 2 h a day on screens, most of that time being TV or movie viewing (Common Sense Media, 2017). Media use doubles among 9- to 12-year-olds, with non-school screen media use averaging about 4.5 h per day (Common Sense Media, 2015). Toy advertising, common in children's media, is a domain where socialization and developmental forces converge. Children easily swayed by having fun (automatic processing) and by attractive toys and characters (heuristic processing) are especially vulnerable to advertising because of their inability to recognize its persuasive nature (Buijzen et al., 2010). Advertising to children is gender-differentiated in multiple ways. Advertising targeting boys uses male voice-overs while advertising targeting girls uses female-voice overs (Johnson & Young, 2002), capitalizing on the greater likelihood of boys to model other males and girls to model other females. Portrayals of children in advertising is stereotype-consistent, with boys more often portrayed playing aggressively and girls portrayed playing domestic activities (Larson, 2001). Kahlenberg and Hein (2010) analyzed all commercials played on the children's cable television network Nickelodeon during a daytime block (2 p.m. to 7 p.m.) over 2 weeks. Most ads portrayed single-gender groups playing with gender-typed toys. More than half of ads featuring only girls were for dolls, and no ads for dolls included boys. Action figures and transportation toys were more often shown with boys, and no ads for these toys included girls. Advertising is one domain in which children have many same-gender models acting in traditionally gender-typed ways, and very few counterstereotypic models.

4.3 Conclusions

The tenets of SCT are that learning happens through modeling, practice, instruction, and reinforcement and punishment (Bussey & Bandura, 1999). There are many powerful social forces that provide contexts for learning about gender, of which we discussed several in this chapter: family, peers, school, and toys/media. Children have ample examples in all of those contexts of same-gender models who are largely gender-typed in their actions. Children process gender-linked encounters at multiple levels, but may be particularly influenced by encounters that are enjoyable (automatic persuasive processing) or predictably gender-typed (heuristic persuasive processing). Moreover, environmental contexts also provide opportunity to practice gender-differentiated skills. It is therefore not surprising that social influences operate to produce and perpetuate gender roles, gender-differentiated behavior and self-efficacy, and gender-stereotyped attitudes.

Yet, we also know that counterstereotypic models can produce less gendered outcomes. Given the strongly gender-differentiated messages children are exposed to in their environment, there is ample room to introduce counterstereotypic or gender-neutral messages into the cultural conversation. Despite children's well-documented preference for gender-typed toys, research also shows that children are interested in neutral toys, albeit less strongly than same-gender toys, and parents may even prefer to purchase neutral toys when available (Coyle & Liben, 2018; Weisgram & Bruun, 2018). Broadening the scope of behavior that children model has the potential to foster a wider skillset for both boys and girls, build self-efficacy for children in gender-nontraditional domains, and break down some of the barriers that children perceive to achieving their family and career goals in adulthood.

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Chapter 5
Contemporary Cognitive Approaches to Gender Development: New Schemas, New Directions, and New Conceptualizations of Gender

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Abstract The focus of this chapter is on two decades of advances in theory and research involving cognitive theories of gender development. The primary ways in which contemporary research has built upon previous work include (a) expanding the measurement and conceptualization of gender identities, (b) broadening the scope of gender-related cognitive constructs, and (c) detailing more closely the processes underlying gender development and describing the interrelations among these processes. In this chapter, we review the major themes underlying cognitive approaches, detail recent advances in research involving cognitive theories of gender development, and provide suggestions for future work that will capitalize on these advances.

Keywords Gender identity · Gender schema · Cognitive development · Gender development · Cognitive theories · Identity development

Gender development throughout the life span has long been a focus of psychological research. Theorists have proposed a number of biological, social, and cognitive explanations for how and why gender identity and behavior develop the way they do, and recently emphasis has been given to thinking about how the combination of all these influences shapes an individual's gender development (Leaper, 2011a, 2011b). Theories labeled as "cognitive" emphasize the active role of the developing individual in interpreting the social world and from that basis, influencing and creating their own gender development. It is the elucidation of this active role that comprises the bulk of past and recent cognitive research on gender development.

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The focus of this chapter is on the advances in theory and research involving cognitive theories of gender development. The primary ways in which contemporary research has built upon previous work include (a) expanding the measurement and conceptualization of gender identities, (b) broadening the scope of gender-related cognitive constructs, and (c) detailing more closely the processes underlying gender development and describing the interrelations among these processes. In this chapter, we begin with a brief review of the major themes underlying cognitive approaches. Next, we review changes in the way that gender is conceptualized and refinements in how gender self-categorization motivates gender development. The third section involves discussion of new perspectives on the concept of gender identity. In the fourth section, we provide examples of recently developed cognitive constructs that represent a movement in contemporary theories to address more focused and specific cognitions. Next, we present advances in thinking about the processes driving gender development and how researchers are determining the interrelations among the various processes to better understand the patterns and variability seen in gender development. In this section, we review the Dual Pathways Model (Liben & Bigler, 2002) in which individuals develop ideas about gender norms via external stimuli as well as personal preference, and we discuss the model developed by Tobin et al. (2010) in which the relations among stereotypes, identity, and gender groups are described. Finally, we present promising directions for future research efforts. Coinciding with changes in cognitive theories have been changes in conceptualization and terminology referring to gender as well as in research involving gender, gender identity, sex, and sexual orientation (see Del Giudice, in press; Hyde et al., 2019). As our goal in this chapter is to present both the past views of gender development and the more current views, we illustrate these changes and consider their influences on cognitive theories. Nonetheless, throughout the chapter, we use the terms "gender" and "gender identity" to represent a person's own view of self, which may or may not correspond to their sex assigned at birth. Furthermore, while we acknowledge that gender is not a binary social category, we also recognize that many individuals are perceived by others in a binary way. Thus, we attempt to communicate the ways research has represented gender in theories and empirical studies, while recognizing that this may not always reflect all individuals' lived experiences of gender.

5.1 Themes of Cognitive Theories of Gender Development

Cognitive approaches to gender development vary in their focus but share common themes. Since the cognitive underpinning of gender was first proposed in Cognitive Developmental Theory by Kohlberg (1966), a large number of cognitively oriented theories have been proposed, including: Gender Schema Theory (Bem, 1981; Martin & Halverson, 1981), the Social Cognitive Theory (Bussey & Bandura, 1999), Dual Pathways Model (Liben & Bigler, 2002), and Developmental Intergroup Theory (Bigler & Liben, 2007). These theories relate to different aspects of the gender

development process and are discussed in detail elsewhere (e.g., Berenbaum et al., 2008; Martin et al., 2002). Briefly, these theories differ in their emphasis on the role of cognition, the focus on development over time, and their focus on how schemas form and how they are applied. More specifically, some theories downplay the role of cognition (e.g., Social Cognitive Theory); some theories focus strongly on developmental issues (Gender Schema Theory, Cognitive Developmental Theory); one theory gives a particularly detailed account on how schemas function and relate to behavior (Gender Schema Theory); another elaborates how schemas form (Developmental Intergroup Theory); one set of theories describes different ways that schemas and personal interests may coevolve to influence development (Dual Pathways); and others focus attention on the ingroup-outgroup nature of gender (Gender Schema Theory, Developmental Intergroup Theory). Despite the differences in emphases, there are themes and assumptions common to them all.

Cognitive theories emerged at a time when learning theories were prominent and the prevailing explanations for gender development characterized children as passive recipients of gendered information from their social environment (e.g., Bussey & Bandura, 1999; Mischel, 1966). In contrast, cognitive theories posit that children actively process gender information and assign meaning to it. For example, children encounter direct (observation of behaviors) and indirect (socially transmitted messages about gender) information from parents, peers, and the media about what activities, traits, and preferences are appropriate for boys and girls. However, this information does not affect all children in the same way. Instead, there are differences in the degree to which individuals attend to information, encode it, and incorporate it into their concepts of gender groups and self-concept. According to cognitive theories, it is because of individual cognitive processes that children do not perfectly replicate their socialized environments. The cognitive processes involved are influenced by changes in cognitive development, such as learning to apply multiple categories when interpreting information (Bigler & Liben, 1992) and understanding the meaning of gender as a social category (Kohlberg, 1966). These cognitive processes are also influenced by individual differences in the salience of gender which affects how likely an individual is to apply gendered thinking in viewing the social world (Bem, 1981, 1993).

5.2 Rethinking Gender as a Social Category and as a Motivator

Early cognitive theories of gender development provided a different perspective on how gendered behavior and thinking might occur compared to learning theory approaches. Nonetheless, some of the assumptions underlying these cognitive theories have undergone, and are undergoing, change. Here, we discuss several of these changes. First, we illustrate that the assumption that sex and gender are equivalent is unnecessary and misleading. Then, we discuss qualities associated with viewing

gender as a social category (e.g., stability and consistency/constancy) and whether these qualities hold the same meaning today as when early theories of gender development were proposed. Next, we discuss the empirical evidence that confirms that the basic understanding of gender is an important motivator of gender development.

5.2.1 Sex Does Not Equal Gender

Even fifty years ago when an influential series of theories of gender development was first published (Maccoby, 1966), there was an awareness of sex and gender variations in adults such as intersex conditions, "transsexuals," and gender nonconforming individuals. Nonetheless, rather than directly acknowledging any of these variations, early cognitive theorists focused their attention on children's development of understanding of the concept of gender as a category that was essentially equivalent to sex assignment at birth. The difference is a framing issue: Does a child "learn" who they are—that is, learn which birth sex assignment they have been given—or do they develop a sense of who they are, which may or may not correspond to birth assignment? For instance, in early approaches, it was common to discuss how children learn to "recognize" their gender (as determined by the researcher) and to allow only binary descriptors in measuring gender development in children (e.g., to assess gender stability, "when you grow up will you be a mommy or a daddy?"). Contemporary cognitive theories acknowledge that gender identity is not equivalent to sex assignment at birth and are using gender terminology more carefully (e.g., Fast & Olson, 2018; Gülgöz et al., 2019).

5.2.2 Gender Is Not Unchanging

Cognitive theories of gender development employed a cognitive developmental view of gender in which gender was equated with other un-changing social (e.g., human) and physical (e.g., volume conservation) entities. Kohlberg (1966) assumed there were important consequences of constancy and stability of gender as motivators of gender development, and these ideas paralleled Piaget's ideas about the important changes that occur in children's thinking once they understood the constancy of volume (conservation) (see Piaget, 1954). This approach assumed gender to be a stable and unchanging feature of individuals. Coming to understand these features of gender was, considered by Kohlberg, an important milestone in motivating the adoption of gendered behaviors. Because of the links to Piaget's cognitive development ideas, Kohlberg asked the question: How do children come to understand that (for most people) their gender identity/sex classification remains the same over time (gender stability) and over changing circumstances (gender consistency or constancy)? Not surprisingly, much of the early cognitive research

examined issues involving gender constancy such as when children acquire understanding of gender or identify the consequences associated with different types of understanding (Kohlberg, 1966; see Ruble et al., 1981). For many children, a clear progression in understanding was seen with gender identity (i.e., self-labeling as a boy or girl) occurring first around the age of 2–3 years, gender stability second (around age 4–5 years), and gender constancy/consistency last (around age 6–7 years), but the age of onset of these stages was not clear and could depend on how questions were framed (e.g., Ruble et al., 2007; Trautner et al., 2005) and cultural influences (Gibbons, 2000; Wong & VanderLaan, 2020).

Contemporary cognitive theories of gender development are faced with questions about how and whether to measure stability and constancy of gender. With the increasing visibility of transgender individuals and with more individuals recognizing the fluidity of their gender, questions have arisen about using and interpreting these measures (see Fast & Olson, 2018). If a child says that gender is not stable, is it a lack of understanding or is it an advanced understanding of gender fluidity? When a girl is asked, "When you were born, were you a boy or a girl" (a standard stability question), if she answers, "a boy," does this indicate a lack of understanding that for most individuals gender is a stable characteristic, does it signal that the child wants to socially transition to the other gender, or does it indicate a child who feels gender identity is fluid and may change day to day? Disentangling the meaning of these answers is difficult given young children's limited verbal capacities to explain complex ideas they may hold about gender identity. Rethinking these measures and considering how to better assess children's understanding of gender as a social category are challenges for future researchers in this area. We will return to this issue later in the chapter.

5.2.3 The Expanding Role of Gender Labels/Identity as Motivator of Behavior

Early cognitive approaches differed in their focus on gender constancy (Kohlberg, 1966) and basic gender understanding, such as labeling the self and others by their gender (e.g., Martin & Halverson, 1981). In contrast to Kohlberg—who thought that understanding stability and constancy of gender provided much of the motivation to learn about and adhere to norms associated with one's own gender—in gender schema theory (GST, Martin & Halverson, 1981), whether children understood the constancy or stability of gender was of less importance than labeling the self as belonging to a gender group. According to GST, children's acquisition of basic knowledge of gender identity motivates learning and adoption of gendered behaviors. This was a radical departure from Kohlberg's view.

There are two types of schemas in GST that motivate learning about gender. One type of schema is the "ingroup-outgroup schema" (also called a superordinate schema), which contains two important types of information for individuals. First,

it is a description of what boys and girls look like, act like, and do (a binary perspective); essentially, this is a set of gender stereotypes. Second, this schema is informative about what features are related to the ingroup (i.e., one's own gender group) and which features are associated with the outgroup (i.e., the other gender group). According to this theory, the ingroup information is a guideline about what is normative and of interest for members of one's own gender; the outgroup information is what is to be avoided and is not of interest. The second type of schema is called an "own-gender schema." This schema contains the stereotypic information from the ingroup-outgroup schema about one's own group but also includes more detailed, in-depth information for behaving in an "appropriate" way for one's own gender. While initially considered to contain only gender-group-appropriate information, within a few years of proposing the theory, Martin and Halverson expanded this schema to include whatever behaviors were considered self-relevant (Bradbard et al., 1986).

Being motivated to learn about gender means seeking information about both the superordinate and own-gender schemas, and is also expected to lead to increased interest in enacting one's own gender schema. Children fill both schemas with information drawn largely from the social world around them. Children see what women and girls do, what men and boys do, what they look like, what they do not look like; they use this information to form their schemas. What is particularly interesting is how *salient* gender becomes to children once they begin this process. For example, a young girl notices that her mother's female friend was wearing red nail polish. She then insists that she needs to wear red nail polish because "that's what girls do." In cases like this, as described by early cognitive theorists, children search for cues about gender by attending to members of their *own* gender rather than looking to other-gender models for these cues (Bem, 1983; Liben & Bigler, 2002; Martin, 2000; Martin & Halverson, 1981; Martin & Ruble, 2004).

As the salience of gender increases for children, they more fully develop both the superordinate and own-gender schemas with more extensive information about the genders, and they internalize this information. Both of these schemas influence what is remembered and attended to (Bradbard et al., 1986; Martin & Halverson, 1983). Children use these schemas to guide their own behaviors to be consistent with their views of gender in a process called "schematic consistency." These beliefs may or may not follow conventional gender typing. That is, a girl who sees sewing as a girl-typical activity, who has seen her grandmother sew, may internalize sewing as an activity for girls, and thus be motivated to learn how to sew herself. Likewise, a girl who sees her mother playing soccer and girls being successful athletes in worldwide competition may internalize that soccer is for girls and thus become motivated to learn soccer ("soccer is for girls and I am a girl, so soccer is for me"), and she may come to develop a stereotype that soccer is typical for girls.

How these gender developmental self-socialization processes occur has been refined in recent research and theorizing. One change is in the increased confidence that we now have about the importance of gender labels/identity in gender development. As outlined above, according to GST, once identifying as a boy or girl, children should show heightened motivation and increasing levels of gender-typical

behaviors. In an extensive review of the literature, this is the pattern often seen when examining age of labeling and interest in gender-typed toys (see Martin et al., 2002, 2004). However, few studies explored whether this pattern occurred in the same children over time. This shortcoming was addressed in a longitudinal study by Zosuls et al. (2009): They assessed naturally occurring use of gender labels of 82 toddlers using an intensive language diary protocol, and compared the onset of labeling in a toddler with observation data on the toddlers' interest in gender-typed play. They found that soon after the adoption of gender labels at around 19 months, children showed heightened interests in "gender-appropriate" toys (Zosuls et al., 2009). That is, once children labeled themselves and others by gender (e.g., labeling other people as man or woman; labeling the self as girl or boy), their tendencies to play with dolls increased over time for girls but not for boys, and with trucks for boys but not for girls. Other studies suggest that there are additional motivational effects of understanding that gender is stable over time (Stangor & Ruble, 1987). However, children's understanding of gender consistency across situations appears to motivate gender-typed behavior less strongly, perhaps because they understand that performing other-gender-typed *behaviors* does not necessarily change their gender *identity* (Martin & Halverson, 1983; Ruble et al., 2007).

More recent research has employed a shift in the framing of these early theories so that they continue to be broadly applicable to explaining gender development even with modern views of gender. Rather than focus on *recognizing* one's gender, a shift is made to *affirming* one's gender. Given that the original focus of GST was on the cognitive *consequences* of children coming to a conclusion about one's identity and not on the *processes* that informed identity, the shift to affirmed identity is consistent with the major tenets of GST and explains the patterns of findings for transgender children. Specifically, once children affirm their gender identity, they are motivated to learn more about what it means to be a member of that group (their ingroup), which involves learning how to behave in ways that are consistent with their concepts of their gender (see Gülgöz et al., 2019). There is evidence that this reframing is reasonable: Fast and Olson (2018) and Gülgöz et al. (2019) conducted a number of studies with young socially transitioning children—children who a) identify as a gender other than the sex assigned at birth and b) are beginning to live as their identified gender (e.g., changing name or pronouns, dressing and behaving like their identified gender). In this work, the gender identity development and well-being outcomes of the largest ever group of transgender children ($n = 317$) are compared to that of the siblings of the transgender children, and to cisgender children (i.e., children whose sex assigned at birth matches their gender identity) of matching gender and age. The transgender children share many similarities in their gender stereotype knowledge, preferences, clothing, and peer preferences with cisgender children. For instance, transgender boys (raised for years as girls) were found to be very similar to cisgender boys (raised for years as boys). This finding might be surprising from a socialization perspective; however, it is reasonable from a cognitive perspective: The transgender children were motivated by their affirmed gender—they attended to, learned, and adopted behaviors of their affirmed gender, and did so regardless of the sex they were assigned at birth. Furthermore, these

transgender children's psychological adjustment was similar to cisgender children perhaps because their parents were supportive of their social transition (Olson et al., 2016). In cognitive theories, the appeal of exploring and learning about whatever gender identity one affirms can be assumed to be highly motivating. How these processes work and the types of schemas for children with more complex gender identities are worthy of future research.

These studies have also led researchers to consider more in-depth questions about the origins of gender identity. Although theories of gender development (cognitive, socialization, and biological) collectively attempt to elucidate this origin, the answer is not yet clear. Identifying one's gender identity may be a biological process or social process, driven by interests or preferences (see Dual Pathways Model below). It is also possible that the process is transactional such that a child's social environment, biology, and early cognitions about gender shape an identity that may change over time. In addition, there may be different patterns of developmental trajectories for gender identity. However, these fascinating questions are beyond the scope of this chapter and await future research efforts.

5.2.4 Summary

While changes have occurred in how gender is construed, the power and appeal of cognitive approaches remains. Early and contemporary cognitive views of gender development not only provide explanations for why children do not perfectly replicate their socialized environments, they can also work to guide research on increasingly complex/fluid processes of gender identity development and affirmation.

5.3 Expanding and Rethinking the Multidimensionality of Gender Identity

Cognitive theorists and researchers have been focused on understanding the nature of, and consequences associated with, a child's gender identity. In this section, we review how concepts of gender identity have expanded and some resulting changes in measurement. Then, we consider how traditional research constrained gender identity as how the self relates to others within the same gender collective, and the way that recent research suggests comparisons to a larger social world. Finally, we consider future research needed to clarify constructs of multidimensional identity, such as felt pressure to conform to gender norms and newer concepts such as gender norm resistance.

5.3.1 Conceptualizations of Gender Identity

Traditional definitions of gender identity were simple and binary in that gender identity referred to one's sense of self as a male or female (Zucker & Bradley, 1995). While this definition is still used by some scholars, others have expanded the conceptualization of identity to be more broadly inclusive. Egan and Perry (2001) proposed a landmark change in which gender identity was proposed to be a multidimensional set of cognitions encompassing a person's appraisals of, compatibility with, and motivation to fit in with one's gender collective. Five dimensions of gender identity were proposed: 1) knowledge of membership in a gender category, 2) felt compatibility/typicality with one's gender group, 3) attitudes toward gender groups, 4) satisfaction with gender assignment, and 5) felt pressure for gender conformity. Pauletti et al. (2014) provided additional categorization of these types by arguing that felt typicality/compatibility is an internal dimension and the rest are more external aspects of identity. This distinction is needed because one's attitudes do not seem to be equivalent in contribution to identity as one's feelings of being a "good" or "typical" member of a gender group. There may be additional dimensions to consider as well such as gender frustration (Perry et al., 2019).

The proposal of an expanded definition of gender identity spurred research that illustrated how each of these dimensions provided significant understanding of how individuals relate to their social worlds. A number of major findings emerged from this line of research. One is that gender typical individuals tend to have a range of positive psychological and social outcomes, such as higher self-esteem (Egan & Perry, 2001). For this reason, gender typicality became a major focus in research on gender identity. These researchers also found that, often, a combination of having low own-gender typicality and high felt pressure to conform (to gender norms) lead to internalizing problems (Yunger et al., 2004). Because of this, there has been increasing interest in understanding the meaning and processes underlying felt gender pressure. Below we address issues related to these dimensions of gender identity.

5.3.2 Gender Similarity as a Central Dimension of Identity

Recently, Martin and colleagues (Martin, Andrews, et al., 2017a) proposed that gender identity is "a multidimensional, psychological construct that reflects individuals' beliefs about how the self relates to both gender groups" (p. 167). To better capture this definition, these researchers developed scales that assessed individuals' self-perceived similarity (i.e., as opposed to "objective," externally observable gender conformity) to both their own gender and to the other gender. The measure builds on the earlier work on gender typicality but expands it by assessing how the self relates to *both* genders, not just to one's own gender collective. In doing so, this new measure allows for a more nuanced view of this dimension of gender identity. This approach was called a *dual identity approach* because both gender collectives

are used as reference groups instead of only one's own group. (While recognizing that the conceptualization of gender identity is not binary, to be amenable to research on children and to permit exploration of complexity in identities, the researchers used the two most identifiable gender collectives as the comparisons). Consider the difference between using a comparison to one gender versus to both: Using only the scale of own-gender typicality allows for identifying individuals who are typical and those who are low typical/atypical. In the dual identity approach, some individuals may score high on both own- and other-gender similarity, some may score low on both dimensions, and some may be high on only one (i.e., high on own-gender similarity or other-gender similarity, but not both). Indeed, in a sample of children from 5 to 11 years of age, Martin, Andrews, et al. (2017a) analyzed children's comparisons to both gender collectives and found that these comparisons fell into distinct typologies. Four unique types emerged from the data: children who were Own-gender similar (48%), Other-gender similar or Cross-gender similar (6%), Both-gender similar (30%), and Low-gender similar (17%).

The Both-gender similar group was particularly interesting because they likely represent what Bem (1974) meant by the construct of androgyny. According to Bem, individuals who have a broad behavioral repertoire allow them to be flexible and adaptable to changing situations (also see Martin, Cook, & Andrews, 2017b; Pauletti et al., 2017). When the four groups were compared, important differences in the correlates of gender identity were identified. Overall, the Own-gender similar children showed the highest self-esteem (personal adjustment) but the Both-gender children were better socially adjusted in that they had friends of both genders and were less biased toward their own gender group. The Low-gender similar and Other-gender similar groups were less well adjusted, but different from one another: The Other-gender group of children had friends of the other gender but were socially anxious. The Low-gender children did not feel included by either gender.

Using only the own-gender comparison would have collapsed across these typologies to produce a single dimension of typicality ranging from highly similar to their own gender (the Own and Both groups combined) to those who are low in similarity (the Low and Cross groups combined). The advantage of using the typologies is a more fine-grained view of identity and, given their differing correlates, this approach is worthwhile.

These measures have also been used to develop typologies with college-age samples in the USA (Andrews et al., 2019) and in the Netherlands (Endendijk et al., 2018) and to assess correlates of the typologies. The typologies are generally, but not perfectly, replicated across age and countries thus far, and the findings from these studies continue to support the notion that the types identified with the measures are distinguishable in important ways.

5.3.3 Felt Pressure to Conform

Cognitive approaches to gender development consider how individuals perceive, interpret, and act upon social stimuli, and especially information concerning gender

norms and roles (Martin & Ruble, 2004). These cues can be internalized as how one should behave but they may or may not be consistent with an individual's preferences (Liben & Bigler, 2002). How and whether these messages are internalized, and the extent to which they are perceived as pressure, vary among individuals (Egan & Perry, 2001). Pressure to conform to gender norms is one aspect of gender socialization that affects those who resist gender norms, as well as those who conform. Personal characteristics such as age or cognitive development (Halim et al., 2015), schematicity (Bem, 1981; Martin & Halverson, 1981), susceptibility to influence (Maccoby, 1998), and exposure to cultural messages (Aboud & Brown, 2013) are also important factors to consider in understanding how gender norms are internalized.

How do children react to the gender messages they receive? A boy who is instructed that he should not play with Barbies because Barbies are for girls may understand that not only should he not play with Barbies, but that bad things might happen if he does. This kind of gender-role socialization likely creates pressure to conform to gender norms. Felt pressure is described as feeling like one *has to* act/think/feel a stereotypical way because of culturally held notions of what men and women should be like (Egan & Perry, 2001). Menon (2017) wrote that pressure motivates children to act in gender-typical ways (and avoid atypical ways) regardless of whether these behaviors are positive and personally fulfilling or limiting and emotionally damaging. For instance, both boys and girls who internalize masculine norms about emotional stoicism and aggression tend to not do well in school (Rogers et al., 2017; APA, 2018), and girls who focus on feminine norms of self-sexualization may be less concerned with academic achievement (McKenney & Bigler, 2014). When cultural gender norms are internalized, individuals become their own gender police. Thus, the individuals themselves can become another source of pressure to conform to gender norms in addition to pressure from parents, peers, or the media. Few studies have differentiated between sources of pressure, but those that do indicate that different sources can affect gendered and academic outcomes in unique ways (Aoyagi et al., 2018; Cook et al., 2019; Leaper et al., 2012; Nielson et al., 2020). For instance, Leaper et al. (2012) found that parental pressure to conform to gender norms was positively associated with girls' motivation in English, whereas pressure from peers was negatively related with English motivation. Additionally, individuals appear to feel different amounts of pressure from each source, with internalized pressure from the self as the strongest (Cook et al., 2019; Nielson et al., 2020). These studies also suggest that additional research is needed to continue exploring the potentially unique impact of these different socialization sources.

Further, it would be helpful to explore directionality in the relationship between pressure and gender-typing in behavior and identity. Pressure and gender-typing may be a bidirectional process. For example, pressure may motivate children to seek out same-gender peer groups which, in turn, has potential to increase their gender-typed behavior (Martin & Fabes, 2001; Martin et al., 2013). How identity and pressure from various sources develop over time are important questions that are beginning to be addressed (Cook et al., 2019). For instance, evidence suggests that

pressure from peers may change adolescents' gender identity. Specifically, peers can influence adolescents' feelings of pressure for gender conformity and their in-group bias (see Kornienko et al., 2016).

However, not everyone reacts to pressure or internalizes them in the same way; individuals respond to stimuli depending on their personal characteristics and experiences. Schematicity—the degree to which an individual attunes and subscribes to gendered information (Bem, 1981)—affects motivation to conform and felt pressure to conform to norms. For example, two brothers that experience similar messages of gender socialization from their parents might react in different ways depending on their schematicity. One brother might not feel much pressure from the parent to conform to norms because conforming to norms generally aligns with his own gender ideals; he wants to conform to norms. Thus, even if he feels pressure, much of the pressure may come from himself and not the parents' socialization. In contrast, the other brother might prefer less gender-typical pursuits and feel a great deal of pressure from the same messages that produce less pressure for his brother.

Gender typicality may also relate to feeling pressure to conform. Not surprisingly, people who are gender atypical might be expected to feel more pressure to conform, and research indicates that the combination of being low gender typical and feeling high pressure is associated with negative mental health outcomes (Yunger et al., 2004). Interestingly, consistent with Bem's ideas (Bem, 1981), gender typical individuals also feel pressure to conform to norms: Individuals who feel highly similar to own gender and low similarity to other gender feel the highest levels of pressure to conform to norms (Pauletti et al., 2017). Similarly, when using the dual identity approach, individuals who fall into the Own-gender similarity group show the highest levels of felt pressure overall, especially from the self (Nielson et al., 2020). Given that evidence is mounting that strict adherence to certain gender norm ideologies (e.g., for women, physical objectification; for men, emotional stoicism) can be damaging in various ways (APA, 2007, 2018), additional research is needed to understand the factors that influence felt pressure and conformity to these pressures. Furthermore, one fruitful direction for understanding links to adjustment is a deeper understanding of variations in nonconformity: Nonconformity that is a willful resistance to gender norms likely leads to different outcomes than those who are struggling to conform to norms but failing. Which individuals resist norms, why they do so, and the consistency of that resistance are unclear.

In summary, much emphasis has been placed on two dimensions of gender identity—typicality/similarity and felt pressure to conform. Both have been expanded from their initial formulations. Each of these expansions of gender identity increases the range and nuance with which identity can be construed, moving away from a binary view of gender toward a more expansive view of gender identity. As research progresses on the dimensions of identity proposed by Egan and Perry (2001), the perennial question grows in importance: Which of these dimensions are actual features of identity and which are constructs that influence or are simply related to these identity features? Felt pressure is certainly a factor that affects one's gendered experience, but does it play a direct role in the identity label an individual chooses? What other cognitive constructs related to gender may be crucial for

identity and how do these relate to the more well-studied constructs? Some cognitive constructs that need investigation may provide a fuller understanding of how identity relates to an individual's actions and thoughts (see Tobin et al., 2010 for discussion). Questions worthy of further consideration are how to determine the dimensions that constitute gender identity and how to distinguish constructs that relate to, but are not actual dimensions of gender identity. And, perhaps the most abstract question of all, by what metric do we determine what constitutes gender identity?

5.4 Expanding Concepts Related to Gender Groups

One of the most significant advances in contemporary views of cognitive gender development is the expansion in the numbers and types of cognitions that are investigated. Whereas original cognitive perspectives on gender development focused on global gender identity and broad gender stereotypes as representing and contributing to schematicity, which motivates learning of gender roles, contemporary views assume that *specific types of cognitions* may be more closely linked to motivation. This assumption has led researchers to propose and test a wider range of cognitions than has been used in the past; for instance, to consider the cognitions that might underlie gender segregation and same-gender peer preferences. Refining the measurement of central constructs, such as stereotyping, has also been at the forefront of contemporary cognitive theories of gender development. Here, we discuss how thinking about the stereotypes and the concepts associated with social relationships have evolved.

5.4.1 Rethinking Stereotypes

Some of the earliest work on gender-typing involved assessing children's stereotypes about what girls and boys do (see Huston, 1983). While gender differences are found in many activities (Leaper, 2014), how to assess children's gender concepts about these behaviors has evolved. One trend has been a movement away from early forced-choice stereotyping measures in which children were faced with deciding whether boys or girls would want to play in particular activities (e.g., playing with a racing car; playing with a doll buggy) (DeLucia, 1963; Schell & Silber, 1968) to measures such as the COAT (Children's Occupations, Activities, and Traits Measure) and adolescents' OAT (Occupations, Activities and Traits Measure; Liben & Bigler, 2002) that allow for participants to select a "both" response. In studies using the more recent measures, children can respond that both genders like to do the behavior or think it is appropriate for both genders to do so (Bigler & Liben, 2006). This change is significant: It allows for assessments of flexibility or rigidity in stereotyped attitudes. Children who endorse more "both" options are considered more flexible in their gender attitudes.

Another trend has been the growing awareness of how subtle changes in wording may change the nature of the concepts being assessed. For instance, asking children "who can X" is very different than asking them "who is X" (Signorella et al., 1993). Who "can" or who "should" wording is likely to detect gender stereotypic attitudes (prescriptive) and who "is" wording seems more likely to detect stereotypic knowledge (descriptive). Knowledge measures seem less likely to detect individual differences than are attitude measures. Furthermore, knowledge measures tend to show increases with age while attitude measures illustrate individual variations and the two types of measures have different correlates (see Leaper, 2015).

Although how individuals express themselves in clothing and hairstyles are salient aspects of gender, only recently has much attention been paid by cognitive-oriented gender researchers to concepts or stereotypes about these features. Clear developmental trends are found in boys' and girls' choices of clothing and the rigidity with which they adhere to these choices (e.g., girls' interest in pink frilly dresses). The researchers involved in these studies suggest that the growing awareness of clothing norms and stereotypes and the understanding about gender likely influences these choices (e.g., Halim, 2016; Halim et al., 2013).

Another significant advancement in measurement has involved developing assessments that are less susceptible to socially desirable responding. As in social psychology, developmental researchers have become interested in assessing stereotypes through implicit methods (e.g., Implicit Association Test; IAT). Using these approaches, children's reaction times to associations they make are assessed with the idea that compatible associations are recognized faster than incompatible ones. For instance, to assess gender identity, associations between "boy" and "me" versus "girl" and "me" for gender identity are compared; associations between "boy" and "good" and "girl" and "good" are used to assess gender attitudes (see Cvencek et al., 2011, 2016). Having implicit measures in the arsenal of stereotyping measures for children is an important advance and allows for comparisons with explicit stereotype knowledge and protections against socially desirable responding.

In the past, much work on gender development, assessments of stereotypes, and preferences about behaviors and activities has involved cisgender children. Recently, there is increasing research interest in understanding patterns that might be found when children are more gender-diverse (e.g., Fast & Olson, 2018 on socially transitioning children; Martin & Dinella, 2012 on tomboys). For instance, Fast and Olson (2018) found that children who are socially transitioning have strong gender stereotypes about both genders, and these stereotypes are virtually indistinguishable from cisgender children. Martin and Dinella (2012) showed that tomboys hold stereotypes that are not entirely similar to non-tomboys; they are more willing to recognize variations in stereotypes for girls. Recent work has also highlighted more clearly the consequences of challenging gender stereotypes; gender nonconforming children are perceived less positively by peers (e.g., children are less likely to want to share with them or be friends with them; Kwan et al., 2020), nonconforming behavior is met with name-calling and social exclusion (Yu et al., 2017), and gender-based harassment yields lower self-esteem (Jewell & Brown, 2014) and depression (DeLay et al., 2017).

Finally, identities may be better understood using a historical societal perspective on gender that includes consideration of power differentials and the differential status of men and women (e.g., sexism, oppression, privilege). For example, in Western culture, men have more social, relational, and financial power (Walby, 1990). Accordingly, masculine stereotypes are more rigid (Farkas & Leaper, 2016; Leaper, 1994), and both boys and girls understand that infractions for boys are punished more harshly than for girls (Mulvey & Killen, 2015; Tam et al., 2019; Yu et al., 2017). It is an interesting challenge for developmental scientists to more fully explore children's understanding of the broader historical and cultural contexts underlying our gendered society.

5.4.2 Rethinking Gendered Social Relationships

Gender researchers have been interested in relationships with peers for many years, and Maccoby's research and theorizing about the importance and long-term consequences of gender-segregated interactions for children and adults further motivated work in this area (Leaper, 1994; Maccoby, 1998; Maccoby & Jacklin, 1987). What kinds of cognitions might contribute to gender segregation?

Self-efficacy, that is, the belief that one is competent in a range of social situations, is one likely contributor. Researchers who study social behavior developed measures of efficacy (e.g., Bandura, 1997) but given how much time children spend in gender-segregated groups, cognitively oriented gender researchers thought that children may have differing levels of efficacy with same- vs. other-gender peers (see Bukowski et al., 1993). For this reason, one advancement is the development of gender-based relationship efficacy (GBRE) which assesses how much children believe that they are able to get along with, and be comfortable with, girls and boys (see Zosuls et al., 2014). When asked about efficacy with same- versus other-gender peers, most children and adolescents report higher efficacy with same-gender peers, but older adolescents show higher other-gender efficacy compared to younger children (Zosuls et al., 2014). Furthermore, these feelings of efficacy relate to how comfortable children are in school and how well they do in school (Field et al., 2017).

Another concept likely contributing to gendered social relationships concerns whether a child believes that their overtures to join a group will be welcomed. Being rejected by peers is associated with a range of negative outcomes, such as teasing (Brown et al., 2010), whereas being accepted and feeling a sense of belonging are related to positive outcomes such as improved academic outcomes (Master & Walton, 2013; Walton et al., 2012). What beliefs do children hold about being accepted versus being rejected by peers? To better understand gendered peer relationships, it is also important to ask about acceptance and rejection by same- and other-gender peers. This topic was addressed in several articles using new measures of gender inclusion and exclusion. Zosuls et al. (2011) developed a measure of gender-based inclusion with same- and with other-gender peers and a measure that

assessed social costs (e.g., teasing, exclusion) that may be associated with attempts to join groups of same- and other-gender peers (Zosuls et al., 2011). These studies suggest that expectancies about inclusion with same- and other-gender peers differ, and that the social costs associated with exclusion from same- and other-gender group are different. Overall, same-gender interactions are believed to be more positive (more inclusive) and less costly (less likely to lead to teasing and rejection) than are other-gender interactions. Furthermore, these constructs of inclusion and social costs beliefs associated with same- and other-gender peers have been demonstrated to be distinguishable, suggesting the importance of cognitions as contributing to gender segregation (Andrews et al., 2016).

Early studies of gendered peer relationships focused on asking children about their liking of familiar and unfamiliar boys and girls (see Leaper, 1994; Martin, 1989). Research on concepts underlying gendered peer relationships has evolved in several ways. One has been to assess concepts about more narrowly defined groups of peers. For instance, research with adolescents has demonstrated that they are selective beyond gender: Peers who are more gender typical are better liked (e.g., Egan & Perry, 2001; Jewell & Brown, 2014; Rose et al., 2011). Similarly, asking children about how much they like feminine versus masculine boys and girls predicted children's peer preferences in a more fine-grained manner than asking only about preferences for boys or girls (Jewell & Brown, 2014; Martin et al., 1995; Martin et al., 1999).

Another contributor to gendered relationships may be children's beliefs about whether others will pay attention to them and listen to them when they interact. For instance, do children believe that communication with girls and boys might differ? Do children believe that children of their own gender might be more responsive to them than children of the other gender? These questions were addressed in a recent study of children in middle childhood (Xiao et al., 2019). In this study, children's beliefs about both verbal (e.g., "when I talk to boys/girls, I think they will listen to me," ". . .will interrupt me") and non-verbal (e.g., "when I talk to girls/boys, I think they will look at me") aspects of communication with same- and other-gender peers were investigated. Both girls and boys believe that children of their same gender are likely to be more responsive to them than are children of the other gender, suggesting that children develop stereotypes about communication with same- and other-gender peers at a young age.

Children may also respond differently to male and female peers as they come to understand the power and status differentials. When and what do children think are the differences between girls and boys or men and women in their status, their power, and their privilege in society? Children's personal beliefs and evaluations about gender (i.e., private regard) and their perceptions of others' values about gender (i.e., public regard) are important components of gender development. Research shows that children come to hold these values about gender in middle childhood (see Brown & Bigler, 2004). A related topic is whether children perceive sexism and discrimination. Cognitive researchers have been on the forefront of investigating these topics. For example, Leaper and Brown (2008) reported that adolescent girls perceive sexism in academic and athletic domains, and such

perceptions likely increase with age and cognitive development. Few studies have examined younger children's perceptions of others' attitudes, but this research has illustrated that even young children recognize and respond to sexism (see Mulvey & Killen, 2015). Other research discusses in more detail the cognitive skills necessary to perceive and understand sexism, such as understanding others' cognitions, moral reasoning, and the use of social comparisons (Brown, 2017). Exposure to ideas about gender-conformity pressure, feminism, and gender egalitarianism lead to increased ability to perceive sexism. Because learning about sexism and feminism can influence individuals' gender role attitudes and gendered behaviors, further elucidating the development and correlates of sexism perception will be important for future research to understand gender development. A related and important topic for future investigation concerns the origins of sexist attitudes and behaviors. When do these attitudes and behaviors emerge and what are the correlates of sexist behavior in children and adolescents?

In summary, we discussed the changes that have occurred in contemporary cognitive approaches to gender development in two broad areas in this section: Stereotypes and social relationships. Researchers interested in gender stereotypes and in social behavior have investigated new constructs and used new methods to better understand the concepts underlying social behavior.

5.5 Rethinking and Expanding Processes of Gender Development

This section considers two theories that explain the processes underlying gender stereotype and identity development – the Dual Pathways Model and the Intrapsychics of Gender.

5.5.1 Dual Pathways

In the Dual Pathways Model, Liben and Bigler (2002) propose two pathways of gender identity development. The Attitudinal Pathway draws on gender schema theory to illustrate how social gender cues are observed by children, who interpret them and use that interpretation to guide behavior. This may be described as the "other-to-self" pathway because some children will make assumptions about what their own gender might like based on information they receive from others, which in turn has potential to influence their own gender-typed preferences. The Personal Pathway has received less attention but adds another perspective on gender development and this pathway concerns a process that is, in some ways, the reverse of the attitudinal pathway. This pathway also may be crucial for understanding less common developmental patterns. The process described by the Personal Pathway was

first identified in an experimental study (Martin et al., 1995) in which children generalized their own preferences for novel toys to others of their same gender but not to peers of the other gender. The personal pathway (Liben & Bigler, 2002) then elaborates this process and how it might lead to changing stereotypes. For example, if Ryan likes to play with Barbies, he may assume that other boys like to play with Barbies as well, because he, a boy, likes Barbies. It can be described as the "self-to-other" pathway because the child's own interests can modify their stereotypes, thereby potentially allowing for more diverse and flexible roles.

The Personal Pathway has seldom been tested, and when it has, results are mixed. Experimental evidence using novel toys that are not gender-typed often tend to find support (Martin et al., 1995; Weisgram et al., 2009). In contrast, when studies examine activities that are strongly gender-typed, a more mixed picture emerges. For instance, tomboys and any girls who have interests in male-typical sports and activities would be expected to have a strongly developed Personal Pathway with more inclusive stereotypes (both girls and boys can engage in an activity). In a study of these girls, Martin and Dinella (2012) found that the subgroup of tomboys had only marginally more inclusive stereotypes than did non-tomboys. Interestingly, however, and supportive of the Personal Pathway model, the more girls (regardless of whether they were tomboys) endorsed liking of masculine activities, the more they endorsed these activities being appropriate for "both boys and girls." Tomboys, in particular, recognized that there are exceptions to stereotypes (e.g., "are there some girls who like to play with tool sets?") but this pattern was only found for stereotypes about girls. Other research suggests that the link between behavior and identity is stronger than between behavior and attitudes and presumably stereotypes, although the attitudes tested were not equivalent to asking direct questions about the appropriateness of girls and boys engaging in various activities (Endendijk et al., 2016).

5.5.2 Tobin's Intrapsychics of Gender

One recent theoretical advancement is an expansion of the self-socialization model, which delineates the interrelations among the self, gender groups, and attributes (see Tobin et al., 2010). This model characterizes the degree to which an individual associates a gender group with attributes as gender stereotypes (e.g., "girls like dolls"), the self with attributes as attribute self-perceptions (e.g., "I like dolls"), and the self with a gender group as gender identity (e.g., "I am a girl"). Tobin et al. (2010) posited that any one of these constructs can be predicted from the other two; for example, the degree to which a child identifies as a girl can be predicted by knowing how strongly they associate playing with dolls with the "girl" gender group and how much they perceive themselves as someone who plays with dolls. In addition, this model represents the self-socialization process as one of cognitive consistency (similar to the idea of schematic consistency in GST): If this child considers girls to play with dolls (a positive association between girls and dolls)

and considers themselves a person who plays with dolls (a positive association between self and dolls), their identification with the girl gender group would be positive; if they believe girls play with dolls and they do not like playing with dolls (a negative association between self and dolls), their association of the self with the girl gender group would be negative. More research is needed to establish how individuals combine the results of this cognitive process for every possible attribute (i.e., domain of gender typing; e.g., activities, appearance, behaviors), which can be an array of positive and negative associations with their gender (i.e., several attributes consistent with and inconsistent with gender norms), into one composite assessment of their gender identity. In addition, it is possible that an individual who considers attributes to be associated with the other gender group (positive) would believe that they have those attributes (positive), but does not associate themselves with the other gender group (negative). Further research is needed to understand the process individuals go through to reconcile cognitive inconsistencies such as these and to explore potential developmental differences related to cognitive changes over the life span.

5.6 Future Directions in Theory and Research

Contemporary cognitive approaches to gender development have been gathering momentum toward understanding gender identity and the links between identity, stereotyping, and other domains of gender typing (e.g., behaviors). Cognitive theories have a long history of predicting links between various constructs and domains of gender typing but especially among identity and stereotyping with other domains (Leaper, 2014). One particularly interesting challenge for cognitive theories is developing a more expansive and detailed understanding of the many facets of identity and then investigating how those individual facets develop, how they relate to each other and influence one another, and how they interact to influence and relate to other domains of gender typing.

5.6.1 Expanding the Range of Gender Identity and Social Comparisons

As described earlier, the new dual identity approach (Martin, Andrews, et al., 2017a) has allowed for researchers to demonstrate important distinctions among individuals who vary in gender identities. Individuals who claim similarities to both genders—who may be considered to be androgynous—tend to have a wider array of friends, are less in-group biased, and have better mental health (Martin, Andrews, et al., 2017a; Pauletti et al., 2017). Much is left to be learned about these typologies or in

using the two dimensions separately, such as how does similarity to the other gender develop and what are the risks of not feeling similar to either gender.

Whereas clinicians and personality psychologists have pushed the boundaries in thinking about the range of individual gender identities (Ehrensaft, 2013; Tate et al., 2014), developmental and social psychologists have been on the forefront of thinking about how social relationships are part of personal identity and how they should be assessed (Aron et al., 1992; Schubert & Otten, 2002; Tropp & Wright, 2001). For example, identities may vary across time (see Fast & Olson, 2018; Tate et al., 2013), across contexts (e.g., such as more or fewer men or women being present; Mehta & Dementieva, 2017), and intersectional combinations of gender, race, and sexual orientation (Ghavami & Peplau, 2013, 2018). In addition, considering stability or variability in gender identity seems to be an important next step in the measurement of gender (e.g., van Anders, 2015).

In addition, researchers are more aware of and more interested in adopting a more contextualized approach to gender development. For instance, using an intersectional approach (i.e., considering multiple social identities simultaneously rather than as separate variables; considering the underlying histories of oppression and privilege associated with gender, race/ethnicity) to gender identity would be useful for providing insights into how social statuses relate to one another and how they relate to discrimination by others. For example, asking individuals about both gender and ethnic-racial stereotypes (i.e., stereotypes about Black boys) produces unique information beyond asking about these social categories individually (i.e., stereotypes about Black children and stereotypes about boys; see Ghavami & Peplau, 2013). Furthermore, the unique combinations may have differing developmental trajectories. This suggests that identity measures should consider assessing identification with more than one social group at a time, although this procedure may be challenging for children.

5.6.2 Broadening Understanding of Gender-Diverse Children

Contemporary gender development theories are entering an exciting time where the tenets of theories are likely to be modified as we learn more about variations in gender identity and behavior. Continuing to pursue questions of gender variability in all forms should be the focus of contemporary views of gender development. There is more variability in the ways that children are being allowed to express their identities, and this is providing even more impetus for conducting research on children who are gender nonconforming. Below we give one example.

Because an increasing number of parents are allowing their young children to socially transition their gender identities (Ehrensaft, 2011; Hidalgo et al., 2013), it is now possible to investigate how these children think about gender and how they are adapting (Fast & Olson, 2018; Gülgöz et al., 2019).

Because transgender children in these studies have spent years being treated as, and raised in accordance with, their sex assigned at birth, it is important to underscore how similar transgender children are to peers of their same gender (i.e., their preferences for clothing, toys, and peers and whether their perceived similarity to gender groups are similar to cisgender children of their gender). Although parental socialization was not directly studied early in these children's lives, in general, parents treat children differently depending on their gender; in fact, many parents provide direct messages to conform to gender norms (see Lytton & Romney, 1991). In the latest study of transgender children, the authors asked parents for photographs of the child when they were quite young; these children were dressed as the sex assigned to them at birth suggesting that parents raised them in a typical gender-conforming manner. Nonetheless, the parents did ultimately allow their children to socially transition, so these parents may be more flexible than other parents who might not allow such transitions (Gülgöz et al., 2019). Given the strong similarities between the transgender children and the control children, it is clear that transgender children's identities were not "thwarted" by parental socialization pressures, as their self-categorization matched their gender identity rather than the gender they were being socialized into. Interestingly and not surprisingly, transgender children and their siblings *do* differ from other children in one very clear way: They believe that sex assigned at birth and gender identity need not match (Fast & Olson, 2018).

Socialization is not a one-way street. The parent-child socialization effect is likely bidirectional. Ehrensaft's (2007, 2011) research on gender "creative" children indicates that the efforts made by gender nonconforming children to resist parental pressure to conform to norms can socialize parents and other family members toward more inclusive gender ideologies. Future research should also investigate the effect on transgender children of being raised by gender-inclusive parents who might initially provide environments that are accepting of gender diversity versus those who do not.

In addition to providing information about the qualities of transgender children, these studies support cognitive approaches to gender development by suggesting that self-socialization forces are strong. These self-socialization forces may even outweigh the direct socialization that likely occurs when socializing agents such as parents, friends, and siblings provide opportunities and treat a child according to their expectations of that child based on sex assignment at birth. That is, the child's own perception of their identity appears to be strong and a powerful motivator of learning but it is focused on learning the roles, characteristics, and preferences of their affirmed gender. To learn the roles of their affirmed gender requires the transgender child to be attentive to social norms; however, it is the social norms in the broader culture as to what men and women are like that are important—more so than the specific and direct pressures of being raised and treated as the gender that matches their sex assignment at birth. Why and how this happens, however, remain to be explored.

5.6.3 *Integration as a Theme in Future Theory Development*

Cognitive theories of the future can benefit from broad, multidisciplinary approaches. They need to enlist concepts from biological and social approaches (Hines, 2015; Leaper, 2011a, 2011b). A variety of methods need to be employed to enhance and support theories. For example, experimental methods are essential because they inform the field about how interventions aimed at reducing stereotyping or discrimination might be achieved (e.g., Pahlke et al., 2014). Researchers should refer to such experimental methods as those used by Bigler and colleagues to understand the influence of making salient a group characteristic (e.g., appearance, gender) on children's behavior and thinking (Bigler et al., 1997; Bigler & Liben, 1993); to the research by Leaper and Brown (2008), which seeks to understand how children think about discrimination (also see Brown, 2017); and to Shutts et al. (2010), which seeks to understand how children apply the social category of gender when processing information about other people. Longitudinal studies provide the only reliable descriptions of patterns over time in gender identity and gender typing (e.g., Golombok et al., 2008; Martin & Fabes, 2001; Yunger et al., 2004). Meta-analyses are useful for identifying themes and summarizing facets of gender development that hold across many studies (e.g., Hyde, 2005). Studying the complex dynamics of gender development is needed. For example, early hormone exposure has the potential to influence individuals' interests and their flexibility in learning gender-related roles (Berenbaum & Snyder, 1995; Hines, 2015; Hines et al., 2016). Consider that girls and boys are born with individual and gender-related characteristics due to hormone exposure (Berenbaum & Hines, 1992), and these differences can be, and likely are, exaggerated through self-socialization and the social environment, which provides structure, opportunities, and constraints on gender roles. Exposure to these forces also likely continues to exaggerate differences as individuals become more similar to the people (i.e., others with similar gendered characteristics) with whom they spend their time. Studying the multiple forces of development is challenging; it requires developing more sophisticated theoretical frameworks, designing research to incorporate multiple perspectives, working with experts from other disciplines, and encouraging diversity of scientific perspectives that in turn encourage creative problem solving.

5.7 Conclusion

New perspectives, new empirical evidence, and changing social environments have spurred a variety of changes in cognitive approaches to gender development and have led to the development of contemporary cognitive approaches. These changes broaden the appeal and strengthen the case that cognitive approaches continue to contribute to the understanding of gender development in today's world. Cognitive researchers are breaking new ground in developing measures to capture the

multidimensional nature and the temporal and situational flexibility in gender identity and other cognitive constructs related to social relationships. As societal attitudes toward gender have changed, so too have views on gender diversity. Increasingly, a deeper understanding is needed of the development of gender diversity along with its consequences for personal and societal development.

Spotlight Feature: The Malleability of Gender: Conceptualizing Gender as a Contextual Variable

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Theoretical and conceptual models of gender as contextually malleable have been around since the late 1980s. Deaux and Major (1987) were the first psychologists studying gender to propose a contextual model of gender. Their contextual model promoted a social constructivist approach to gender and posited that rather than reflecting an individual's personality traits, all gendered attributes including gendered attitudes, behaviors, femininity, and masculinity reflect an individual's interaction with their immediate context (Deaux & Major, 1987, 1998). Viewed this way, gender is dynamic, context dependent, and continuously enacted, changing across time, relationships, and social context (Deaux & Major, 1987, 1998; Leszczynski & Strough, 2008; Shields, 1998).

While this theoretical work has undoubtedly contributed to psychologists' understanding of gender as contextually dependent, social constructivist theory has not substantially shaped how researchers conceptualize and study gender (Mehta, 2015) and many psychologists studying gender continue to largely conceptualize gender as a single aspect of personality that remains stable across time and contexts. There are, however, a few exceptions (e.g., Cota & Dion, 1986; Pickard & Strough, 2003; Leszczynski & Strough, 2008). Below, we briefly review research studies that have conceptualized and investigated femininity/communion and masculinity/agency as contextually malleable, state variables.

Pickard and Strough (2003) modified the Bem Sex Role Inventory, a measure of stereotypical gender-typed traits (Bem, 1978) to investigate variations in femininity/communion and masculinity/agency in a sample of college students. Specifically, they asked students to rate the extent to which they *currently* identified with feminine/communal and masculine/agentic adjectives (e.g., "I currently feel nurturing"; "I currently feel aggressive") both before and after interacting with a same-gender peer and an other-gender peer. They found that participants endorsed more feminine/communal adjectives after playing Jenga® (a turn-taking game in which blocks are removed from a tower) with an other-gender confederate than after playing Jenga® with a same-gender confederate. Additionally, male and female's self-endorsement of masculine/agentic adjectives did not vary by context.

Using the same methodology, Leszczynski and Strough (2008) replicated these findings in a sample of young adolescents. In this study, both female and male adolescents endorsed more feminine/communal adjectives after playing Jenga® with a female confederate than after playing Jenga® with a male confederate. It could be that some aspects of gender are responsive to situational demands. For example, stereotypical beliefs about appropriate ways of interacting with women (e.g., being polite, collaborative) may have led participants to endorse femininity/communion to a greater extent when interacting with females. In this

sample, masculinity/agency once again remained constant across partners. This may reflect that Jenga® elicits masculinity/agency, as even when played collaboratively, the game is competitive as players seek to win.

While these experimental studies have made important contributions to our understanding of femininity/communion and masculinity/agency as contextually modifiable state variables, they are limited in that they have low ecological validity and do not tell us much about how gender varies outside of a research lab, in people's real-life contexts. To address this limitation, my research group employed Ecological Momentary Assessment (EMA) to study contextual variations in femininity/communion and masculinity/agency. EMA is a research methodology that allows for the repeated measurement of highly variable phenomena across time and contexts (Larson & Richards, 1994). Participants in EMA studies are prompted at random time points across a day to respond to a survey using a smartphone or other digital device (Mehta et al., 2014). Using this methodology, we are able to assess participants' real-time endorsement of masculinity/agency and femininity/communion in their daily contexts, increasing ecological validity and reducing recall bias (Larson & Richards, 1994).

We used EMA to conduct a 2-week study investigating contextual variation in endorsement of femininity/communion and masculinity/agency. We found that femininity/communion and masculinity/agency varied over the course of the study. These variations were associated with social context. Specifically, men endorsed femininity/communion to a greater extent when they were in the company of women in comparison to when they were in the company of men. Men also reported greater masculinity when they were in the company of men (Mehta & Dementieva, 2017). It may be that masculinity norms—that encourage men to reject stereotypically feminine activities and behaviors (Bosson & Michniewicz, 2013)—lead men to exhibit and endorse low levels of femininity/communion and higher levels of masculinity when they are with other men (Mehta & Dementieva, 2017). Men may endorse greater femininity/communion when they are with women because they feel less pressure to conform to male gender role norms in these contexts (Werking, 1997).

There was no difference in women's endorsement of femininity across female and male contexts, a finding that may be explained by our femininity measure picking up on a general activation of a socialized general communal/relational and cooperative orientation for women that exists across contexts (Mehta & Dementieva, 2017). Women did, however, report greater masculinity when they were in the company of men, perhaps reflecting women's desire to build their own status by endorsing characteristics associated with a higher status gender group (Mehta & Dementieva, 2017).

To conclude, I believe that whether gender-related variables are stable or vary across time and context has important implications for the study of gender. In this brief spotlight feature, we have reviewed research that has examined variation in femininity/communion and masculinity/agency across the gender composition of people's social contexts. However, other types of contexts such as physical context (e.g., home, school, and work) and activity context (playing competitive or

cooperative games, volunteering, negotiating, etc.) should be considered. Researchers are often unable to find reliable and reproducible gender differences across a number of gender-related constructs. This is likely to be because many gender-related constructs are not reproducible as they vary across time and space. Consequently, if we do not incorporate context into gender research, our understanding of gender is likely to be incomplete. Furthermore, whether gender-related variables are stable or are contextually malleable has important implications for our broader societal understanding of gender. Shields (2013) describes a reciprocal cycle in which essentialized beliefs about gender differences, based on conceptualizations of gender-related variables as stable, are popularized by the media. The media in turn influences scientific enquiry, which then informs the media. By demonstrating that gender-related variables are not in fact innate pre-determined traits, but rather states that vary according to context, research that can illustrate the contextual specificity of gender-related constructs has the potential to break the cycle of gender essentialism that serves to underscore exaggerated societal beliefs about gender differences (e.g., Hyde, 2005).

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Chapter 6
Origins and Consequences of Childhood Gender Segregation: Toward an Integrative Developmental Systems Model

Campbell Leaper

Abstract Gender segregation refers to the tendency of most children to affiliate primarily with same-gender peers. This chapter reviews the development and consequences of this phenomenon. First, the developmental trajectory of gender segregation from early childhood into adulthood is summarized. Second, possible explanations for the emergence of gender segregation in early childhood are critically examined. These include the possible influences of family, school, popular media, behavioral compatibility, and gender-related cognitions. In the third section, the maintenance and consequences of gender-segregated peer groups during middle childhood, adolescence, and adulthood are considered. In the last section, I present a preliminary integrative developmental model. It takes into account the interacting influences of early-appearing variations in behavioral dispositions (including play interests and temperament), ingroup gender identities, and peer group processes on children's gender development. The model addresses gender development in cisgender children as well as those with transgender or other nonbinary gender identities. Finally, I offer several recommendations for future theorizing and research.

Keywords gender identity · peers · interests · play · temperament · social identity · stereotyping

Gender relations underlie many of the contemporary issues that dominate the news headlines. Some examples include the bullying of gender-nonconforming children and youth (e.g., Levin, 2019), sexual harassment in the workplace (e.g., Carlsen et al., 2018), the underrepresentation of women in high-paying occupations (e.g., Metz, 2019), biased representations of gender in the media (e.g., Harris, 2019), relationship challenges in dating and married couples (e.g., Miller, 2018), and sexism in politics (e.g., Kimmel, 2018). These problems reflect social-structural

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gender inequalities in society that shape gender socialization during childhood (see Leaper, 2000, for a review). In the present chapter, I focus on the peer context in this process. Specifically, I address the phenomenon of gender segregation, whereby children who identify with their birth-assigned gender (*cisgender*) typically spend much of their childhood affiliating with same-gender peers while mostly avoiding other-gender peers. I also consider children who do not conform to cultural expectations for their assigned gender (i.e., *gender-nonconforming* children) and those who do not identify with their assigned gender (i.e., *transgender* or other *nonbinary* children).

In the first section of the chapter, I summarize patterns of gender segregation typically observed from childhood into adulthood. Next, I review possible explanations for the onset of same-gender peer preferences during early childhood. Afterward, I consider the maintenance and consequences of gender segregation at later age periods. Finally, to foster greater theoretical synthesis in psychology (see Leaper, 2011, 2015), I propose a preliminary integrative systems model of gender segregation that bridges complementary theories and research areas.

6.1 Gender-Segregated Peer Affiliations from Childhood into Adulthood

Gender-segregated peer affiliations are prevalent from childhood into adulthood (Leaper, 1994; Maccoby, 1998; Mehta & Strough, 2009). The general patterns seen at different age periods are summarized below.

6.1.1 Early to Middle Childhood

For nearly a century (e.g., Parten, 1933), developmental psychologists have documented that most children begin to favor social interactions with same-gender over other-gender peers starting around 3 years of age (see Maccoby, 1998). Child-initiated preference for same-gender peers has been widely observed around the world when children have opportunities to select among multiple peers close in age. Indeed, researchers have documented childhood gender segregation in countries in North America, South America, the Caribbean, Europe, Africa, South Asia, East Asia, and the Pacific Islands (e.g., Fouts et al., 2013; Harkness & Super, 1985; Lloyd & Duveen, 1992; Maccoby & Jacklin, 1987; Munroe & Romney, 2006; Whiting & Edwards, 1988).

Based on research conducted primarily in Western, industrialized countries, same-gender peer preferences steadily increase from early childhood into middle childhood. For example, in one study in the USA, the average ratio of same-gender to mixed-gender interactions went from 3:1 around 4 years of age to 11:1 around

6 years (Maccoby & Jacklin, 1987). In another US study, partner gender accounted for an estimated 70% of the variance in peer selection during early childhood (Martin & Fabes, 2001). Some research indicates that preference for same-gender peers peaks in middle childhood (see Maccoby, 1998; Martin & Ruble, 2010; Mehta & Strough, 2009; Serbin et al., 1993). However, one US longitudinal study found that affiliation with same-gender peers increased throughout middle childhood and did not peak until early adolescence (Lam et al., 2014).

Girls appear to favor same-gender peers at an earlier average age compared to boys (e.g., LaFreniere et al., 1984). However, by around 5 or 6 years of age and continuing throughout childhood, boys preferred same-gender peers more strongly than did girls in multiple cultures (Benenson et al., 2012; LaFreniere et al., 1984; Munroe & Romney, 2006). Indeed, gender boundaries and gender conformity pressures are generally more rigid for boys than girls throughout childhood and adolescence (see Leaper, 2015). Furthermore, children may be more likely to segregate based on gender than ethnicity or race (e.g., Lee et al., 2007).

Although cross-cultural research indicates a general trend toward same-gender peer preference in early childhood, there are variations across cultures in the average proportions of young children's peer affiliations with only same-gender members (Aydt & Corsaro, 2003; Larson & Verma, 1999; Munroe & Romney, 2006; Whiting & Edwards, 1988). For example, in their study of six diverse cultures, Whiting and Edwards (1988) reported average rates of same-gender, non-sibling peer social interactions among children between 4 and 5 years that ranged across cultures from 42% to 78% for girls and ranged from 22% to 74% for boys. Among children 6–10 years of age, these ranges were 71% to 90% for girls and 67% to 88% for boys. In all of the sampled cultures, gender segregation became more prevalent with age.

In societies where younger children's rates of gender segregation were relatively low, Whiting and Edwards (1988) noted there was limited access to same-age peers (see Harkness & Super, 1985; Lew-Levy et al., 2020, for similar findings). Relatedly, children in some cultures were assigned subsistence or domestic tasks that limited their time with peers. These cultural practices reflected social-structural gender inequalities in the larger society, such as the assignment of girls to childcare (see Whiting & Edwards, 1988, p. 277).

Besides possible cross-national differences, variability in rates of gender segregation within a society appear likely in at least three ways. First, there is a *gradient* among children in their proportions of same-gender play. For example, Martin et al. (2014) observed preschool children generally affiliated with mostly same-gender peers but individuals varied in how strongly they demonstrated these preferences. Second, variations may occur *across time and place* within a given community. For example, Messinger et al. (2019) collected continuous movement data among 5-year-olds in a US classroom across 3 days. They identified variability across the days in the gender composition of children's peer groups. Finally, degrees of gender segregation may differ *across groups within a larger community*. For example, researchers found variations in gender segregation related to youth's ethnicity/race (Kovacs et al., 1996) and economic class (Pfaff, 2010).

Even among children who primarily affiliate with same-gender peers, there are contexts when researchers in the USA have observed relaxed and friendly mixed-gender interactions. First, researchers found cooperative mixed-gender group play or mixed-gender dyadic friendships commonly occurred among children in private settings, such as their homes when companion choices were usually limited (Smith & Inder, 1990; Sroufe et al., 1993; Strough & Covatto, 2002). Second, researchers have noted that positive mixed-gender interactions can transpire during adult-structured activities (Sroufe et al., 1993). For example, this occurs in many coeducational classrooms in the USA (and other countries) when teachers assigned students to collaborate on a project in mixed-gender groups (see Leaper & Brown, 2014, for a review). In both of these situations, researchers noted a low risk of peer teasing. However, children who pursued mixed-gender contact in public or child-structured settings often faced peer rejection (e.g., Sroufe et al., 1993).

6.1.2 Adolescence

During middle and late adolescence, the maintenance of gender-segregated peer groups and friendships may begin to relax in some cultural communities—perhaps especially in many Western industrialized societies (Larson & Verma, 1999; Whiting & Edwards, 1988). In a longitudinal study of youth in Canada (grades 6–10; Poulin & Pedersen, 2007), the average percentage of *other*-gender companions increased over the course of adolescence. Studies conducted primarily in North America suggest mixed-gender friendships often occur when peer groups differentiate into smaller cliques based on shared interests (Ellis & Zarbatany, 2017). These cliques may offer greater flexibility for teens to find a crowd compatible with their interests. In some US communities, a few examples include "the jocks," "the brains," and "the artists" (see Sussman et al., 2007).

The advent of mixed-gender peer groups occurs around the same period when youth are undergoing puberty and sexual-romantic interests are increasing. For many heterosexual adolescents, mixed-gender peer groups may be contexts for exploring heterosocial friendships and then pursuing romantic relationships (Connolly et al., 2004). However, research suggests that adolescents generally do not establish romantic relationships with individuals from their friendship peer groups; instead, these relationships can create bridges to other peer networks leading to dating relationships (Kreager et al., 2016). For LGBTQ youth, friendship groups comprised of mixed-gender and mixed-orientation peers can be helpful social supports during their explorations of sexual and gender identities (e.g., Chong et al., 2019; Diamond & Dubé, 2002).

In some cultures, older children and adolescents do not demonstrate increased affiliations in mixed-gender cliques or other peer groups. First, some youth in non-industrialized and rural societies may have few or no opportunities to participate in different interest-based cliques. For example, this may occur when adults expect children to assist in subsistence activities or infant care (e.g., Rogoff et al., 2010).

Second, research suggests adolescent youth in industrialized Western nations may be more likely to spend time in peer groups than those in other parts of the world (Larson & Verma, 1999; Whiting & Edwards, 1988). By extension, corresponding average cultural differences in time spent in mixed-gender peer groups may ensue (e.g., Basu et al., 2017). However, these are broad generalizations based on a few studies, and a deeper and more extensive analysis of cultural variations is required. Finally, in some cultural communities, strict boundaries are imposed on adolescents' mixed-gender contacts. For example, this is common within some countries such as India and China (Basu et al., 2017) as well as Orthodox Jewish, Muslim, and Amish religious communities (Williams et al., 2017).

6.1.3 Adulthood

Upon entering adulthood, individuals in industrialized countries typically attend college or professional training programs, enlist in the military, or join the workforce (Mehta & Strough, 2009). Among those attending coeducational colleges, women and men regularly interact in mixed-gender group settings in classrooms, dormitories, student organizations, and classrooms (e.g., Wong et al., 2018). Studies suggest mixed-gender platonic friendships may be common among undergraduates in coeducational colleges, but most friendships tend to remain with same-gender peers (e.g., Li & Wong, 2018; Mehta & Strough, 2009). Although coeducational colleges can offer many opportunities for positive mixed-gender interactions, some common institutional barriers in coeducation colleges that perpetuate gender segregation are reviewed later in this chapter (Sect. 6.3.2).

In many (but not all) countries, the military is gender-segregated during basic training, and most combat roles are limited to only men (Mehta & Strough, 2009). In the workforce, many occupations are effectively gender-segregated due to their overrepresentation of one gender (see Guinea-Martin et al., 2018; Mehta & Strough, 2009). Furthermore, men are disproportionally represented among the highest-paying occupations (e.g., computer engineers). Men similarly dominate most positions of power in corporations and government. Notably, the relative representations of women and men in high-paying occupations and powerful positions are among the World Economic Forum's (2020) criteria for ranking countries in their relative degrees of gender equality.

Very little research has addressed gender segregation outside of work settings during the middle and late adulthood years (see Mehta & Strough, 2009, for a review). Based on the available research conducted primarily in the USA and Canada, most individuals' friendships and social networks were primarily with same-gender persons (see Mehta & Strough, 2009). The gender composition of adults' friendship networks may be partly affected by the degree to which their occupations are gender-segregated (Mehta & Strough, 2009).

6.2 Possible Explanations for the Emergence of Gender Segregation in Early Childhood

In this next section, I review the evidence regarding possible explanations for the emergence of gender segregation during early childhood (approximately 2½ to 5 years of age). I consider the evidence for family and school pressures, media influences, same-gender behavioral compatibility, and the acquisition of gender-related cognitions as possible reasons for the emergence of same-gender peer affiliations during early childhood. Later in the chapter (Sects. 6.3.1 and 6.3.2), I review processes associated with gender segregation during middle childhood, adolescence, and adulthood.

6.2.1 Families and Schools

There is no evidence that the *initial emergence* of same-gender peer preferences in young children is due to adult family members' or preschool teachers' pressures on children either to affiliate with same-gender peers or to avoid other-gender peers (see Maccoby, 1998). However, family members and preschool teachers may have an *indirect* influence on the development of childhood gender segregation inasmuch they contribute to the development of gender-based identities, attitudes, and behavioral preferences. For many children, gender-differentiated socialization occurs at birth when infants are assigned their gender. Their first names are commonly gendered ("Michael" versus "Michelle"); moreover, the color and type of clothing readily signals their designated gender (Bigler & Liben, 2007; Wong & Hines, 2015). In addition, by around 1 year of age, most adult relatives provide gender-stereotypical (i.e., gender-typed) toys to children, and they avoid offering counter-stereotypical (i.e., cross-gender-typed) toys to them (Leaper, 2015; Lytton & Romney, 1991). Also, parents may reinforce gender segregation by arranging play dates for their children only with same-gender peers (e.g., Feiring & Lewis, 1987; Hollingsworth & Buysse, 2009).

Preschool teachers may have an indirect influence on the emergence of gender segregation in ways similar to that of parents or other family members. For example, this may occur by using gendered language (e.g., "Good morning, girls and boys") and organizing activities by gender (e.g., Bigler & Liben, 2007; Chen & Rao, 2011; Hilliard & Liben, 2010). It also occurs through tacit acceptance of children's expressions of gender-stereotyped attitudes and behaviors (Hyde et al., 2019). However, there are exceptions. Some teachers and schools deliberately challenge children's gender stereotypes or foster cooperative mixed-gender interactions (e.g., Mulvey et al., 2020; Ryan et al., 2013; Shutts et al., 2017; and see Leaper & Brown, 2014, for a review).

As children get older, parents and other adults may have a more direct influence on children's gender segregation. In middle- and upper-income communities in the

USA and other countries, many parents enroll their children in same-gender extracurricular activities (e.g., sports). Moreover, some children and adolescents are sent to single-gender schools or schools with single-gender classrooms (Pahlke et al., 2014; also addressed later in Sect. 6.3.2.1). Alternatively, in coeducational schools, teachers may use gender to organize activities in the classroom (e.g., same-gender workgroups). Moreover, in most schools, it is customary to separate girls and boys in athletic activities (Anderson, 2008; also discussed later in Sect. 6.3.2.3). Finally, in some cultures, adults impose gender segregation on children and adolescents. For example, children may be assigned gender-segregated chores, such as cooking and childcare for girls and subsistence tasks for boys (Maccoby, 1998; Rogoff et al., 2010). Finally, as I noted earlier, in some religious communities, girls and boys are separated at adolescence, and any mixed-gender contact must be supervised (Williams et al., 2017).

6.2.2 Popular Media

In books, television, movies, and online media, young children are commonly exposed to characters who are gender-differentiated in prominence, appearance, and behavior (e.g., Walsh & Leaper, 2020; Ward & Aubrey, 2017). Representations of gender in popular media inform young children's emerging schemas of what it means to be "a girl" or "a boy" (and generally without nonbinary representations of gender). For example, mass media provide pervasive images linking masculinity with athleticism and dominance while linking femininity with sexual attractiveness and communion (see Mazzarella, 2015; Ward & Aubrey, 2017). Another way that popular media may contribute to gender segregation is through the color-coding of toys, clothing, and other objects as pink for girls and blue for boys (Bigler & Liben, 2007; Wong & Hines, 2015).

Several studies have documented a link between media consumption and gender stereotyping in early childhood and beyond (Lemish, 2015; Ward & Aubrey, 2017). Furthermore, as they get older, girls and boys increasingly seek out television shows, videogames, and other media that reinforce gender-stereotyped expectations (Cherney & London, 2006)—including preferences for same-gender peers. Thus, exposure to popular media may indirectly reinforce children's emerging preferences for same-gender peers via its impact on children's developing gender stereotypes and interests (Lemish, 2015). However, to my knowledge, there has been no research testing this premise.

6.2.3 Behavioral Compatibility

In general, preschool-age children seek peers with whom they experience positive affect (Snyder et al., 1996). By extension, children may enjoy interactions with

others who have similar interests and behavioral styles. According to the behavioral compatibility hypothesis, gender segregation initially emerges because same-gender peers are likely similar in their interests and behavioral styles (Maccoby, 1998; Martin et al., 2011b; Serbin et al., 1994). Some psychologists have posited sex-linked behavioral dispositions evolved over human history to help prepare males for combat and females for childcare (e.g., Benenson, 2014; Geary, 2021; however, also see Wood & Eagly, 2012, for an alternative biosocial perspective that incorporates both social-structural and biological factors). To evaluate the behavioral compatibility hypothesis, it is first necessary to document the incidence of average behavioral differences already present around 3 years of age when children usually begin to favor same-gender over other-gender peers.

6.2.3.1 Evidence for Early Average Gender Differences in Behavior

As summarized below, researchers have documented reliable gender differences with meaningful effect sizes in several types of behavior among samples of young children. To evaluate the magnitude of difference between two groups, the Cohen's *d* statistic indicates the standardized difference between the means of two groups. By one convention, small yet meaningful effect sizes are indicated when $d = 0.20$ (equivalent to 92% overlap between two groups). Moderate or medium effect sizes are denoted when $d = 0.50$ (equivalent to 80% overlap). Finally, large effect sizes occur when $d = 0.80$ (equivalent to 67% overlap) or greater (Cohen, 1988; and see Magnusson, 2020, regarding estimates of overlap). Thus, even with significant group differences in behavior, within-gender variability and between-group overlap are seen.

Interests: Average differences between females and males in interests appear early in childhood. Within children's first year, researchers in a few studies have detected average sex differences with moderate effect sizes in children's *interests in people versus inanimate objects* (e.g., pictures of faces vs. mechanical objects, respectively). Girls demonstrated greater average interest in people, whereas boys exhibited greater average interest in objects or "things" (see Alexander & Wilcox, 2012). However, many girls and boys did not show a preference for one type of stimuli over the other.

In addition, average differences with large effect sizes have been noted between girls' and boys' preferences for particular *toys and play activities* during childhood (Cherney, 2018; Davis & Hines, 2020; Todd et al., 2017). Girls were much more likely than boys to choose feminine-stereotyped toys and play activities such as dolls, dress-up, and playing house. Conversely, boys were much more apt to favor masculine-stereotyped toys and play activities such as vehicles, construction toys, balls and sports activities, rough-and-tumble play, and action-adventure fantasy play. These preferences begin to appear around 18 months of age for many children (Serbin et al., 2001).

Preferences for gender-typed toys and play activities generally increase with age (e.g., Davis & Hines, 2020). For some young children, these interests may be

especially strong or "extremely intense" (DeLoache et al., 2007; Halim et al., 2014; Johnson et al., 2004). In a study of 177 (presumably cisgender) children between 1 and 6 years of age, DeLoache et al. (2007) defined an extremely intense interest as "relatively long lasting, shown in several different contexts..., and independently noticed by people outside the immediate family" (p. 1579). The researchers found 29% of the children had "extremely intense" interests, 37% had "moderate" interests, and 34% did not indicate any strong interests. Extremely intense interests seen predominantly or only among boys included vehicles, trains, machines, or dinosaurs. In contrast, extreme interests found predominantly or only among girls were dress-up and books/reading. (Overall, intense interests were substantially more likely among boys than girls.) Researchers also noted a few intense interests seen in both girls and boys (e.g., live animals). Intense interests emerged between 1 and 2 years of age, and they tended to persist for an average of 22 months.

A second set of children may express intense interests in toys and activities that are counter-stereotypical for their assigned gender—and simultaneously show disinterest in objects and activities that are stereotypical for their assigned gender (Ahlqvist et al., 2013; Bailey et al., 2002; VanderLaan et al., 2015). These include (but are not limited to) children who self-identified as transgender or were classified by clinicians with gender identity disorder or gender dysphoria. Based on a recent estimate of the incidence of youth self-identifying as transgender, one might tentatively infer that intense cross-gender-typed interests occur among at least 1% of children (Zucker, 2017).

Finally, in the previously reviewed studies, many toddlers and preschool-age children did not initially exhibit different interests in people versus objects (Alexander & Wilcox, 2012) or to masculine- versus feminine-stereotyped toys (DeLoache et al., 2007). Accordingly, this third group of children may be relatively susceptible to greater gender-role flexibility during development. Indeed, research in the USA (Sandberg et al., 1993) and China (Yu & Winter, 2011) suggests that many girls and boys express a combination of gender-typed and cross-gender-typed interests and behaviors. However, this potential flexibility and breadth of interests may partly depend on gender socialization practices (e.g., Brown & Stone, 2018; Endendijk et al., 2018). For example, children infer messages from their environments regarding socially desirable and undesirable behaviors for their gender ingroup (e.g., Bigler & Liben, 2007; Martin et al., 2002), which may affect their subsequent motivations (Bussey & Bandura, 1999).

Physical activity level and related behaviors: Some (but not all) facets of temperament seen between 3 months and 13 years of age have been associated with reliable average gender differences with small-to-moderate effect sizes (Else-Quest et al., 2006). These include physical-activity level and high-intensity pleasure-seeking, which tend to be higher among boys than girls. Consistent with higher average activity levels and high-intensity pleasure-seeking, studies indicated boys tended to engage in more rough-and-tumble play than did girls (Else-Quest et al., 2006).

Socioemotional competencies and related behaviors: During early childhood (approximately 3–5 years of age), several behaviors related to socioemotional

competence have been observed more likely among girls than boys with small-to-moderate effect sizes. These included higher mean levels for girls in interpersonal concern or empathy (e.g., Braza et al., 2009; Rhee et al., 2013), language and communicative competence (e.g., Rhee et al., 2013; Leaper & Smith, 2004), and impulse control (e.g., Else-Quest et al., 2006).

In contrast, researchers have noted higher average levels in physical aggression and other externalizing behaviors among boys than girls with moderate-to-large effect sizes (Card et al., 2008; Chaplin & Aldao, 2013). Also, studies indicated higher average uses of controlling or domineering communication among boys than girls during early childhood with a small effect size (see Leaper & Smith, 2004).

Interrelations among behaviors: Several of the above behaviors are interrelated during early childhood: First, children's differential interest in people versus objects during their first year predicted interests at 4 years of age in feminine-stereotyped versus masculine-stereotyped toys, respectively (Lauer et al., 2018). Second, children with high activity levels may be especially interested in physical play activities (Pellegrini et al., 2007). Third, high-intensity pleasure may lead children toward rough-and-tumble play (Else-Quest et al., 2006). Fourth, language and communicative skills may be related to empathy (Rhee et al., 2013). Fifth, children's preference for feminine-stereotyped toys was associated with socioemotional abilities (Wong & Yeung, 2019). Finally, effortful control negatively predicted the likelihood of physical aggression (Hay, 2007).

6.2.3.2 Evidence Regarding the Behavioral Compatibility Hypothesis

Only a few studies have tested the behavioral compatibility hypothesis in relation to the *onset* of children's preference for same-gender peers during early childhood (from approximately 2½ to 5 years of age). Among the identified studies reviewed below, the evidence is mixed. There is stronger support regarding some forms of behavioral compatibility than others. With few exceptions the available studies cited below were conducted in the USA, Canada, or the UK and with mostly White, middle-class samples. Also, many of them were based on small samples (and thus the total *N* is indicated for each cited study).

Links to toy and play interests: Four studies conducted in the USA or Canada were identified that tested for associations between play interests and gender segregation (or self-reported preference for same-gender peers) in early childhood. Two studies of toddler and preschool-age children did not find associations between play preferences and early gender segregation (Maccoby & Jacklin, 1987 [$N = 41$]; Powlishta et al., 1993 [$N = 57$]). However, shared play-activity preferences and peer affiliations were related in three studies of preschool children in the USA and Canada. In a study of children in Canada between 3 and 7 years (Serbin & Sprafkin, 1986 [$N = 147$]), self-reported same-gender peer preferences and gender-typed toy preferences were positively correlated. Among preschool children in the USA from diverse ethnic backgrounds (Halim et al., 2013 [$N = 229$]), increases from 4 to 5 years in gender-typed play and gender segregation were modestly correlated with

one another. In another study using stochastic modeling (Martin et al., 2013 [$N = 292$]), children between 4 and 5 years tended to demonstrate ties to same-gender peers with similar gender-typed activity preferences; however, the emergence of gender segregation was more strongly related to peer gender (57% of the variance) than to peer play activity (18% of variance). With the exception of the latter study, the previously cited reports do not provide strong evidence linking gender-typed toy and play interests to the initial emergence of same-gender peer preferences in early childhood.

Other studies have examined older children (4–13 years) with intense *cross*-gender-typed toy and play interests. These youth tended to favor other-gender peers who shared their interests (e.g., Ahlqvist et al., 2013; Bailey et al., 2002; Fridell et al., 2006). The implications of the latter trend will be explored more fully later (see Sect. 6.4.3).

Links to activity level and related behaviors: Six studies of preschool-age children in the USA tested the association between activity level and same-gender peer preferences. In support of the behavioral compatibility hypothesis, three of them found that preschool-age children with high-activity temperaments were more likely to affiliate with peers based on activity level than gender. In one report, the pattern was seen in both girls and boys (Gleason et al., 2005 [$N = 75$]); in a second, it was indicated only among girls (Pellegrini et al., 2007 [$N = 73$]); and, in a third, it was found only among boys (Martin et al., 2011a [$N = 74$]). Finally, four other studies of preschoolers did not detect associations among child gender, activity level, and peer preference (Hoffmann & Powlishta, 2001 [$N = 39$]; Howes & Phillipsen, 1992 [$N = 40$]; Maccoby & Jacklin, 1987 [Sample 1: $N = 53$; Sample 2: $N = 43$]).

As noted earlier, higher average levels of physical activity and high-intensity pleasure-seeking may be related to preferences for rough-and-tumble play (Else-Quest et al., 2006). In support of the behavioral compatibility hypothesis, two studies of preschoolers in the USA found that boys were likely to favor peers who engaged in rough-and-tumble play (Colwell & Lindsey, 2005 [$N = 60$]; Martin et al., 2011b [$N = 74$]). In one of these studies, girls also disfavored boys who engaged in rough play (Colwell & Lindsey, 2005). Two other investigations conducted in the USA did not find associations between rough-and-tumble play and gender segregation (Hoffmann & Powlishta, 2001 [$N = 39$]; Maccoby & Jacklin, 1987 [Sample 2: $N = 43$]). Another study unexpectedly found the association between rough play and gender segregation was positive among girls and nonsignificant among boys (Maccoby & Jacklin, 1987 [Sample 1: $N = 53$]).

Links to socioemotional competencies and related behaviors: A few studies conducted in the USA or Canada tested the association between socioemotional competence and the onset of gender segregation. In one pertinent investigation of 3-year-olds (Moller & Serbin, 1996 [$N = 57$]), preschool teachers rated gender-segregating girls as higher in social skills and lower in disruptive behavior compared to gender-segregating boys. Teachers rated non-segregating girls and boys as more similar in social skills and disruptive behavior. However, a longitudinal study of 1- to 4-year-olds did *not* find gender differences in social skill predicted same-gender friendships; instead, similarity in social skills was related to all friendships regardless

of the child's gender (Howes & Phillipsen, 1992 [$N = 40$]). Also, three studies did not find that gender segregation in preschool samples was related to peer similarities in either impulse control (Gleason et al., 2005 [$N = 75$]) or aggressive behavior (Hoffmann & Powlishta, 2001 [$N = 39$]; Martin et al., 2011b [$N = 74$]).

Perhaps social skills become more important in girls' peer preferences once gender segregation is underway. For example, in a study of 5-year-olds in Spain, socioemotional behaviors (e.g., talking, affection, sharing resources) predicted same-gender peer preferences among girls but not boys (Braza et al., 2012). In general, however, there has been no consistent evidence that behavioral compatibility regarding socioemotional skills or aggression underlies the *initial* emergence of gender segregation around 3 to 4 years of age.

6.2.4 Gender-Related Cognitions

According to gender schema theory, the acquisition of a concept of gender shapes children's perceptions of their worlds and self-concepts. That is, once children self-categorize themselves into a gender category, they tend to pay more attention to information that is relevant to their gender ingroup (Martin et al., 2002). By extension, according to the cognitive consonance hypothesis, children will prefer peers who belong to their self-identified gender ingroup (see Perry et al., 2019; Tobin et al., 2010). This proposition is also consistent with social identity theories of group belonging (Harris, 1995; Tajfel & Turner, 1979) as well as the gender self-socialization model (Perry et al., 2019; Tobin et al., 2010). As reviewed below, the evidence in support of the cognitive consonance hypothesis is mixed.

6.2.4.1 Early Gender-Related Cognitions

The marking of gender via appearance (e.g., hairstyles and length, makeup, clothing colors) and language (e.g., gendered nouns and pronouns) heightens the salience of gender in children's everyday lives (Bigler & Liben, 2007). Children show increasing evidence of category-attribute associations (e.g., linking female and male faces with gender-typed toys) between 1 and 2 years of age—and possibly even younger (see Martin et al., 2002; Serbin et al., 2001). They demonstrate a verbal concept of gender around 2 years of age when they use verbal gender categories to reference others (i.e., gender labeling). Evidence of gender self-categorization (i.e., gender identity) occurs around 2½ years of age (see Martin et al., 2002). During the preschool-age years, most children also begin to form rigid gender-stereotyped beliefs (see Martin et al., 2002). This is the same age period when children typically begin to affiliate more with same-gender peers. With increases in cognitive flexibility during the transition into middle childhood (around 7 years of age), children become somewhat more flexible in their gender beliefs (Katz & Ksansnak, 1994).

6.2.4.2 Evidence Regarding the Cognitive Consonance Hypothesis

According to the cognitive consonance hypothesis, young children (between approximately 2 and 4 years of age) are more likely to prefer same-gender playmates if they acquired the ability to gender label others (gender labeling) or themselves (gender identity or self-categorization). Two studies in the USA lent support to this hypothesis. One employed observations of peer preference (Fagot, 1985 [$N = 54$]) and another study was based on self-reported peer preferences (Martin & Little, 1990 [$N = 61$]). However, five other studies did not detect an association between gender concepts (labeling or identity) and same-gender peer preferences. The latter included research conducted in the USA, Canada, or the UK (Campbell et al., 2004 [$N = 56$]; Moller & Serbin, 1996 [N = 57]; Serbin & Sprafkin, 1986 [$N = 147$]; Smetana & Letourneau, 1984 [$N = 64$]), as well as across four diverse non-Western cultures (Munroe & Romney, 2006 [$N = 192$]). Perhaps variations across studies in measures or other methods led to the disparate findings (see Martin & Ruble, 2010).

Whereas the capacity for the verbal categorization of gender may not be necessary for the initial emergence of gender segregation, perhaps nonverbal category-attribute associations (e.g., Serbin et al., 2001) are a precursor. To my knowledge, this has not been tested. Also, as I review later in the chapter (see Sect. 6.3.1), the formation of gender schemas (e.g., stereotyped expectations) is implicated in the development and maintenance of gender segregation from early to middle childhood.

6.2.5 Need for Multidimensional and Multi-Domain Approach

With a few exceptions, the research has not lent strong support to either the behavioral compatibility or the cognitive consonance hypotheses for the beginning of gender segregation in early childhood (approximately 2½ to 5 years). Going forward, we must seek a deeper understanding of the possible combined impacts of behavioral compatibility and gender-related cognitions on child-initiated gender segregation (e.g., Martin et al., 2011b). Toward this aim, more studies with larger samples need to consider the interrelations among multiple variables over time (e.g., Barbu et al., 2000; Berenbaum et al., 2018; Martin et al., 2005; Martin et al., 2011b) as well as how they are measured (see Martin & Ruble, 2010). I discuss some possible directions below.

6.2.5.1 Multi-Domain Approach to Behavioral Compatibility

As summarized earlier, there are multiple types of behavior associated with average gender differences in early childhood. These include toy and play interests,

temperament, aggression, and interpersonal styles. However, children may vary in the particular kinds of gender-related behaviors that they find most attractive in peers. For some, having similar temperaments may be key, whereas for others shared play interests may be more important. Therefore, when testing the influence of behavioral compatibility on the emergence of gender segregation, researchers may find it helpful to consider several behavioral domains in which children experience behavioral compatibility.

Within each behavioral domain, further differentiations can be made. For example, even among children with gender-typed interests, there are variations in specific types of preferred play (Tobin et al., 2010). For example, one boy may favor sports while another boy may enjoy action figures, and each boy might not share the other's play interest. Also, there are multiple facets of temperament (e.g., activity level, self-control) and competence-related social behaviors (e.g., aggression, empathy, communication) that each may affect some children's peer preferences more than others.

Thus, children may differ in the relative importance they attach to facets of each of these behavioral domains when seeking out peers. However, if several features are correlated with gender, the ultimate effect may be a probabilistic tendency toward same-gender peer affiliations. This view is reflected in *dynamic systems* models of gender development (e.g., Martin & Ruble, 2010), which emphasizes the interplay of multiple sub-systems (e.g., physiological, cognitive, interpersonal, cultural). Also, the dynamic systems approach acknowledges how different experiences and processes can lead to similar outcomes, known as *equifinality* (von Bertalanffy, 1968; Leaper, 1985; Rosenfeld, 2002). Thus, children may vary in particular processes that lead them to favor same-gender peers. For example, for some children, having compatibility in one set of behaviors may be important; in contrast, for other children, compatibility in another set of behaviors may matter.

6.2.5.2 Multidimensional and Multi-Domain Approach to Gender Identity and Schemas

Applying a multidimensional and multi-domain model of gender-related cognition may reveal if and how young children's gender concepts guide their peer preferences. Developmental scientists have long emphasized the multidimensional nature of gender schemas (e.g., Huston, 1985; Liben & Bigler, 2002; Perry et al., 2019; Ruble et al., 2006; Signorella, 1999; Tobin et al., 2010). For example, children commonly form concepts and beliefs about gender in relation to physical appearance, recreational activities, personal-social traits, relationships, roles, and other domains (Tobin et al., 2010).

Contemporary models of gender identity are also multidimensional (e.g., Tobin et al., 2010). Besides a person's self-labeling into a gender category, gender identity incorporates evaluative components. These include *felt typicality* (perceived similarity to same- or other-gender peers), *centrality* (importance of gender as an identity), and *contentedness* (satisfaction with expectations for gender ingroup), among other components (see Perry et al., 2019). Specific gender identity

dimensions have been implicated in the development and maintenance of gender segregation (and other ingroup affiliations) from early childhood into adolescence (e.g., Martin et al., 2011b; Molano & Jones, 2018; Tobin et al., 2010; Perry et al., 2019). For example, in one study (Martin et al., 2011b), preschool children's proportion of gender-segregated play was moderately associated with their perceived similarity (i.e., typicality) to same-gender peers.

Extending a multidimensional and multi-domain approach to studies of preschool-age children may illuminate if and how gender-related cognitions affect the onset of same-gender peer preferences. Furthermore, to make things even more complicated and ambitious for a given study, researchers might investigate interrelations among multiple forms of behavioral compatibility *and* multiple dimensions of gender-related cognition. To my knowledge, this kind of analysis has not yet been conducted.

6.3 Maintenance and Consequences of Gender Segregation in Childhood and Beyond

As reviewed above, the research evidence is somewhat ambiguous regarding reasons for the initial onset of gender segregation during early childhood. In contrast, there is a clearer understanding of the processes that maintain gender segregation during childhood and adolescence. In this next section, I summarize how group socialization processes function in children's gender-segregated peer groups. Finally, I highlight some of the consequences of institutionalized forms of gender segregation in school and work settings.

6.3.1 Peer Groups in Childhood and Adolescence

Identifying with a group is generally associated with a set of cognitive and social processes (Harris, 1995; Tajfel & Turner, 1979). These include ingroup bias, ingroup assimilation, outgroup stereotyping and prejudice, and (sometimes) outgroup hostility. Developmental scientists have documented how these processes shape children's gender in the context of same-gender peer groups (see Bigler & Liben, 2007; Leaper, 1994, 2000, 2015; Maccoby, 1998; Martin et al., 2017; Powlishta, 1995; Tobin et al., 2010). This work is explained next.

6.3.1.1 Ingroup Bias

Once individuals identify with a group, they routinely develop ingroup bias whereby persons and attributes associated with the ingroup are typically valued over those of

the outgroup. Accordingly, as children get older, they tend to affiliate more with same-gender peers. Also, they commonly evaluate ingroup members and the characteristics (e.g., styles, objects, traits, activities, roles) associated with their gender ingroup more favorably than those associated with the gender outgroup. Indeed, the tendency toward positive ingroup bias was seen during the preschool years as children started to affiliate with same-gender peers (Gasparini et al., 2015; Yee & Brown, 1994). This bias also appears pervasive throughout middle childhood (Castelli et al., 2007; Peragine et al., 2020; Powlishta, 1995; Robnett & Susskind, 2010; Serbin et al., 1993; Zosuls et al., 2011).

Ingroup bias is also emphasized in the gender self-socialization model, which integrates aspects of social identity theory, balanced identity theory, and gender schema theory (Perry et al., 2019; Tobin et al., 2010). According to the model, "the primary role of gender identity is to motivate children to emulate whatever stereotypes they have internalized" regarding their gender ingroup (Tobin et al., 2010, p. 613). As studies guided by gender schema theory have previously documented, children generally pay more attention to information viewed as relevant to their gender ingroup (Liben & Bigler, 2002; Martin et al., 2002). Over time, they usually adopt more gender-typed attitudes and behaviors and they strengthen their gender ingroup identity (described more fully in the next section).

Research suggests that ingroup bias may increasingly motivate children's gender segregation from early to middle childhood. Moreover, this bias may override selecting peers based on behavioral compatibility. In a short-term longitudinal study, Pellegrini et al. (2007) followed children in a preschool from fall to spring. Highly active girls initially preferred playing with similarly active boys at the outset of the year; however, by the end of the year, highly active girls sought peers based on their gender more than their activity level. For the boys, peer preferences during both fall and spring were based primarily on the peer's gender group membership rather than the peer's activity level.

6.3.1.2 Ingroup Assimilation

Positive ingroup biases can become a basis for self-esteem when individuals feel good about belonging to an ingroup (Harris, 1995; Perry et al., 2019; Tajfel & Turner, 1979). These sentiments can strengthen children's motivation to maintain ties with the group. Thus, a second process associated with group socialization is ingroup assimilation. Group members commonly enforce conformity in one another through praise or criticism (Harris, 1995; Miller et al., 2013; Tobin et al., 2010). Ultimately, however, individuals who value their ingroup membership usually internalize the group's behavioral and attitudinal norms. Accordingly, some researchers have characterized children's same-gender peer groups as "gender cultures" in which differing social norms are expressed and maintained (see Maccoby, 1998; Rose et al., 2011; Underwood, 2004). In support of this supposition, Martin and Fabes (2001) observed that the amount of time that preschool or kindergarten children spent with same-gender peers predicted increases over

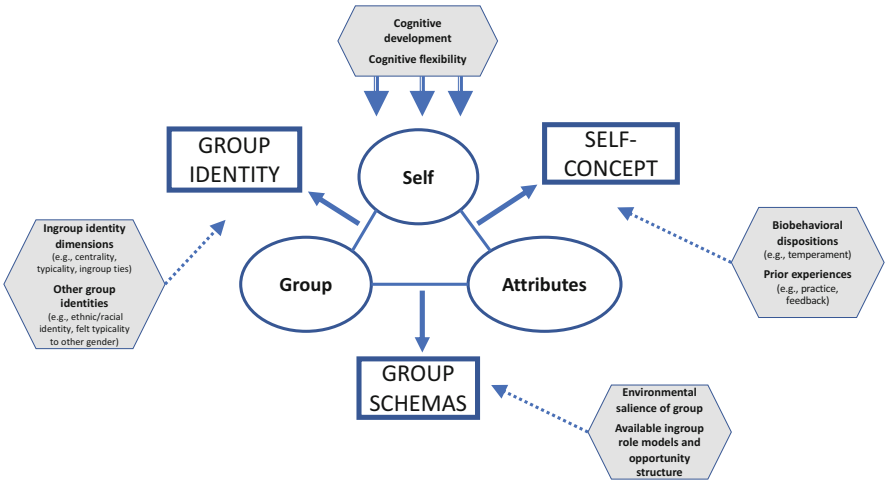

Fig. 6.1 Adaptation of gender self-socialization model (based on Greenwald et al., 2002; Tobin et al., 2010). *Self-concept* is based on associations between self and personal-social attributes (e.g., interests, self-perceived competencies, values). *Group identity* is derived from associations of self and group (e.g., gender ingroup identity). *Group schemas* reflect associations between groups and attributes (e.g., gender knowledge, stereotyped, attitudes). Constructs in shaded hexagrams are hypothesized *moderators* of self-concept, group identity, and group schemas. Also, *cognitive development* and *cognitive flexibility* are hypothesized to moderate several components in the model. These are some of the notable factors that would be expected to moderate the dynamic interaction of the components in the model

6 months in gender-typed behaviors and decreases in cross-gender-typed behaviors. The researchers characterized this process as a gradient or "social dosage effect," whereby the degree of ingroup assimilation was proportional to the amount of time affiliating with ingroup members (also see Bennet et al., 2020; Halim et al., 2013; Neal et al., 2017 for longitudinal studies documenting similar effects during early childhood).

The process of ingroup assimilation is explained in the gender self-socialization model (Tobin et al., 2010), which is based on the balanced identity theory (Greenwald et al., 2002). In the model, children are motivated to seek concordance across their gender group identity (i.e., individual's association between self and group, e.g., "I am a girl"), gender group-based schemas (i.e., individual's associations between groups and personal-social attributes; e.g., "Girls like playing with dolls"), and self-concepts (i.e., individual's associations between self and personal-social attributes; e.g., "I like playing with dolls"). An adapted version of the model is presented in Fig. 6.1.

Three types of processes are postulated in the gender self-socialization model: *Stereotype emulation* occurs when children who strongly identify with their gender ingroup subsequently seek to adopt gender-typical attributes (e.g., "I identify as a girl and therefore I like what other girls like"). *Stereotype construction* transpires when children assume other ingroup members share many of the same interests and

values ("I like being a boy and I like football, and therefore other boys must like football"). In addition, *identity construction* ensues when children observe they and other ingroup members share similar interests ("I like dolls and other girls like dolls, and therefore I identify as a girl"). In the gender self-socialization model, these processes occur in tandem and reciprocally over time (Tobin et al., 2010). (Balanced identity theory and the gender self-socialization model refer to stereotypes and attitudes rather than schemas. I favor the latter term because schemas encompass gender-based knowledge in addition to stereotyped beliefs and attitudes).

Although younger children may not have the cognitive abilities to logically infer consistency across all three components at the same time (Abrams et al., 2014; Patterson & Bigler, 2018), evidence suggests concordance tends to occur between at least two of the components in early childhood—such as between group identity and group-based stereotypes (see Tobin et al., 2010). Also, concordance among all three components may more likely occur at an implicit (i.e., unconscious) than explicit level of cognitive processing among children (Cvencek et al., 2016) and adults (Greenwald et al., 2002).

Stereotype (or schema) construction, identity construction, and stereotype (or schema) emulation have been implicated in studies of early gender segregation. From approximately 3–6 years of age, children begin to formulate expectations about their gender ingroup (i.e., stereotype/schema construction). For example, during this period, researchers observed that children increasingly expected same-gender peers would share similar gender-typed play interests (Barbu et al., 2000; Martin et al., 2011b; Powlishta, 1995). During the same period, children increasingly expressed preference for peers with similar play activity interests (i.e., identity construction [Alexander & Hines, 1994]). Studies also indicated children increasingly anticipated social approval for selecting same-gender peers and disapproval for selecting other-gender peers. Holding these expectations, in turn, was correlated with children's own same-gender peer ties (Martin et al., 1999). As researchers have documented, these expectations often reflect children's reality; that is, children who violate group norms are often subjected to peer disapproval and teasing (e.g., Miller et al., 2013; Reigeluth & Addis, 2016; Sroufe et al., 1993).

The peer group's attitudinal and behavioral norms often become personal standards and interests (i.e., stereotype/schema emulation). As a consequence, children's internalization of the group's norms has a *self-regulatory* function (Bussey & Bandura, 1999; Martin et al., 2002; Tobin et al., 2010); that is, over time, children and adolescents are usually motivated to seek consonance among their gender identities, gender beliefs, and behavioral preferences (Tobin et al., 2010). Furthermore, they are apt to hold negative views toward gender-nonconforming peers (e.g., Kwan et al., 2020; Nabbijohn et al., 2020).

The maintenance of these boundaries and the imposition of conformity pressures are generally more rigid among boys than girls (see Leaper, 2015). This pattern is consistent with intergroup research indicating ingroup boundaries are generally more rigid for high-status than low-status groups (e.g., Bigler et al., 2001)—and males have higher status than do females in patriarchal societies (Glick &

Fiske, 2001). Whereas cross-gender-typed behavior can sometimes enhance a girl's status, it typically diminishes a boy's status (Feinman, 1981).

Another reason that ingroup assimilation ensues is that peer groups provide children with opportunities and incentives to practice particular behaviors (Leaper, 1994, 2000; Leaper & Bigler, 2018; Martin & Fabes, 2001). In same-gender peer groups, children engage in the behaviors that are typical for the ingroup (e.g., girls will likely play together with dolls). Conversely, they are not likely to practice behaviors that are considered more typical of any outgroups (e.g., girls are unlikely to play together with trucks). Children's enactment of gender-typed behaviors thereby increases. In contrast, their expression of cross-gender-typed behaviors diminishes over time as a function of time spent with same-gender peers (Halim et al., 2013; Martin & Fabes, 2001). This process helps to account for how contextual variations in peer norms affect the likelihood that particular behaviors become adopted (e.g., see Chang, 2004; Jewell et al., 2015).

The opportunity structure in peer groups can have long-term consequences (Leaper, 2000). Practiced behaviors are more likely to foster feelings of self-efficacy and lead to greater competence (Bussey & Bandura, 1999; Martin et al., 2013). Hence, gender-differentiated experiences may affect the kinds of academic competencies, recreational interests, and socioemotional skills that are developed (Leaper, 2000, 2015; Leaper & Bigler, 2018). Indeed, many average gender differences in these domains increase during childhood and adolescence (Leaper, 2015; Rose & Rudolph, 2006).

The foregoing review of ingroup assimilation has focused on gender development in the context of peer *groups*. When examining gender segregation, it is pertinent to distinguish between interactions among members of a peer group (or a friendship network) versus individuals in dyadic friendships. Children are usually more sensitive to how others view them within group settings than dyadic relationships (Harris, 1995). Consequently, individuals are more likely to conform to others' expectations during group settings than dyadic interactions. That is, processes of ingroup assimilation generally occur within group contexts. In contrast, individuals are more likely to explore their personal interests in dyadic relationships. Thus, social identities tend to be enacted within group settings, whereas personal identities are expressed in dyadic relationships (Harris, 1995). Accordingly, researchers observed that children and adolescents were more likely to affiliate with other-gender peers in friendships outside of school settings (Sroufe et al., 1993). Also, some studies indicated average gender differences in social behavior (e.g., assertive and affiliative communication, activity choices) were less likely in mixed-gender than same-gender relationships during early and middle childhood (e.g., Fabes et al., 2003; Leaper & Smith, 2004; Underwood, 2004).

Relative differences in amounts of time spent in groups versus dyadic friendships may also affect gender socialization. In research comparing children's average time in groups versus either dyads or triads, boys spent more time in groups and girls spent more time in dyads or triads (Benenson et al., 1997). By spending greater time in groups, many boys therefore may experience more conformity pressures that inhibit facets of their personal identities. Conversely, by participating more in dyadic

friendships, many girls may experience greater flexibility to pursue a wider range of interests associated with their personal identities (see Harris, 1995).

6.3.1.3 Outgroup Stereotyping, Prejudice, and Hostility

A third set of intergroup processes include outgroup stereotyping and prejudice (Bigler & Liben, 2007; Harris, 1995; Leaper, 2000, 2015). More specifically, these intergroup biases include exaggerating differences between members of one's ingroup versus an outgroup (between-group contrast), viewing outgroup members as sharing similar characteristics (outgroup homogeneity [i.e., stereotyping]), and possibly holding hostile attitudes toward an outgroup (outgroup hostility).

From approximately 3–7 years of age, children quickly learn and endorse cultural gender stereotypes (e.g., Liben & Bigler, 2002). During middle childhood, youth better recognize that many forms of gender typing are cultural conventions that can be challenged (e.g., Carter & Patterson, 1982). Nonetheless, many children internalize these conventions as personal standards and values (Bussey & Bandura, 1999; Carter & Patterson, 1982; Kwan et al., 2020), and they endorse traditional gender ideologies regarding expected behaviors for boys and girls (e.g., Farkas & Leaper, 2016; Richmond et al., 2015; Thompson Jr. & Bennett, 2015). Gender-segregated peer groups are potent contexts for establishing and maintaining these biases (Leaper, 1994, 2000, 2015). Furthermore, as discussed next, the internalization of these ideologies can lead to sexist behaviors.

Intergroup researchers have noted that individuals sometimes express hostility or negative bias toward outgroups (i.e., outgroup hostility or intergroup bias [Harris, 1995; Tajfel & Turner, 1979]). With regard to gender-segregated peer groups during childhood, however, developmental researchers have generally found positive ingroup bias more common than outgroup hostility (Powlishta et al., 1994; Robnett & Susskind, 2010; Zosuls et al., 2011). For example, in these studies, children tended to evaluate traits associated with their gender ingroup more positively than those associated with the gender outgroup; however, they did not typically denigrate the traits associated with the gender outgroup. One exception was seen in a US study of 9- and 10-year-olds, wherein boys with many same-gender friends were apt to derogate feminine-stereotyped traits (Robnett & Susskind, 2010).

Intergroup hostility is most likely when there is a competition for resources (Green & Rechis, 2006). Given that most girls and boys tend to play apart from one another during childhood, they may largely act in separate worlds that do not usually elicit outgroup hostility. However, manifestations of gender-outgroup hostility become more apparent during adolescence with the advent of heterosexual dating expectations for many youth (Leaper, 2015).

Simultaneous increases in both heterosexual intimacy and gender-outgroup hostility during adolescence may seem paradoxical. As explicated in ambivalent sexism theory (Glick & Fiske, 2001), traditional heterosexual dating scripts are inherently ambivalent. Even though women and men are interdependent in heterosexual relationships, asymmetries traditionally exist in their relative status and power.

Ambivalence is manifested via the combination of hostile and benevolent types of sexism. *Hostile sexism* refers to a belief in male superiority as well as negative attitudes toward gender-nonconforming individuals. These attitudes help to maintain men's dominance in gender relations (Glick & Fiske, 2001). *Benevolent sexism* includes protective paternalism (i.e., belief that men must protect women) and complementary gender differentiation (i.e., belief that women and men are different and complement one another). Although facets of benevolent sexism are attractive to many heterosexual women and men, they perpetuate traditional gender roles and status imbalances (Glick & Fiske, 2001; Leaper et al., 2020).

Benevolent sexism is typically manifested during adolescence through traditional heterosexual dating scripts. For example, these include the expectations that the boy asks the girl for a date and then pays for any expenses. Many heterosexual youth continue to favor these traditional scripts, as documented in studies with adolescents in the USA (Farkas & Leaper, 2016), adolescents in Spain (Montañés et al., 2013), and undergraduates in the USA (Paynter & Leaper, 2016; Robnett & Leaper, 2013).

Hostile sexism, expressed as sexual harassment, tends to increase over the course of adolescence in the USA and other countries (see Leaper & Brown, 2018 for a review). For example, it includes sexually disparaging comments, anti-LGBTQ insults, unwanted sexual attention, unwanted touching, and sexual coercion. Many cisgender boys and girls instigate sexual harassment toward other-gender (as well as same-gender) peers. However, boys are more likely than girls to be the perpetrators of these acts. Also, transgender and other gender-nonconforming youth are at higher risk as targets for sexual harassment (see Leaper & Brown, 2018; Shiffman et al., 2016).

According to some researchers, gender-based power asymmetries and hostility seen during adolescence partly emanate from the bifurcated gender relations experienced throughout childhood (e.g., see Leaper, 2000; Maccoby, 1998). They further argue that these effects could be mitigated through greater gender integration during childhood and adolescence (e.g., Fabes et al., 2018; Leaper, 1994). For example, this can be achieved through the creation of cooperative mixed-gender workgroups in classrooms and extracurricular programs (see Fabes et al., 2018; Leaper & Brown, 2014).

6.3.2 Institutionalized Gender Segregation in School and Work Settings

As reviewed next, several institutional practices perpetuate and maintain gender segregation in many educational and work settings.

6.3.2.1 Single-Gender Schooling

Many children are sent to single-gender schools or to coeducational schools with single-gender classrooms. Also, some adults elect to attend single-gender colleges. Proponents of single-gender schooling have argued that students fare better in these contexts for a variety of presumed reasons (e.g., putative sex differences in learning). However, a comprehensive meta-analysis concluded there were no meaningful differences in academic outcomes between students at coeducational and single-gender schools when controlling for socioeconomic background, prior performance, and other factors (Pahlke et al., 2014). Moreover, several developmental researchers have criticized single-gender schools and classrooms for perpetuating traditional gender divisions and reinforcing gender-stereotyped attitudes (e.g., Bigler et al., 2014; Fabes et al., 2018; Halpern et al., 2011). Based on recent research of high school and college students enrolled at either single-gender or coeducational schools in Hong Kong, those attending single-gender schools found it more challenging to adapt to mixed-gender interactions, even after controlling for a range of potential confounding factors (Wong et al., 2018). However, as reviewed next, coeducational colleges also can reinforce gender divisions and inequities.

6.3.2.2 Fraternities and Sororities

At many coeducational colleges in the USA, students affiliate with gender-segregated fraternities and sororities. These are potentially influential contexts for the formation of gender-based social identities that exaggerate some aspects of gender typing. In some studies, students who belonged to fraternities or sororities were more likely than other students to endorse traditional gender roles, anti-LGBTQ attitudes, and rape-tolerant attitudes. Furthermore, these affiliations were associated with higher likelihoods of men's sexual objectification of women, women's self-objectification, and men's sexual assaults against women (DeSantis, 2007; Minow & Einolf, 2009; Murnen & Kohlman, 2007; Worthen, 2014).

In a meta-analytic review, researchers tested men's fraternity membership in relation to their attitudes and self-reported behaviors concerning sexual aggression (Murnen & Kohlman, 2007). Small yet meaningful average effect sizes were indicated; however, the size of the college's student body and the men's age moderated the magnitude of the correlations. Larger effects were seen at smaller than larger colleges as well as among older than younger men. The authors speculated that fraternities might have a more pronounced impact on men at smaller colleges because there are fewer alternative opportunities for peer group affiliation. Also, the stronger association among older men may reflect the socializing effect of belonging to the fraternity over time. However, longitudinal research is needed to better understand if and how fraternities shape men's misogynistic attitudes and behaviors.

6.3.2.3 Athletic and Academic Programs

With few exceptions, school athletics remain largely gender-segregated from elementary school into college. Some critics have argued that this segregation reifies traditional gender ideologies and prejudices (e.g., Anderson, 2008; Messner & Bozada-Deas, 2009). Consequently, they have called for greater gender integration in physical education classes and some school sports teams (e.g., Hills & Croston, 2012; Women's Sports Foundation, 2011; see Staurowsky et al., 2007, for a review of issues and debates concerning gender equity in physical education and athletics).

In addition, there is informal gender segregation through college students' selection of particular majors in college. Of particular concern to policymakers and researchers has been the gender gap in engineering, computer science, and the physical sciences (see Cheryan et al., 2017). Men are disproportionally represented in these majors in the USA and many other countries. In contrast, women are disproportionally represented in majors in nursing, teacher education, and the humanities (U.S. Department of Education, 2018). Researchers have highlighted multiple social processes that perpetuate these gender inequities (e.g., Cheryan et al., 2017; Leaper & Starr, 2019).

6.3.2.4 Occupations

Work settings can provide adults with opportunities to interact and form collaborative relations with other-gender peers (Markiewicz et al., 2000). However, several occupations remain largely gender-segregated across the world (Cohen, 2013; Das & Kotikula, 2019). Notably, the fields that remain male-dominated are among the highest-paying occupations (U.S. Department of Education, 2018). Furthermore, women who enter male-dominated college majors or professions, such as computer science or engineering, often encounter a masculine culture that makes it challenging to feel like they belong (Cheryan et al., 2017). Accordingly, increasing greater parity based on gender (as well as other identities) in occupations at all levels is considered key to reducing inequalities in society (World Economic Forum, 2020).

6.4 Toward an Integrative Developmental Systems Model of Gender Segregation

In this section, I present a preliminary integrative systems model of gender segregation that weaves together some of the research programs and theories reviewed in earlier parts of this chapter (also see Leaper, 2018). Systems models of gender development emphasize the dynamic interplay of multiple sub-systems at physiological, cognitive, interpersonal, and cultural levels (e.g., Martin & Ruble, 2010).

I begin by highlighting the relevance of variability during development, which includes the ranges within each gender group as well as the overlap between groups in behaviors. As subsequently explained, some children appear to have strong dispositions (e.g., interests, personalities) appearing at early ages that are either highly gender-typed (e.g., girls interested in dress-up play) or highly cross-gender-typed (e.g., boys interested in dress-up play). Those children with strong gender-typed dispositions may become salient role models that many same-gender peers emulate. However, children with strong cross-gender-typed interests may find it difficult to reconcile their personal interests with traditional gender-role expectations.

6.4.1 Between-Group Overlap and Within-Gender Variability

For reasons subsequently explained, both between-group overlap and within-gender variability need to be considered more systematically when investigating the development of gender segregation. As highlighted in numerous meta-analyses testing for average (cis)gender differences, there is typically much overlap between girls and boys in the distributions of their scores for a given behavior (Hyde, 2005). For example, consider the very large average gender difference of $d = 1.6$ for toy preferences that was documented in a recent meta-analysis (Davis & Hines, 2020). This effect size corresponds to a 42% overlap between groups (Magnusson, 2020)—meaning that many cisgender girls and boys have similar toy interests despite the very large average difference. Relatedly, there is also variability within each gender group. For example, girls vary in the extent that they prefer doll play while boys vary in the degrees that they enjoy construction play.

As previously reviewed, there are average gender differences in interests and behavioral styles. At the same time, there are within-group variations among cisgender girls and among cisgender boys. For any given domain, some children's interests and behavioral styles may be highly concordant with gender-based cultural expectations. Other children's interests and behaviors may be highly incompatible with these cultural expectations. Finally, many children may fall somewhere between these ends of the continuum and exhibit a mixture of gender-typed and cross-gender-typed interests and behaviors (see Carothers & Reis, 2013; Joel & Vikhanski, 2019, for illustrations of this kind of analysis). This variability may help to explain if and when behavioral compatibility affects children's peer preferences (Leaper, 2018).

Earlier it was noted that some children have especially intense interests in particular toys and play activities. For example, researchers observed that boys were more likely than girls to have intense interests in toy vehicles, whereas girls were more likely to have intense interests in dress-up (DeLoache et al., 2007). Also, some children have strong behavioral dispositions. For example, boys were more likely than girls to have high-activity temperaments (Else-Quest et al., 2006). Research additionally indicates that some children have intense interests and

behavioral dispositions that are *counter*-stereotypical for their gender (Bailey et al., 2002; Halim et al., 2014; VanderLaan et al., 2015). For example, some boys intensely like dress-up play, and some girls greatly enjoy physically active play. In between these extremes of intense stereotypical tendencies and intense counter-stereotypical tendencies, many young children do not initially have strong interests or behavioral styles.

For children with intense interests, behavioral compatibility may play a more critical role in choosing peers. For example, boys with intense interests in sports or vehicles may be especially attracted to peers who share this interest (who are most likely cisgender boys). In one study previously described, preschool-age girls with high-activity temperaments initially affiliated more with boys who were compatible in activity level; however, in succeeding years, these girls shifted toward playing with girls as their gender identity possibly became more central (Pellegrini et al., 2007). In a similar manner, researchers observed gender-nonconforming children who strongly preferred cross-gender-typed play activities were more likely to interact with other-gender peers (e.g., Fridell et al., 2006).

In my proposed model, gender-related variations in intense interests and strong behavioral dispositions may be important in the development of gender segregation for many children. Those with strong gender-typed interests and behavioral styles may be especially prone to seeking out peers with similar dispositions. Furthermore, as explained next, children with strong gender-typed behavioral dispositions may become role models for other peers to follow.

6.4.2 Emulating Culturally Meaningful Role Models

Cultures vary in their relative degrees for equal versus inequal opportunities in society for individuals based on their gender (Brandt, 2011; Leaper, 2000; World Economic Forum, 2020). Children generally look to prototypical models in their environments to inform their understanding of desirable behaviors for their gender ingroup (Bussey & Bandura, 1999; Tobin et al., 2010). When individuals have strong interests and behavioral styles that are highly concordant with cultural expectations for their gender ingroup, they may become role models that other children emulate. Hence, individuals who are highly representative of gender archetypes in their culture may be salient and influential exemplars for other peers—perhaps especially among either those who are already somewhat gender-typed in their interests and behavioral styles or those who do not have intense interests or strong behavioral dispositions. In contrast, peers who are highly emblematic of cultural gender prototypes may not be seen as attractive to children with cross-gender-typed interests and styles.

According to the gender self-socialization model (Tobin et al., 2010), individuals seek to attain concordance across their gender group identity, their self-perceived personal-social attributes, and their beliefs about the personal-social attributes associated with their gender ingroup. Hence, if a person's self-perceived personal-social

attributes are concordant with a gender ingroup, they may identify more strongly with that group (i.e., identity construction). By extension, perhaps young children with gender-stereotypical intense interests or strong gender-typed behavioral dispositions are most likely to favor same-gender peers with compatible personal-social attributes.

As additionally posited in the gender self-socialization model, if children identify with a gender ingroup, then they are motivated to adopt the characteristics associated with the gender group (i.e., stereotype/schema emulation). Therefore, children with relatively weak-to-moderate gender-typed interests and behavioral styles may be susceptible to emulating the behavior of their highly gender-typed peers—especially if these peers are high in perceived status (e.g., see Prinstein et al., 2011). That is, if girls or boys do not have strong dispositions pushing them one way or another, they may be more inclined to try new behaviors. Once children practice these behaviors, they may become increasingly internalized as personal preferences (Bussey & Bandura, 1999); in turn, these preferences may strengthen their identification with their gender ingroup (Tobin et al., 2010).

The dual-pathways gender schema model is also pertinent here (Liben & Bigler, 2002, 2008). According to this model, children variously use their gender schemas (gender filter) or personal interests (interest filter) to guide their behavioral choices and attitudes. In *the attitudinal pathway*, individuals initially use their gender schemas to infer whether an object or activity (or other attribute) is concordant with their gender ingroup (Liben & Bigler, 2002; Martin et al., 2002). For example, a toy categorized as "for girls" would likely lead to increased interest for girls but decreased interest for boys. Conversely, in *the personal pathway*, individuals prioritize their personal interests to initially decide whether to pursue an object or an activity. In turn, they may subsequently infer that if they like the object or activity, then it is acceptable for their gender ingroup (i.e., gender stereotype/schema construction).

Although gender-stereotyped expectations generally shape the development of many interests (i.e., the attitudinal pathway), most cisgender children engage in some activities they find pleasurable regardless of whether they are considered typical for their gender (i.e., personal pathway). At the same time, they usually seek to assimilate into their same-gender peer group and avoid straying too far from the norms of their peers in interests and behavioral styles (i.e., attitudinal pathway). For many cisgender children, holding a few cross-gender-typed interests often can be reconciled with their gender identity if they additionally have some gender-typed interests.

Individual differences in gender-schematicity affects the relative likelihood of attitudinal and personal pathways (Liben & Bigler, 2002). That is, children vary in the degrees that they use gender schemas to filter their perceptions and understandings of the world. Some young children who endorse fewer gender stereotypes may be more likely to use their interest filter to approach new objects or activities (Weisgram, 2016). However, at older ages, the likelihood of individuals using one's interest filter to guide choices may become constrained through group socialization pressures (e.g., Miller et al., 2013).

The attitudinal pathway may reflect how many children increasingly assimilate into their same-gender peer groups when exposed to others who are highly emblematic of cultural gender stereotypes. To illustrate, consider boys with highly active temperaments and strong interests in sports-related toys and play. Cultural constructions of masculinity in many cultures emphasize sports and athleticism (Kidd, 2013). Physically active and athletic boys may be seen as protypical role models in many same-gender peer groups (e.g., Farmer & Rodkin, 1996)—as athleticism is one of the strongest predictors of popularity among boys in many cultures (e.g., Caravita et al., 2011; Closson, 2009; Dijkstra et al., 2010; Shakib et al., 2011). Thus, boys with average activity levels may conform to these same-gender role models and thereby increase their activity levels and athletic competence over time (e.g., Martin & Fabes, 2001).

Analogous processes may emerge in girls' same-gender peer groups. In many communities in the USA (and other countries), cultural constructions of femininity stress physical appearance. Concerns with appearance have been observed in girls from preschool-age into adolescence (e.g., Closson, 2009; Halim et al., 2018). Also, physical attractiveness is a predictor of popularity for both girls and boys from early childhood to adolescence (e.g., Caravita et al., 2011; Closson, 2009; Dijkstra et al., 2010)—although in one study appearance concerns were more important for girls in an affluent, predominantly White suburban school than girls in a low-income, mostly non-White urban school in the USA (Becker & Luthar, 2007). When appearance norms are tied to popularity, many girls may emulate same-gender peers who are physically attractive, sociable, and show strong interests in dress-up and appearance.

In sum, I propose that children who do *not* have intense interests in a particular domain (e.g., a play activity) may be susceptible to following the attitudinal pathway in the formation of their activity choices and gender beliefs regarding that domain. That is, they may be prone to same-gender ingroup assimilation and to emulating peers who reflect prototypical gender-role models. At the same time, children without strong behavioral inclinations may be the most amenable to adopting more flexible gender norms when exposed to a broader range of role models (e.g., Katz & Ksansnak, 1994). In contrast, as explained next, children with intense interests and behavioral dispositions that are cross-gender-typed may contest ingroup assimilation.

6.4.3 Gender-Nonconforming Children

My proposed model has implications for understanding how and why gender-nonconforming children are less likely either to identify with their birth-assigned gender group or to assimilate into a same-gender peer group (Leaper, 2018). For example, this might occur when a birth-assigned girl sees that other girls generally like dolls, but she does not personally like dolls. Analogously, it might occur when a birth-assigned boy strongly favors dress-up play, but he recognizes that other boys do not (e.g., Ahlqvist et al., 2013; Gleason et al., 2005; Golombok et al., 2012).

When children hold strong cross-gender-typed interests and behavioral preferences, it may be untenable to accommodate to the prescriptions and proscriptions associated with their birth-assigned gender ingroup. Instead, they may pursue their own interests. By extension, these children may find their self-concept is not congruent with the gender identity expected for them.

In the dual-pathways model mentioned earlier, the attitudinal pathway transpires when individuals' gender schemas drive their behavioral choices and subsequent attitudes (Liben & Bigler, 2002). Children with intense interests and strong behavioral styles that are *highly discordant* with expectations for their gender ingroup, however, may find it difficult to reconcile their interests with social pressures for gender group assimilation. These youth may be more inclined to follow the personal pathway despite backlash from peers and family. That is, their personal interests may override gender-stereotyped expectations (Liben & Bigler, 2008). Furthermore, unlike most of their peers who may hold a combination of cross-gender-typed and gender-typed interests, these children may hold few interests that are consistent with the cultural expectations for their birth-assigned gender.

Children with strong cross-gender-typed (i.e., gender-nonconforming) personal interests are commonly stigmatized by peers and adults if they do not accommodate to gender-conformity pressures (Drescher & Byne, 2012; Perry et al., 2019; Wallien et al., 2010). Given this high cost for pursuing their personal preferences, it is not surprising that high rates of psychological distress have been reported for populations of gender-nonconforming children (e.g., van der Miesen et al., 2018), including those that were labeled by clinicians with gender identity disorder or gender dysphoria (Drescher & Byne, 2012). However, tolerance for gender-nonconforming children has increased in some communities within the USA and other countries; and comparatively lower rates of distress have been indicated when gender-nonconforming children experienced support from family and peers (e.g., Olson et al., 2016; VanderLaan, 2018; Vasey & Bartlett, 2007).

In sum, the proposed model may help to address why some gender-nonconforming children do not identify with the gender category assigned to them at birth. If the norms among peers are rigid, nonconforming children may not consider themselves typical of the gender group to which they are expected to belong. Moreover, rejection from peers and family may lead to a sense they do not belong to a given gender group. As a consequence, some of these children may ultimately identify as transgender (i.e., identify with a different gender category than the one assigned at birth), gender-fluid (i.e., identify with more than one gender category), or agender (i.e., do not identify with any gender category) (Boskey, 2014). Some evidence suggests recent increases in the numbers of youth and young adults embracing transgender or other nonbinary gender identities (e.g., Steensma & Cohen-Kettenis, 2011; Zucker, 2017). This may reflect greater flexibility in gender expression within some segments of society (e.g., Olson et al., 2016).

6.4.4 *Summary and Conclusion*

In an earlier essay, I advocated for greater efforts aimed at theoretical synthesis in psychology (Leaper, 2011). Toward this goal, in this chapter and elsewhere (Leaper, 2018), I have posited a preliminary integrative developmental systems model of gender development seeking to bridge the interrelated influences of sex-related dispositions, identity, and peer group socialization in a given cultural context (see Fig. 6.1). Weaving together a set of complementary theories and research areas, I propose that sex-related dispositions (such as temperaments and intense interests) affect the process of assimilation within same-gender peer groups. Individuals with behavioral dispositions and competencies that are congruent with culturally valued gender-ingroup prototypes in a particular community (e.g., the athletic boy or the physically attractive girl) may function as prototypical models that establish standards for other group members to emulate. The majority of children who do not have strong temperamental dispositions or intense interests may be most amenable to the social influences of peer groups.

In contrast, children with personal-social attributes that are highly discrepant from the available prototypes for their birth-assigned gender may find themselves disinclined (or possibly unable) to adapt to the group's norms. As a result, they may be rejected and then withdraw from the peer group; in turn, they may de-identify with the gender associated with the group. If gender-nonconforming children have inadequate social supports, they may be more susceptible to adjustment difficulties (e.g., anxiety, depression). However, this trend can be mitigated when they are accepted and their social environments promote a greater range of gender identities and gender expressions.

6.5 Looking Ahead: Building an Integrative Dynamic Systems Model

Although the integrative model of gender development proposed above is based on existing theory and research, some components have not been thoroughly tested. Hence, it should be viewed as a preliminary effort (also see Martin et al., 2014, for a complementary integrative model of gender segregation). Accordingly, I close the chapter with a few recommendations for scientists to consider in future research.

First, it will be necessary to utilize sophisticated methodologies to consider the dynamic interrelations among multiple dimensions of behavior and cognition in the emergence and maintenance of gender segregation. A few examples of promising methods applied in recent studies include longitudinal social network analysis, hierarchical linear modeling, and taxometric methods. In longitudinal social network analysis, patterns of social connections between individual children within a group are charted over time. For example, in a study of US middle school students, researchers used this method to identify patterns over time of peer influence on

particular facets of gender group identity, including intergroup bias and conformity pressure (Kornienko et al., 2016). In hierarchical linear modeling, it is possible to take into account embedded levels in a system, such as how gendered patterns might vary across multiple classrooms. For example, using this method, it was possible to document how different social norms across several classrooms in China predicted the extent of gender differences in social behavior (Chang, 2004). With taxometric methods, researchers can determine whether the latent structure of a construct is best conceptualized as dimensional (i.e., along a continuum) or categorical. An analysis of multiple gender-correlated behaviors and attitudes illustrated how this approach could help advance multidimensional models of gender (Carothers & Reis, 2013; also see Joel & Vikhanski, 2019).

Second, my proposed model builds upon the premise in balanced identity theory, which is incorporated in the gender self-socialization model, that individuals seek concordance among their self-concepts, group identity, and group-related beliefs (Greenwald et al., 2002; Tobin et al., 2010). The authors of the gender self-socialization model were careful to advance their model as a set of hypotheses (e.g., identity construction hypothesis, stereotype emulation hypothesis). More research needs to test the model at different developmental periods (e.g., see Abrams et al., 2014; Patterson & Bigler, 2018) and using both implicit and explicit measures (e.g., Cvencek et al., 2016).

A third proposal is to incorporate several moderators into the model (see Fig. 6.1 for some suggestions). As I explained, children's self-concepts can be affected by their biobehavioral dispositions (e.g., temperament, intense interests) in ways that can be congruent or discrepant with gender-based expectations. Also, ingroup gender identities vary along dimensions such as centrality and felt typicality (e.g., Perry et al., 2019). Furthermore, the formation and activation of gender schemas partly depend on the salience of gender in the environment, available ingroup role models, and socialization (e.g., Bigler & Liben, 2007). Yet another moderator to consider in the model is how children may identify with more than their birth-assigned gender group. That is, children may view themselves as more typical of other-gender peers or typical of both same- and other-gender peers (Martin et al., 2017). Furthermore, children's identifications with other types of group identities (e.g., ethnicity/race) can additionally moderate their gender identity and gender expression (Mays & Ghavami, 2018).

Fourth, only a few studies have been conducted on children's intense interests. We know relatively little about the origins, prevalence, consistency, and developmental course of these interests. Evidence suggests variations in prenatal hormones may contribute to the development of some intense interests. For example, genetic females exposed to high androgen levels during prenatal development later exhibited higher levels of physical activity and interest in some masculine-stereotyped forms of play relative to comparison females (Berenbaum, 2018; Hines, 2018). Prenatal androgens are not necessarily related to variations in all intense interests, and other physiological (and environmental) processes may lead to the development of particular intense interests (e.g., see Hines, 2018; Theisen et al., 2019).

My fifth recommendation is to consider more fully the experiences of gender-nonconforming children in peer-group settings. Outside of clinical studies, few investigations of children's gender development have focused on children with transgender or other nonbinary identities. However, there is an increasing trend away from a disorder and deficit model and toward viewing these children as normal variations in human development (Dunham & Olson, 2016). This is analogous to the earlier shift in perspective toward acceptance of diversity in sexual orientation during development (Drescher, 2015).

Finally, developmental scientists are increasingly recognizing the need for intersectional and cultural approaches that take into account how gender and peer-group relations may be constructed in diverse sociocultural, economic, and power contexts within a society (Mays & Ghavami, 2018) as well as across different cultures (Best & Bush, 2016). Notably, researchers observed the adjustment difficulties often associated with gender nonconformity in many Western cultures were less prevalent in societies more accepting of gender nonconformity (e.g., Vanderlaan, 2018; Vasey & Bartlett, 2007).

As we better understand the origins and consequences of childhood gender segregation, multiple scientific and practical benefits are apt to follow. Many facets of development involve a complex combination of the kinds of physiological, socio-cognitive, interpersonal, and cultural processes implicated in gender segregation. By extension, advancing research and theory on gender segregation may prove useful for thinking about children's development more generally. Furthermore, as suggested at the outset of my chapter, research on gender segregation has practical implications for the improvement of people's lives. In particular, this work can inform practices to reduce the negative impacts of gender segregation (see Fabes et al., 2018; Leaper & Brown, 2014). These effects include the restricted opportunities to develop a broader range of interests and skills, the stigmatization of gender-nonconforming youth, and the perpetuation of sexism in adolescent and adult relationships. By overcoming these barriers, individuals will better actualize their potential. In turn, our society will be enriched.

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Spotlight Feature: Education Beyond Academics: Gender-Segregated Schooling and Students' Interpersonal Development

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Gender segregation is pervasive in various social contexts throughout the life span and has wide-ranging consequences in individuals' psychosocial development from attitude and value formation, maintenance of interpersonal relationships, to education and career inclination (for a review, see Mehta & Strough, 2009). In general, same-gender peer preference starts as early as age 2 years (Maccoby & Jacklin, 1987), peaks at school age, and declines from adolescence (Mehta & Strough, 2009) but continues to dominate one's friendships and social interactions even after entering adulthood (Mehta & Wilson, 2020). Prior research suggested that children's experiences in gender-segregated peer groups increase their tendency to engage in gender-typed behaviors and interactions which in turn contribute reciprocally to further gender segregation (Martin & Fabes, 2001).

While individuals have a spontaneous tendency to form themselves into same-gender groups, they are also subject to structured forms of gender segregation (e.g., schools, military, organized sports), of which single-sex schooling is most relevant to children's psychosocial development. Along with the recent revival of single-sex schooling, for example, in the USA (fueled by the 2006 amendment of Title IX) and in Shanghai, China (where all-boy classes are being advocated to restore masculinity in boys), there are increasing research interests and ongoing debates over the globe regarding the effects of institutionalized gender segregation in school contexts (Chiu, 2014; Halpern et al., 2011; Hernández, 2016; Liben, 2015; Pahlke et al., 2014). Many of the existing studies on single-sex schooling focused on academic outcomes (e.g., educational aspirations, performance and attitudes of different subjects), and found trivial to no differences between single-sex and coeducational school students after controlling for potential confounds such as students' initial performance and family socioeconomic status; gender stereotyping was also frequently studied but the findings were mixed and many of the studies were uncontrolled (see Pahlke et al., 2014 for a meta-analysis). The effects in interpersonal outcomes such as friendships and romantic relationships, however, have not been fully tested or understood.

Despite the insufficient support from scientific evidence, some of the major rationales for single-sex schooling draw on the claim that removing other-gender peers from the classroom is necessary because they would otherwise bring adverse influence on students' educational outcomes, and that segregating boys and girls can

protect students from other-gender distractions in the classroom (Bigler et al., 2014). Some educators and policy makers also think that single-sex schooling can prevent students from engaging in dating behaviors and romantic relationships prematurely when they should be focusing on studying (Bigler et al., 2014).

However, after graduating from single-sex schools, students will enter normative contexts that require mixed-gender interactions. For example, at college, they need to cooperate with other-gender classmates for group projects; at work, they need to build good relationships with other-gender colleagues or business partners; in daily life, they need to maintain mixed-gender friendships and intimate relationships with other-gender partners and/or family members. Experience of spontaneous or supervised mixed-gender interactions provides practice to learn the skills to properly and effectively interact with the other gender (Grover et al., 2007). Thus, compared to coeducational school students, the significantly reduced heterosocial experience in single-sex school students at school age, a critical stage of interpersonal development, may lead to challenges in the future, including difficulty fitting into mixed-gender groups, forming mixed-gender friend circles, or initiating and sustaining romantic relationships with other-gender partners; the lack of intergroup exposure may also result in misperceptions and thus stronger biases against the other gender (Grover et al., 2007).

Besides, students' beliefs about gender may be influenced by their observation of gender-based treatments in school policies and teacher behaviors. For example, the gender-segregated school context may implicitly give a hint to the students that boys and girls are inherently different to justify being educated separately (Halpern et al., 2011). The developmental intergroup theory (Bigler & Liben, 2007) proposed that intergroup biases develop from psychological salience of social attributes, which increases when the individual is in the minority group, when the group membership is noticeable, and when there is explicit or implicit use of group identity. Based on this theory, however, both single-sex and coeducational schools have certain characteristics that would increase students' gender salience, such as the gender labels commonly seen in the school names of single-sex schools and opportunities for teachers' different treatment to boys and girls in coeducational schools.

Thus, researchers, education practitioners and parents have concerned about how gender-segregated schooling affects students' gender salience, heterosocial anxiety, friendships, dating experience, and sexual orientation, and to what extent such effects will prolong after graduation. Some prior findings have given clues to these questions indirectly. For example, a study found girls in single-sex classes endorse less and react more slowly to feminine traits (which was taken to reflect lower gender salience) but another found higher gender stereotyping and pressure to conform to gender norms in single-sex school girls; having other-gender siblings was found to predict higher dating efficacy; single-sex school graduates were more likely to report lower marital satisfaction with higher divorce rate; and adults in single-sex environments reported more same-sex sexual behavior (see Li & Wong, 2018; Wong et al., 2018 for reviews). However, these studies either did not directly measure the interested outcomes or did not test the effects of gender-segregated schooling per se.

To fill this knowledge gap, a recent cross-sectional study (Li & Wong, 2018; Wong et al., 2018) compared such outcomes between Hong Kong Chinese students who were studying in or college students who graduated from single-sex and coeducational high schools. Potential confounding factors including parental income and education, school's academic banding, and the numbers of siblings were statistically controlled. Students attending single-sex schools reported higher gender salience (the spontaneous reference of gender when describing oneself) than those attending coeducational schools although no difference was found in the graduates (Wong et al., 2018). Similarly, in an ongoing longitudinal study of high school graduates (funded by Hong Kong Research Grants Council, General Research Fund, Grant No: 17610818), after balancing students' characteristics using a propensity score matching technique, we found that single-sex school students reported higher gender salience than coeducational school students in their final year of high school but not after graduation. Also, it was found in the cross-sectional study that both current and graduated students from single-sex schools reported higher levels of anxiety in mixed-gender interactions and a smaller proportion of other-gender friends than their coeducational counterparts, suggesting a potential long-term effect of school gender segregation on students' heterosocial anxiety and mixed-gender friendships (Wong et al., 2018). Besides, single-sex school graduates also reported having a larger proportion of same-gender close friends, higher levels of past same-gender sexuality, later onset of first date, and smaller number of boyfriends/girlfriends than coeducational school graduates although no significant difference was found in time spent with and preference for same-gender friends and in various dating activities (Li & Wong, 2018).

These findings provided important implications for future investigations of gender-segregated schooling. First, the differences in mixed-gender interpersonal outcomes between single-sex and coeducational school students call for a well-rounded consideration, not only of the academic performance but also of the social outcomes, in the evaluations of single-sex and coeducational schooling. Apart from acquiring academic knowledge, developing interpersonal skills and getting prepared for future challenges in life are also major developmental tasks for school-age children and adolescents. Schools likely provide a relatively safe environment for young students to learn the social scripts with higher tolerance for mistakes than the workplace. Second, the finding that students attending single-sex schools were more gender salient than those attending coeducational schools (Wong et al., 2018) implies that the structuralized gender segregation in schools may act as a hidden curriculum to convey subtle messages of gender concepts to students, which may further strengthen their gender stereotyped attitudes.

In sum, beyond academic training, schools should also be a place where students receive whole-person education and learn to work with different people regardless of their gender. The gender-segregated nature of single-sex schooling, however, may limit the opportunity for students to meet and interact with other-gender peers. Recent research has found that the gender-segregated school context is related to students' gender salience, heterosocial anxiety and friendship status. It may be beneficial for single-sex schools to provide more mixed-gender activities for

students to learn to build good relationships with peers of different genders. However, further investigation is required to attest how gender-segregated schooling affects other interpersonal outcomes and how long such effects last or whether the lack of exposure to other-gender peers in earlier years can be compensated by engaging in mixed-gender interactions after graduation.

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Chapter 7
Gender, Toys, and Play: How Gendered Early Experiences Shape Later Development

Erica S. Weisgram

Abstract Gender differences in children's play behaviors are large and consistent across the psychological literature. These play behaviors include children's toy interests, play styles, and peer preferences during play. Contemporary research has investigated the biological, social, and cognitive influences on children's gender-typed toy play including the role of prenatal androgens, parental and peer socialization, gender cognitions, and gender stereotypes. Contemporary research also suggests that children's gender-typed play behaviors may lead to gender differentiation throughout development. Specifically, the large differences in boys' and girls' play behaviors may lead to gender differences in children's physical, social, and cognitive development. Theoretical implications are discussed as well as limitations of the current literature that necessitate future research.

Keywords Gender · Children · Toys · Play · Gender roles · Gender stereotypes

Among young children, play is a predominant part of their leisure time and an essential part of their development. However, play is also a largely gendered experience with children demonstrating large gender differences in their toy interests and play styles (Martin et al., 2011; Weisgram & Dinella, 2018). Within the field of developmental psychology, specifically in the area of gender development, there is keen interest in the factors that lead to gender differences in children's toy interests and play as well as how these differences may lead to gender differentiation of children's cognitive, social, and biological development (see Weisgram & Dinella, 2018, for a review). Children's toy play is one of the first gender-typed experiences in which children engage first-hand, thus making this domain a heuristic for the study of other gendered behaviors, interests, and attitudes at an early developmental timepoint.

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The goal of this chapter is to provide an up-to-date review of the literature on children's gender, toys, and play and to organize the literature into a developmental theoretical framework. First, I will present a new theoretical model that represents the causes and consequences of children's gender-typed play. Then, I will discuss the research that represents the biological, social, and cognitive causes of gender-typed toy play. Following, I will discuss how gender-typed toy play may lead to gender differentiation of children's physical, social, and cognitive abilities. Lastly, I will discuss the complexity of the relationships outlined in this model and future directions of this area of study.

7.1 A Model of Gender Differentiation via Children's Gender-Typed Toys and Play

In examining gender-typed toy interests and play behaviors, two research questions characterize much of the literature: (a) What are the causes of gender differences in children's toy interests and play behaviors? and (b) What impact do these gender-differentiated interests and behaviors have on children's abilities, attitudes, and behaviors? Gender-typed toy interests and play behaviors are at the center of a biopsychosocial theoretical approach that includes biological, social, and cognitive causes *and* consequences of gender-typed play behaviors (see Fig. 7.1).

This model serves as a method of organizing the literature on the topic of children's gender-typed toys and play, but also illustrates the complexity of the topic. Although many scholars (including myself) studying the causes of gender-typed play behaviors may often take a particular biological, social, or cognitive perspective in their work, it is important to consider that these influences on children's gender-typed play are not mutually exclusive, but are simultaneously impacting children's toy interests, play styles, playmate choices, and other play behaviors (Weisgram & Bruun, 2018). Within each of these perspectives, there also may be multiple theories that are used to explain gender differences in children's play behaviors. In addition, play with certain toys or engaging in certain activities

Fig. 7.1 Model of gender differentiation via gender-typed toys and play

may simultaneously affect children's neural, social, and cognitive development. To add to the complexity, it is possible that there are "feedback loops" between components such that changes that arise as a result of gender-typed play behaviors may cause gender-typed toy interests and preferences in the future. For example, if playing with gender-typed toys increases children's endorsement of gender stereotypes, these gender stereotypes may subsequently lead to selection of gender-typed toys. As noted previously, this model helps to organize the literature and conceptualize the complexity of the topic, but it also will serve as a way of denoting where additional research is needed. For example, one area that is clearly needed is longitudinal research that simultaneously tests multiple pathways depicted here.

Before discussing each aspect represented in the model, it is important to expand on the central aspect depicted: gender-typed play behaviors. For the purpose of this chapter, I will consider gender-typed play behaviors to consist of (a) gender-typed toy interests, (b) gender differences in play style preferences and behaviors, and (c) gender segregation children during play.

7.1.1 Gender-Typed Toy Interests

Gender differences in children's toy interests are consistent and large with boys showing a large preference toward masculine toys and girls showing a large preference toward feminine toys (Davis & Hines, 2020; Farr et al., 2018; Todd et al., 2018). Toys that are considered traditionally masculine toys include vehicles, sports equipment, construction toys, toy weapons, and action figures and toys that are considered traditionally feminine toys include baby dolls, fashion dolls, domestic toys, and princess dress-up (Blakemore & Centers, 2005; Cherney & London, 2006). In fact, these categories of toys are labeled as "masculine" *because* of boys' greater interest and "feminine" due to girls' greater interest (as documented in the literature) and thus it is unsurprising that differences occur when examining these categories of toys (Blakemore & Centers, 2005; Cherney & London, 2006; Weisgram & Bruun, 2018). Some gender differences in children's toy interests have been found in infancy (Boe & Woods, 2018; Todd et al., 2017; Zosuls & Ruble, 2018), but gender differences are larger and more consistent in the preschool years (see Davis & Hines, 2020, and Todd et al., 2018, for meta-analyses). Recently, researchers have found a link between visual preferences in infancy and gender-typed toy interests in preschool children. Specifically, they note that visual preferences for masculine items in infancy (6 to 13 months of age) predicted interest in masculine-typed toys at age 4 years as reported by caregivers (Lauer et al., 2018). Future research should examine these links further into childhood and how environmental inputs may contribute to these links.

Studies within this area of research vary in their methodology and thus it is important to consider how gender-typed toy interests are assessed and in what contexts. For example, many studies interview children about their toy preferences by presenting toys or pictures of toys and asking about their preferences on an age

appropriate rating scale (Martin et al., 1995; Weisgram et al., 2014) whereas other studies have presented children with a variety of toys and observed how long children play with each toy (e.g., Berenbaum & Hines, 1992; Dinella et al., 2017). In one study that used both interview and observations with the same toys and similar samples, researchers found that children were more gender-typed in their self-reported preferences via interview than in their actual play duration (Dinella et al., 2017). In addition, researchers have assessed children's toy preferences and/or play behaviors through parent interviews (Weisgram & Bruun, 2018) and assessed infants' toy preferences with visual preference techniques (e.g., Lauer et al., 2018). Lastly, a few researchers have also had adults report on their childhood toy preferences or behaviors retrospectively (Voyer et al., 2000; Weisgram & Bruun, 2018). Each of these methods clearly has benefits and pitfalls and represent the varied methodology that is possible in this area of research (Davis & Hines, 2020).

It is also important to examine *context* in assessing gender-typed play behaviors. The presence of a parent or teacher has been shown to magnify the level of gender-typed play in some studies but not others (e.g., Goble et al., 2012; see Todd et al., 2018 for a review of observational studies). In addition, the presence of peers may affect children's gender-typed play behaviors (Goble et al., 2012). For example, Gobel and colleagues found that girls played less with feminine toys and more with masculine toys in the presence of boys than in solitary play and they also played less with masculine toys in the presence of other girls than in solitary play. In the same study, boys played less with feminine toys in the presence of other boys and less with masculine toys in the presence of girls. Children may also engage in different toys at home than in school or laboratory settings (Todd et al., 2018). Todd and colleagues found that boys engaged with more gender-typical toys in lab observations than in home observations. Despite these variations due to context and methodological approaches, robust gender differences in children's toy interests and play behaviors are present.

In this area of gender-typed play, there is also considerable research that is needed to fill in gaps in the literature. For example, some studies have been conducted in various countries (e.g., Nelson, 2005 [Sweden]; Servin et al., 2003; Wong & Hines, 2015 [England]; Yeung & Wong, 2018 [Hong Kong, China]), but little cross-cultural comparisons have been done of children's gender-typed toy interests, or even whether the same toys are gender-typed in the same way across cultures (Wong, 2018). In addition, it is informative, but not elegant, for researchers to consider interests in and attitudes toward individual toys (e.g., Blakemore & Centers, 2005; Davis & Hines, 2020; Weisgram & Bruun, 2018), yet more efficient and more generalizable for researchers to consider toys as part of categories (e.g., masculine toys, feminine toys) and thus future research should consider the merits and drawbacks of both of these approaches.

7.1.2 Gender Differences in Play Style Preferences

Play styles and interaction patterns during play can also differ by child gender. In her work, Eleanor Maccoby (1998) suggested that the play styles and interaction patterns of groups of boys and girls were so different that they produced "two cultures of childhood" (p. 32) and later gender differentiation. Children's play styles have been conceptualized in a number of ways in the literature, including activity levels, physical play, rough-and-tumble play, nurturing play, pretend play, and prosocial/cooperative play. Some research has suggested that boys are more active than girls (Finn et al., 2002; Pate et al., 2004; Riddoch et al., 2004; Trost et al., 2002), but a closer look at the literature suggests that contextual factors may play a role. For example, some research has found that when children are playing alone, there are no gender differences in activity level, but that boys are more active than girls when in the context of other boys (Halverson & Waldrop, 1973; Maccoby, 1998). In addition, enrollment in organized sports may play a role in gender differences in activity level as boys more often enroll in sports than girls (Vilhjalmsson & Kristjansdottir, 2003). Other research suggests that boys may engage in exercise play, play involving gross motor movements, more than girls particularly in preschool (Lindsey, 2014; Pellegrini & Smith, 1998).

Rough-and-tumble play may be one of the most gender-differentiated play styles. Rough-and-tumble play typically begins in preschool, increases through middle childhood, before decreasing in adolescence (Howe & Leach, 2018). Across numerous research studies, boys have been found to engage in rough-and-tumble play, including play fighting, more than girls throughout childhood (Colwell & Lindsey, 2005; Fabes et al., 2003; Lindsey & Mize, 2001; Moller & Serbin, 1996; Smith & Inder, 1993; see Rose & Smith, 2018 for review). In addition, Howe and Leach (2018) suggest that children's play styles may interact with the theme of children's play with action/adventure themes dictating more physical or rough-and-tumble play than domestic themes. It is yet unclear whether children choose these themes to accommodate their play styles, or whether the preferred themes lead to the play styles under investigation; further research on the dynamic link between the constructs is needed.

Other interaction patterns and play styles have received less research attention, but are also important to understanding children's gender-typed play behaviors. In general, girls spend more time talking in their peer groups than boys (Rose & Smith, 2018; Smith & Inder, 1993). Boys' play groups are also typically larger than girls' groups and are more likely to contain both friends and non-friends (Rose & Smith, 2018). Children are more likely to associate males with power and dominance in peer interactions and girls are less likely to see themselves in a powerful position in mixed gender groups than in single gender groups (Charafeddine et al., 2020). These findings, among others, suggest that the gender of the peer group strongly interacts with the play styles of the group members. Thus, gender segregation of children during play is strongly linked to the play style exhibited by children's peer groups.

There is considerably less research on children's play styles when children are playing alone or within the family context.

7.1.3 Gender Segregation of Children During Play

Gender segregation is a common feature of children's play behavior in childhood (Maccoby, 1998). Blakekmore et al. (2008) note that "playing primarily in same-sex groups and having friends who are predominantly the same-sex as oneself is one of the most robust differences between boys and girls across most if not all cultures in the world" (p. 305). Research has found that gender segregation is present across ethnic groups and cultures and typically begins around age 3–4 years (Halim et al., 2013; Munroe & Romney, 2006). Although girls may form segregated play groups earlier than boys, boys tend to be more strongly segregated than girls (Munroe & Romney, 2006). These primarily gender-segregated peer groups, along with gender-typed play styles and toy interests, contribute to the idea of "two cultures of childhood" as peer groups reinforce gender norms and stereotypes contributing to increasingly gender-typed play behaviors (Maccoby, 1998).

The intersection between gender-typed play styles and gender segregation has been the source of considerable research (Alexander & Hines, 1994; Leaper, 1994; Maccoby, 1998; Martin et al., 2011; Martin et al., 2013). Researchers have historically reasoned that children are attracted to other children who have the same play style—a hypothesis introduced as the behavioral compatibility hypothesis (Martin et al., 2011). However, recently, Martin and colleagues suggested that behavioral compatibility may be only one component leading to gender segregation with perceived similarity (i.e., similarity of interests and behaviors) being as important or even more important (Martin et al., 2011; Martin et al., 2013). In their work, Alexander and Hines (1994) developed a novel method for testing both hypotheses. In this study, they showed children two cards depicting gender-neutral drawings of target playmates (line figures) and gave each target a description that depicted a masculine or a feminine play style. Here, children most often chose the playmate described as having a similar play style to themselves. On another trial, they showed line drawings depicting male or female targets without information about play styles. Children most often chose the playmate who was depicted as the same gender as themselves. Lastly, in the "conflict conditions," the researchers showed the children male or female targets and gave a description of a cross-gender play style with each target (e.g., masculine play style with female target or feminine play styles with male target). In this case, children often chose the target whose play style matched their own rather than a target with the same gender identity as the participant (see also Pasterski et al., 2011). These studies indicate that there are factors other than gender identity that contribute to gender segregation, particularly behavioral and play compatibility. Future research should continue to examine the interaction between play style and gender segregation in both naturalistic and experimental designs.

7.1.4 Conclusion

Gender-typed play behaviors are well established in the psychological literature and well-documented aspects of children's play. Although much research examines gender-typed toy interests, play styles, and peer preferences as separate constructs, the complex interplay between these factors contributes to the "two cultures of childhood" and thus has implications for children's development throughout childhood and beyond.

7.2 Factors Shaping Children's Gender-Typed Play Behaviors

The model described previously (see Fig. 7.1) posits that there are multiple factors that contribute to gender-typed play behaviors. In the following sections, I will briefly review how factors from biological, social, and cognitive perspectives may contribute to gender-typed play behaviors (see also recent reviews by Dinella & Weisgram, 2018 and Wong & VanderLaan, 2020).

7.2.1 Biological Factors

The bio-evolutionary perspective suggests that gender-typed play behaviors may be evolutionarily programmed and/or influenced during prenatal development. Scholars who utilize this perspective suggest evolutionary explanations and biological underpinnings for gender-typed play behaviors because they: (a) are found to be present and similar across many cultures (as discussed previously), (b) may be present in infants and nonhuman primates, and (c) have been found to vary with prenatal or postnatal androgen levels.

From an evolutionary perspective, scholars suggest that many gender-typed behaviors have evolved as a result of the historical gender roles of men and women. For example, Alexander (2003) suggests that gender segregation by boys in early and middle childhood may have developed because of the utility of close bonds needed by adult males while hunting together. Others suggest that the play styles of males have evolved to include rough-and-tumble play as a way of establishing dominance over peers particularly in early adolescence mirroring dominance establishment in nonhuman primates (Pellegrini, 1995). In addition, Alexander (2003) argues that preference for gender-typed toys may have evolved as a result of visual processing biases that emerged as a result of the distribution of men and women into social roles. Thus, she states that "preferences for objects such as toys may indicate a biological preparedness for 'masculine' or 'feminine' gender roles" (Alexander, 2003, p. 7). Indeed, anthropological and historical research suggests that

children's toys in the pre-Industrial eras mimicked the tools used by men and women in their roles (e.g., toy chariots and weapons for boys; dolls for girls) although it is unclear whether these toy preferences (and perhaps other gender-typed play behaviors) are evolutionarily programmed or passed down by culture and imitation of same-gender models (Cross, 1997; Jaffé, 2006; Orme, 2001; Weisgram, 2018).

Innate tendencies for gender-typed toy preferences are often proposed as researchers note that gender-typed toy preferences may be present before the development of gender cognitions such as gender identity and gender stereotypes (Alexander, 2003; Todd et al., 2017). However, the literature on young infants' visual preferences for gender-typed toys is mixed and inconclusive (see Zosuls & Ruble, 2018 for a review). For example, one study found gender differences in visual preferences with boys showing significantly more fixation on a toy truck than girls ($d = 0.78$); girls fixated on the doll slightly more than boys ($d = 0.29$) but the difference was not statistically significant (Alexander et al., 2009). When considering within-gender differences of toy type, Alexander and colleagues found that girls looked at the doll significantly more than the truck ($d = 1.27$); boys also looked at the doll slightly more than the truck ($d = 0.39$) though this effect was not significant (Alexander et al., 2009; Alexander et al., 2010 Erratum). However, other studies with very young infants have shown no gender differences in visual preferences for specific toys (e.g., Campbell et al., 2000). Studies with infants over age 12 months have found greater consistency of gender-typed preferences in looking time paradigms (Campbell et al., 2000; Jadva et al., 2010; Serbin et al., 2001). Similar inconsistencies were found in observational studies (where children were reaching, touching, or playing with toys) involving young infants, but gender-typed preferences were found in older infants (Zosuls & Ruble, 2018).

From a bioevolutionary perspective, research with nonhuman primates has also suggested that sex-typed preferences may possibly be found that mirror those of humans, though few of these studies have been conducted (Wallen & Hassett, 2009). In one study, Alexander and Hines (2002) presented vervet monkeys with masculine toys (police car, orange ball), feminine toys (red pot, doll), and neutral toys (books, stuffed animals) and assessed the amount of contact time with each toy. They found that male vervet monkeys have more contact time with masculine toys than females and females had more contact time with feminine toys than males (there were no sex differences for neutral toys). Within-sex comparisons showed that female monkeys preferred feminine toys to masculine toys, though no effect of toy type was found for males. Approach time for each toy was also assessed and no sex differences were found; this finding was unsurprising given that "approach" was defined as getting close without contact with the toys. In a more recent study, Hassett et al. (2008) also found some evidence of sex-typed preferences in nonhuman primates. They presented rhesus monkeys with 6 different wheeled toys (e.g., dump truck, shopping cart, truck, car, construction vehicle) and 6 different plush toys (e.g., doll, turtle, armadillo, teddy bear); it is noteworthy that this study approximated masculine and feminine toy categories, but included other items that researchers may consider gender-neutral within their toy types (Hines & Alexander, 2008). Unlike Alexander and Hines, Hassett and colleagues did not find any between-sex differences in

frequency or duration of play for either toy category. For within-sex comparisons of both the frequency and duration of play, males interacted with wheeled toys significantly more than plush toys; there was no significant effect of toy type for females. Although there are few studies on nonhuman primates' toy preferences, these studies offer interesting insights and comparisons to research with human infants and children, but to establish consistent findings, further research in this area is needed (Hines & Alexander, 2008).

Researchers are also examining the role of hormones in gender-typed play behaviors (see Hines & Davis, 2018, for a review). For examples, studies in which nonhuman female primates were exposed to high levels of testosterone prenatally, they exhibited greater rough-and-tumble play behaviors later in life, although dose and timing have been shown to mediate the effect (Thornton et al., 2009). Some studies have found that maternal testosterone in humans may relate to girls' masculine behaviors in preschool (Hines et al., 2002), though other studies with toddlers have found no relationship (van de Beek et al., 2009). In addition, one study found that testosterone in maternal amniotic fluids predicts masculine play behaviors in male and female children (Auyeung et al., 2009), but other studies have not replicated this effect (Constantinescu & Hines, 2012, for a review). Difficulties measuring hormones may contribute to inconsistent results found in these studies (Constantinescu & Hines, 2012). Recent studies have found that postnatal testosterone in the first 6 months is correlated with children's gender-typed play behaviors in preschool (Lamminmäki et al., 2012; Pasterski et al., 2015).

One of the most consistent research findings from the biological perspective is that girls who are exposed to excess amounts of androgens prenatally due to a genetic condition called congenital adrenal hyperplasia (CAH) are more likely to exhibit masculine-typed play behaviors than their unaffected sisters or age-matched female peers (see Berenbaum, 2018, and Hines & Davis, 2018, for reviews). In this body of literature, girls with CAH have been reported to show increased interest in masculine toys compared to their peers or unaffected sisters (Berenbaum & Hines, 1992; Berenbaum & Snyder, 1995; Servin et al., 2003; Wong et al., 2013). In addition, girls with CAH often have a more masculine play style including increased activity levels, aggression, and rough-and-tumble play (Pasterski et al., 2007; Spencer et al., 2017). Girls with CAH are also less gender-segregated in their play groups and friendships than unaffected girls and were more likely to choose a boy for a best friend (Hines & Kaufman, 1994; Pasterski et al., 2011; Servin et al., 2003) and interest in male-typed activities has been shown to mediate the relationship between CAH and gender-segregated peer groups (Berenbaum et al., 2018; Pasterski et al., 2011). Although girls with CAH consistently show elevated masculine-typed play behaviors compared to unaffected peers or relatives, their play behaviors are often still less masculine than boys with CAH or typically developing boys perhaps due to androgen levels that are not as high as in typical boys or due to environmental messages girls receive (e.g., Hines et al., 2004; Wong et al., 2013).

The role of prenatal androgens is most clearly shown in studies on girls with CAH, yet scholars in this area also recognize the importance of social and cognitive factors in children's gender-typed play behaviors (Hines & Davis, 2018). For

example, researchers have examined the interaction between CAH and parent socialization with one study finding that parents gave more positive feedback to girls with CAH when a feminine toy was chosen (Pasterski et al., 2005) and another, more recent study finding that parents encouraged girls with CAH to engage with masculine toys more than unaffected peers, possibly exhibiting encouragement in response to these girls' preferences for masculine toys (Wong et al., 2013). In addition, researchers have examined the relationship between CAH and cognitive constructs such as dimensions of gender identity and gender attitudes (Berenbaum et al., 2018; Endendijk et al., 2016; Hines et al., 2016). Indeed, although researchers in this area recognize the role of hormones in gender-typed behavior, they also recognize the powerful roles of socialization and gender cognitions as the model presented previously also suggests (Berenbaum, 2018; Hines & Davis, 2018).

7.2.2 Social Factors

Socialization is a primary mechanism contributing to children's gender-typed toy play. Within the socialization perspective, there are many social agents that have been demonstrated to influence children's gender-typed play including parents, siblings, peers, and media and marketing (Brown & Stone, 2018). Societal gender roles have influenced these social agents and reflect historical gender roles. However, it is possible that gender roles and stereotypes are becoming more egalitarian over time as we move through the fourth wave of the feminist movement in the United States. Overall, adults in developed Western countries have been shown to endorse low levels of stereotypes in recent years, although men endorse more stereotypes than women and adults endorse more stereotypes about feminine toys than masculine toys (Endendijk et al., 2014; Freeman, 2007; Weisgram & Bruun, 2018).

Parents and siblings are the primary social agents for children in early child development. In the areas of toys and play, family members often are the primary purchasers of toys for children and are children's first playmates. They are also children's primary models of adult roles which may affect the themes of children's pretend play. Thus, the gender-typed beliefs and behaviors of family members are important contributing factors to children's gender-typed play behaviors. Research suggests that parents are more likely to offer gender-typed toys during play (Wood et al., 2002), be more positive when interacting with toys that are stereotyped for their child's gender (Caldera et al., 1989), and purchase or select gender-typed toys for their children (Etaugh & Liss, 1992; Fisher-Thompson, 1993; Kollmayer et al., 2018; Weisgram & Bruun, 2018). These stereotyped behaviors are more likely to be present for sons than for daughters. Also, fathers are more likely to present children with gender-typed toys than mothers or hold gender stereotyped attitudes about toys (Kollmayer et al., 2018; Langlois & Downs, 1980). Parents' endorsement of gender stereotypes of toys may mediate these effects and parents' own gender-typed play as a child has been found to be predictive of the likelihood they will purchase

gender-typed toys for their own children (Kollmayer et al., 2018; Weisgram & Bruun, 2018).The toys children have in their home settings may influence preferences in laboratory observations with preferences mirroring the toys found at home (Boe & Woods, 2018). In addition, parents are more likely to engage in rough-and-tumble play with sons than with daughters and fathers are more likely to engage in rough-and-tumble play than mothers (Lindsey & Mize, 2001; Paquette et al., 2003). Parents are also more likely to engage in pretend play with daughters than with sons (Lindsey & Mize, 2001). Research on parents' influence on children's gender segregation has been limited.

Although parents often promote gender-typed play behaviors in children, some research suggests that the parents could be purchasing or offering gender-typed toys based on their children's gender-typed interests (Weisgram & Bruun, 2018; Wong et al., 2013). Thus, reciprocal socialization between parents and children is possible. In addition, children may be engaging in gender-typed behaviors because they perceive that their parents, particularly fathers, would disapprove of cross-gender-typed behaviors (Freeman, 2007; Raag & Rackliff, 1998). Further research on the nature of these bidirectional relationships between parents and children is needed in the literature and can contribute to a family systems model of gender development (McHale et al., 2003).

Siblings have also been shown to have an impact on children's gender-typed play behaviors, although considerably less research has been done in this area compared to that with parents. Specifically, research has found that children with older brothers had more masculine play behaviors (Rust et al., 2000). In addition, boys with older sisters were found to have more feminine play behaviors and girls with older sisters were found to have less masculine play behaviors than their peers. It is possible that older siblings socialize younger siblings through initiating and organizing play (Raag & Rackliff, 1998), and it is also possible that children will play with the toys that belong to older siblings or are passed down from older siblings, thus affected their own gender-typed preferences. Further investigation into direct and indirect sibling influences is needed as well as the influence of other family members such as grandparents, aunts/uncles, and cousins, some of whom may be purchasing toys for children.

Peers are another primary social agent for children, especially when they enter preschool and elementary school. As noted earlier, children spend much of their time in gender-segregated play groups (Fabes et al., 2003; Maccoby, 1998). These gender-segregated groups may be formed based on behavioral compatibility and/or perceived similarity to other group members (Martin et al., 2011). Thus, children may choose to play with same-gender children because they have similar gender-typed play styles, like the same gender-typed toys and games, or have similar perceived communication styles (Martin et al., 2011; Xiao et al., 2019). However, gender segregation may also serve to increase gender-typing among children. Brown and Stone (2018) note that children may increase in their gender-typing in regard to toys and play as a result of gender-segregated play: (a) to maintain their membership in the group, (b) to appear gender-typical to their peers, and (c) to gain reinforcement (or avoid punishment) from their peers.

Media and advertising are also social agents that impact children's gender-typed play behaviors. Mechanisms utilized by media and advertising often include the use of: (a) explicit gender labels, (b) implicit labels via gendered modeling, and (c) implicit labels via gender-typed colors. Research suggests that advertising has gotten more gender-typed over time by utilizing these mechanisms in order to advertise to a target market and maximize profits (Fine & Rush, 2018; Orenstein, 2011; Sweet, 2014). Explicit gender labels used in research have been shown to affect children's interest in novel toys (Martin et al., 1995; Weisgram, 2016). Wording on packaging (i.e., Tonka brand's former tagline "Built for boyhood") or placement on shelves labeled "boys" and "girls" may have similar effects. Gendered models are also important cues that can shape gender stereotypes and behaviors (Kahlenberg & Hein, 2010) with stereotypic models reducing gender flexibility and counterstereotypic models increasing gender flexibility about toys (Spinner et al., 2018). In addition, engagement with gender-typed media (i.e., Disney princess) has been associated with gender-typed toy behaviors (Coyne et al., 2016). Lastly, gender-typed colors have been shown to be important cues in determining children's interests (Weisgram et al., 2014; Wong & Hines, 2015). These color cues are often featured prominently in children's toy advertising (Auster & Mansbach, 2012). These explicit and implicit cues used in advertising and media can contribute to children's gender-typed toy interests by way of various cognitive factors.

7.2.3 Cognitive Factors

As they move through early childhood and beyond, children develop several gender cognitions about toys and play. These cognitions can include gender schemas, gender stereotypes, and essentialist beliefs about gender. Gender essentialist attitudes have also been recently examined in regard to children's toy play (Meyer & Gelman, 2016; Taylor et al., 2009; Weisgram & Bruun, 2018). Essentialist beliefs or attitudes are those that suggest that gender differences are based more on biological factors than environmental factors. Research suggests that older children are less likely than younger children to endorse essentialist attitudes about children's gender-typed behavior including toy play (Taylor et al., 2009). These essentialist attitudes have been shown to predict children's gender-typed play activities (Meyer & Gelman, 2016). In examining adults' gender essentialist attitudes about toys specifically, Weisgram and Bruun (2018) found that adults believed that gender differences in children's toy interests were primarily environmentally based. These beliefs were stronger for masculine than for feminine toys but they did not predict adults' retrospective childhood toy interests.

Gender schemas have been featured prominently in the literature about gender and toys as they encompass beliefs about "who usually" (gender knowledge) and "who should" (gender stereotypes) play with each toy type and are often linked to children's interests (Blakemore & Centers, 2005; Cherney & Dempsey, 2010; Freeman, 2007; Hupp et al., 2010; Martin & Dinella, 2012; Martin et al., 1995;

Raag, 1999; Weisgram, 2016). These gender schemas and stereotypes can form as a result of direct instruction, direct or indirect shaping, or observation (Bussey & Bandura, 1999); motivation to categorize items as "own-gender" or "other gender" items (Martin & Halverson, 1981; Martin et al., 1990); or potentially as a result of one's own interest or experience with toys or play behaviors (Liben & Bigler, 2002; Weisgram, 2016). Some research suggests that children's endorsement of gender stereotypes about toys may be independent of parents' beliefs (Freeman, 2007). In addition, children's stereotypes about masculine toys may be more rigid than stereotypes about feminine toys especially among boys (Henshaw et al., 1992; Skočajić et al., 2020; Weisgram et al., 2014). Gender stereotypes about children's playmates and play behaviors have been found to influence peer preferences and enforcement of gender segregation, but have received relatively little attention in the literature compared to toy interests (Xiao et al., 2019; Peplak et al., 2017).

Several cognitive theories of gender development suggest that gender cognitions are influential in determining gender-typed toy interests and play behaviors (Martin & Cook, 2018). Gender schema theory suggests that children are motivated to classify toys and play behaviors in terms of masculine or feminine gender schemas (i.e., gender knowledge and stereotypes) and then use these schemas to drive their own interests and behaviors (Martin & Halverson, 1981, 1983). Thus, if a child identifies as a girl and believes fashion dolls to be appropriate for girls, she will be interested in playing with the toy. However, if a child identifies as a boy and believes fashion dolls to be appropriate for only girls, he will avoid playing with the toy. Extending gender schema theory, Liben and Bigler's (2002) attitudinal pathway model suggests that gender schema theory applies to gender schematic children (i.e., those that endorse and utilize many gender stereotypes) but not gender aschematic children (i.e., those that do not endorse or utilize many gender stereotypes). Social cognitive theory suggests that social agents influence children's gender-typed play behaviors through direct tuition, modeling, and external sanctions (Bussey & Bandura, 1999). Following, children impose self-sanctions on their own behavior in which they avoid cross-gender-typed play behaviors and develop self-efficacy for gender-typed play behaviors, both of which increase gender-typed play behaviors in children. Lastly, the personal pathway model of gender development reconsiders the relationship between gender cognitions and gender-typed interests (Liben & Bigler, 2002; Weisgram, 2016). This model posits that children may derive their gender stereotypes and schemas from their own interests such that they form gender-inclusive stereotypes for items in which they are interested and gender-exclusive stereotypes for items in which they are not interested. Research with novel toys suggests that this is a viable theory (Weisgram, 2016), but further research is needed.

7.2.4 Conclusion

The model presented earlier suggests that biological, social, and cognitive factors are influential in shaping children's gender-typed play behaviors. Research supports

each of the pathways predicting these behaviors, however, the intersection of these factors has not been fully investigated and the multidimensional predictors of gender-typed play behaviors should be concurrently investigated to a greater extent.

7.3 The Impact of Gender-Typed Play Behaviors

The model of gender-typed play behaviors presented earlier not only examines influences of gender differences in play behaviors, but also the impact that gender differences in these play behaviors may have on children's development. This multidimensional model specifically posits that there may be influences of children's gender-typed play behaviors on children's physical, social, and cognitive development. Here, I will briefly discuss these pathways and the research that has been recently conducted investigating the role of gender-typed play behaviors on children's development.

7.3.1 Impact on Physical Development

Gender-typed play behaviors may have an impact on several areas of physical development including brain and physical development. In her work, Eliot argues that gender-typed play behaviors may lead to gender differentiation in the brain via experience-dependent plasticity mechanisms (Eliot, 2009, 2018). However, she notes, "the effects of gender-typed play on the brain are thus largely unknown at present. Nonetheless, it is possible to extrapolate from a broader understanding of brain development to the likely divergence of brain and skill maturation through gender-differentiated play" (Eliot, 2018, p. 169). The effect of environmental stimuli on brain development is well documented among animal models and humans (Perry, 2002). Because children's environments can differ greatly by gender in terms of the activities in which one is engaged and the toys with which one plays, it is plausible that gender differentiation of the brain structures or connections occurs. Further research supporting these specific premises is clearly needed. The effects of gender-differentiated play on children's physical development has been investigated in recent research. Boys' greater physical activity level is predictive of their gross motor skills (Laukkanen et al., 2014). Gender differences in children's and adults' sports participation have been linked to gender differences in physical throwing abilities. Specifically, gender differences in throwing performance (both speed and accuracy) are consistently favoring boys, but recent research has shown that female participants who have athletic experience in sports involving throwing demonstrate similar abilities to male participants in adolescence and beyond (Crozier et al., 2019). Further research on the effects of children's gender-typed play behaviors on other areas of physical development is also needed.

7.3.2 *Impact on Social Development*

Gender-typed play behaviors also impact various aspects of children's social development. Research suggests that masculine and feminine toys are perceived to be associated with different concepts within the area of social development (Blakemore & Centers, 2005; Murnen, 2018). Specifically, feminine toys are perceived by adults to be associated with children's nurturing skills and appearance-related behaviors while masculine toys are perceived by adults to be associated with aggressive behaviors (Blakemore & Centers, 2005). The attributes that masculine and feminine toys afford may impact children's social behaviors throughout childhood and into adulthood. For example, Connor and Serbin (1977) found a positive correlation between masculine play and parallel/cooperative play with other boys. In her recent work, Wong found a link between feminine play and comforting skills among girls as well as a marginal association with empathy (Li & Wong, 2016; Wong & Yeung, 2019). Surprisingly, this work uncovered a negative correlation between feminine play behavior and empathy in boys—a link that should be explored further in additional research (Wong & Yeung, 2019). Wong and Yeung (2019) also found that masculine play has been linked with aggression among 5-year-old boys (but not girls). Few longitudinal studies have been conducted to examine the stability of the associations discussed here, although recent longitudinal research has linked masculine play behavior in young children (boys and girls ages 3.5 years) to aggression in adolescence (Kung et al., 2018).

As noted earlier, research with specific gender-typed toys, rather than broad categories, may yield important findings as well. For example, research by Coyne et al. (2016) found that engagement with princesses, including play with princess toys, predicted other feminine-typed behaviors among girls and prosocial behaviors among boys. Caldera and Sciaraffa (1998) have also linked play with baby dolls with young children's nurturing behaviors. An extensive amount of research has explored the link between play with violent video games, a male-typed play behavior, finding positive associations with children's aggression and negative associations with children's prosocial behaviors (see American Psychological Association Task Force, 2015, for a review). Play with toy weapons has been associated with aggressive behaviors in children (Hellendoorn & Harinck, 1997; Watson & Peng, 1992) but not in adolescence (Smith et al., 2018). Studies such as these illustrate the need to examine gender-typed toys both in aggregate (e.g., feminine, neutral) and in terms of individual items.

Gender segregation and gender-typed play styles may also lead to gender differentiation of social skills (Leaper, 1994; Maccoby, 1998). Among boys, playing in all-male groups may lead to an increase in aggressive behavior which can lead to elevated social status among adolescent boys (Molano & Jones, 2018; Pellegrini, 1995). Boys may socialize each other within gender-segregated groups to be more assertive by being more inclusive of assertive children than less-assertive children while girls may socialize each other to be less assertive by excluding highly assertive girls (Sebanc et al., 2003). Girls may also socialize each other to engage in prosocial

behaviors as these behaviors contribute to girls' (but not boys') popularity (Hsiao et al., 2019). Research has found that gender-typed communication styles are more prevalent within single-gender groups than within mixed-gender groups (Leaper, 1991). These communication styles may be influenced by boys' and girls' typical group sizes. Brown (2014) suggests that girls' smaller peer groups may lead to more advanced interpersonal skills and boys' larger peer groups may lead to greater independence and assertiveness in behavior and communication, hypotheses that need further research to be tested.

7.3.3 Impact on Cognitive Development

The impact of gender-typed play behaviors on children's cognition has been studied to a greater extent than the impacts on children's social or biological development. In a classic study by Connor and Serbin (1977), the authors proposed that play with masculine toys could lead to gender differentiation of cognition, specifically in the area of spatial cognition. Recent research has established this link among boys, but not among girls (Wong & Yeung, 2019). In addition, research by Voyer et al. (2000) found that retrospectively reported play with spatial toys (considered in aggregate) was more common in men than women, and that reported play with spatial toys as a child (e.g., blocks, cars, Lincoln logs, model kits) was a significant predictor of adults' spatial skills. Considering other cognitive domains, scholars suggest that girls' greater verbal skills may be enhanced by dramatic play with feminine toys and play in smaller groups (Brown, 2014; Eliot, 2009) although a greater amount of research is needed to support these hypotheses.

Research with specific toys has shown links to gender-differentiated cognitive skills. In general, a wide variety of research has been published regarding spatial skills compared to other cognitive abilities perhaps because spatial abilities afford greater gender differences than other cognitive abilities or because they are more malleable (Liben et al., 2018; Uttal et al., 2013). Research has linked boys' greater play with blocks and construction toys as well as video games to enhanced spatial skills in both correlational and experimental studies (Caldera et al., 1989; Casey et al., 2008; Jirout & Newcombe, 2015; Nath & Szücs, 2014). Although mathematics skills are not gender-differentiated, research has shown numerous links between block play and mathematical skills (Nath & Szücs, 2014; Verdine et al., 2014) although experimental research on this topic is limited. Gender-neutral toys such as puzzles, board games, and card games are also positively linked to children's spatial and mathematical skills (Jirout & Newcombe, 2015; Laski & Siegler, 2014; Levine et al., 2012; Siegler & Booth, 2005). The gendered nature of a toy (i.e., whether it is marketed toward boys or girls) can also impact one's spatial or mechanical skills developed through use of the toy (Coyle & Liben, 2020; Fulcher & Hayes, 2018; Wong & Yeung, 2019). For example, in a study focused on spatial tasks, Fulcher and Hayes (2018) found that children took longer to build feminine objects with masculine-colored LEGO bricks than with feminine-colored bricks. The

impact of gender-segregated play on children's cognitions has not been thoroughly documented although some suggest that smaller groups may lead to increased verbal skills among girls and use of larger space could enhance spatial skills among boys (Eliot, 2009).

In addition to discussing traditional cognitive abilities, it is worthwhile to also discuss the impact of gender-typed play behaviors on children's gender cognitions. For example, researchers have shown that the more children play in gender-segregated groups, the more gender stereotypes they endorse about others (Martin & Fabes, 2001). In addition, one's own play with gender-typed toys can lead to the cognitive construction of stereotypes about others (Weisgram, 2016) and increased interest in gender-typed activities (Coyle & Liben, 2016). Gender-typed toy interests in childhood are also linked to gender essentialist beliefs about toys (Weisgram & Bruun, 2018) although the direction of effects or presence of a potential third variable should be explored.

7.3.4 Conclusion

The impact of children's play on their biological, social, and cognitive development has been demonstrated across domains (Singer et al., 2006) and an increasing amount of research is being conducted to test whether gender-differentiated play behaviors lead to gender differences across development. Although there is a theoretical basis for play-based gender differentiation (Brown, 2014; Eliot, 2009), there are many areas in which empirical evidence is lacking and needed. In addition, research with specific toys and play behaviors may be more informative than research on gender-typed play interests in aggregate (e.g., feminine toys, masculine toys) as the mechanisms of development may be more clearly identified. Lastly, many of these studies are correlational and/or longitudinal in design and thus high-quality experimental research is needed to determine causal pathways suggested in the model presented earlier (see Fig. 7.1).

7.4 General Conclusions

Gender-typed play behaviors are prevalent in children's development. In this work, I note that there are biological, psychological, and social causes impacting children's gender-typed play behaviors as well as consequences of these behaviors for children's physical, social, and cognitive development. The model described previously illustrates the various pathways between the constructs as well as the complex, multidimensional relationships among the constructs of interest. I suggest that researchers continue to explore these pathways, especially those pathways with limited previous research, as well as investigate the complex interplay of these factors in regard to children's gender-typed play behaviors. An additional area of

investigation is the idea of potential feedback loops between the consequences and the causes of gender-typed play behaviors. These feedback loops are somewhat reflected in the "bent twig" theory (Sherman, 1978; Voyer et al., 2000). The "bent twig" theory suggests that some children may have an innate skill that draws them to a particular toy or activity. Play with this toy or engaging with this activity may, in turn, enhance this same skill. For example, children who have innately advanced spatial skills may choose toys that afford spatial skills such as LEGOs. Play with LEGOS, in turn, also may enhance spatial skills in the future (leading to further interest in LEGOs). Longitudinal and experimental research is needed to disentangle these relationships.

In this area of gender development, and across the developmental psychology as well, there is a great need for further understanding of developmental pathways within diverse populations. In her work, Olson has examined gender cognitions among transgender and gender nonconforming youth, often in the context of toys and play finding that transgender youth are similar to same-gender cisgender youth in their gender cognitions and behaviors (e.g., Fast & Olson, 2018; Olson et al., 2015). Recently, Wang Ivy Wong has noted the "Eurocentric" nature of the research on children's toys and play and called for an increased focus on children from non-Western, and non-US cultures (Wong, 2018; Wong & Yeung, 2019). In addition, as the field considers intersectionality to a greater degree, we need to be concerned with how developmental pathways and pathways between constructs may differ within several intersectional social identities simultaneously (Shields, 2008).

As this volume considers the field of gender development more broadly, it is also important to highlight the implications of this specific topic to the field and to psychology as a whole. Because of children's extensive knowledge and experience with toys and play (and perhaps relatively little knowledge about other domains such as occupations, activities, and traits), this domain is ideal for testing broad theories of gender development, testing theories across developmental psychology, assessing gender cognitions, and exploring the development of gender cognitions and behaviors in young children. Thus, explorations of gender-typed play behaviors can serve as a heuristic for further exploration of the biopsychosocial contributions to gender differences; the cognitive construction of stereotypes, interests, and beliefs; the constructivist nature of children's development through their own interests and experiences in early childhood; and the contextual factors that may contribute to gender differentiation throughout the life span.

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Chapter 8
Family Gender Socialization in Childhood and Adolescence

Olivenne D. Skinner and Susan M. McHale

Abstract Toward illuminating the family ecology of gender development, we focus on the parent-child, interparental, and sibling subsystems, examining their influences on youth gender development across childhood and adolescence. We discuss structural factors, such as sibling and couple sex constellation, but focus primarily on family members' roles as interaction partners, models of gendered behaviors, and providers of information and opportunities pertaining to gender, all of which may influence the many domains of youth gender development. We ground our discussion in family systems and cultural ecological frameworks, which led us to interpret existing evidence in terms of the adaptive, self-organizing nature of families, and the embeddedness of youth gender development and family gender socialization in gender norms beyond the family including sociocultural factors and economic conditions.

Keywords Gender · Gender socialization · Family processes · Gender development

The family is a key context for gender socialization (McHale et al., 2003). Experiences within the family inform the multiple domains of gender development and teach children the gender norms of their culture. The multidimensional nature of gender complicates research on family gender socialization, however, because each dimension may be subject to different socialization influences. In addition, just as family structure and processes are not static, youth's gender-typed characteristics change over time (Crouter et al., 2007; Skinner & McHale, 2018). Further, both youth gender development and family socialization are embedded in gender norms of the larger world beyond the family, such as peer groups, schools, and communities.

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Added to this complexity, families vary in their sociocultural characteristics, including race/ethnicity, social class, and immigration status. Although little studied, the sociocultural contexts in which families are embedded have implications for how gender is constructed. And, sociocultural forces also create diversity in family gender dynamics, with implications for what children and adolescents learn about gender. For instance, the legacy of slavery in the USA coupled with current structural inequalities in domains ranging from education to healthcare have contributed to many single mothers heading African American families and assuming the roles of both nurturer and primary breadwinner. This has implications for childrearing practices, family roles and responsibilities, resources, and ultimately what children learn about gender. In contrast, in the face of more egalitarian norms in the USA and other Western countries, some immigrant families maintain cultural values and practices of their origin country that support distinct roles for men and women (Suárez-Orozco & Qin, 2006).

A relatively small empirical literature documents that family processes contribute to both sex differences and individual differences in gender development (Endendijk et al., 2018; McHale et al., 2003). These family processes include family members' gendered behaviors that are modeled and reinforced in everyday interactions, deliberate instructions about gender roles and behaviors, and the provision of opportunities for developing gender-typed knowledge and skills (Parke & Buriel, 1998). We discuss such family socialization processes in the following pages. Consistent with some prior reviews (e.g., Endendijk et al., 2018), we ground our discussion in a family systems framework, emphasizing the adaptive, self-organizing nature of families as open systems that adapt to change and challenges in the larger environment (Cox & Paley, 2003). We add to prior literature by focusing on the relatively neglected topic of sociocultural factors in family gender socialization, applying ideas from cultural and ecological perspectives (Bronfenbrenner & Morris, 2006; Garcia-Coll et al., 1996). These perspectives direct attention to cultural values and practices within families as well as to the embeddedness of families in the larger cultural, social, political, and economic contexts. Ecological models also highlight the role of individual characteristics, including the role of youth as active agents in their own development and how youth characteristics interact with family processes and contextual characteristics in development. In this chapter, we highlight the experiences of groups within the USA defined by particular gender and race/ethnicity categories, recognizing that the intersections of these social positions create distinctive experiences that influence family gender dynamics and socialization (Cole, 2009).

Toward illuminating the ecology of family gender socialization, in the following sections, we focus on three family subsystems—the parent-child, interparental, and sibling subsystems. We consider structural factors, such as sibling and couple sex constellation, but focus largely on several domains of family processes: family members as interaction partners, models of gendered behaviors, and providers of information and opportunities pertaining to gender. Although gender development occurs across the life course, because of limited research on family gender

socialization after the first two decades of life, we focus primarily on the family context of gender development in childhood and adolescence.

8.1 Parenting and Gender Development

Parents enter their roles with diverse gender-typed characteristics, preferences, and ideologies that may influence children's gender development through a number of processes. These processes range from those grounded in genetic factors to social learning via modeling, including in their relationships with other family members (e.g., with a spouse; with a sibling of the other sex), to more active and direct socialization activities such as in parents' roles as instructors and opportunity providers. We begin with a discussion of these mechanisms; however, it is important to note that socioeconomic status, race/ethnicity, immigration status, and experiences related to these social positions also underlie parents' roles, behaviors, and socialization activities in the family. These sociocultural factors mark opportunities and resources—but also constraints and challenges to parents' capacities to pursue their goals and enact their values in everyday family life. Although parents may prefer gender stereotypical roles for fathers as breadwinners and mothers as caregivers, for example, economic pressures, including those grounded in racial/ethnic discrimination or economic disadvantage, may require mothers to instead take on the breadwinner role.

8.1.1 The Role of Genetics in Parents' Gender Socialization

For parents raising their biological children, their influences include those tied to genetic factors, ranging from prenatal hormone exposure to pubertal timing and body build, and should not be ignored in discussions of parents' role in youth gender development. The role of genetics in developmental processes has been described in terms of three ways in which genes influence children's environments (Scarr & McCartney, 1983). First, via passive-gene environment correlations, biological parents provide environments that are correlated with the child's genotype as when, for example, parents who are more physically coordinated have children who also display better motor skills. A second pathway is through children's evocative effects, such as when children with large and strong statures are recruited into athletic activities in which their body type may help them excel. Later in their development, their increasing autonomy means that youth can actively choose niches that fit the characteristics they have developed—such as by trying out for a sports team—the third process through which genetic factors have implications for children's environments.

Applied to youth gender development, parents' genetic make-up has implications for children's environments as when parents and children are similar in their

gendered interests and skills—for instance, in playing sports versus literary pursuits. In families with highly stereotypical parents, socialization pressures toward stereotypicality may mean that parents' genetically based dispositions are realized only in same-sex children. In less stereotypical families, however, parents' dispositions may be promoted in a same-sex child as well as a child of the other sex—such as a daughter who is genetically disposed to be tall and agile taking after her basketball-playing father. In turn, this daughter will create further socialization experiences for herself through niche-picking processes, such as by her choice of free time activities and peers with shared interests in basketball.

As children develop, their emerging characteristics**,** stemming from niche-picking and evocative processes, may further promote gender development trajectories. For example, the timing and physical changes of puberty, which are in part physiologically (genetically) based, may be an impetus for parents to intensify their gender socialization—such as by granting more autonomy to sons and increasing their protectiveness toward daughters (Hill & Lynch, 1983). Importantly, intersectionality between gender and race/ethnicity is evident in the timing of pubertal development, with African and Mexican-American girls reaching menarche and attaining sexual maturity in some areas (e.g., breast development) a few months earlier than their White American counterparts, and African American boys exhibiting sexual maturity earlier than White boys (Chumlea et al., 2003; Susman et al., 2010). Gender norms that proscribe autonomy-granting for boys may help to explain findings that more physically mature, low-income, urban boys were monitored less by their parents—although such parenting practices may put these boys at risk factor for delinquency and other problem behaviors (Cunningham et al., 2003). More generally, individuals of color in the USA are subject to negative stereotypes, economic and social marginalization, and acts of discrimination (Causadias & Korous, 2019; Ghavami & Peplau, 2018); what we know less about is whether and how the pubertal transition may exacerbate these prejudices as youth acquire adult-like features and their world beyond the family expands. Among ethnic minority families, parental gender socialization post-puberty may include messages and practices that are informed by awareness of the vulnerabilities their sons and daughters will face because of their race or ethnicity (Varner & Mandara, 2013), including those due to their daughters' emerging sexuality—which may be perceived as alluring—and their sons' physical growth and size—which, for some ethnic minority boys, may be perceived as threatening.

8.1.2 Parents' Differential Treatment of Girls and Boys

Early reviews on parents' differential treatment provided limited evidence that parents treated girls and boys differently (Lytton & Romney, 1991). However, Lytton and Romney (1991) analyzed broad categories of parental socialization, and more recent work suggests that gendered treatment is more likely to be observed when specific behaviors are analyzed (Wong & VanderLaan, 2020). Such studies,

for example, find support for parental differential treatment of boys versus girls in domains such as physical control, emotional socialization, and discipline (Chaplin et al., 2005; Leavell et al., 2012). In addition, most of the studies used in Lytton and Romney's (1991) analyses relied on laboratory observations of mainly White samples with young children and used between-family designs to compare groups of parents who had sons to groups of parents who had daughters (McHale et al., 2003). Few studies have focused on gendered differential treatment as a within-family dynamic. Within-family comparisons of how the same group of parents treats their sons versus their daughters can provide a different picture; a within-family design essentially treats each parent as his/her own "control." Results from studies using this kind of design show, for example, that in mixed-sex dyads, mothers displayed more warmth toward daughters than sons, that each parent spent more time with the sibling of his/her own sex, and that girls spent more time in housework than their brothers, regardless of birth order (McHale et al., 2000). Such comparisons are not possible using between-family designs in which boys from one group of families are compared to girls in another group of families.

Although most studies using within-family comparisons to document differential parenting of boys and girls have focused on White samples, some research has examined this process among African American and Mexican American families. The majority of these studies, however, have used between family comparisons. For example, African American fathers with sons spend more time with their child than do those with daughters in early childhood (Leavell et al., 2012). Further, African American mothers have been found to be more demanding of their adolescent daughters than sons—engaging in greater monitoring of their behaviors and holding higher expectations for their academic achievement, though these gender differences were sometimes qualified by birth order (Varner & Mandara, 2013; Varner & Mandara, 2014). Studies using within-family comparisons likewise documented gendered differential treatment of adolescent aged children, showing that African American mothers spent less time with older sons and more time with younger daughters (Stanik et al., 2013) and that fathers engaged in more racial socialization with sons than daughters (McHale et al., 2006). We know little about the antecedents of such gendered differential treatment, but some scholars have proposed that barriers such as racial discrimination promote differential treatment of girls and boys in this sociocultural group. Indeed, Varner and Mandara (2014) found that mothers of sons were more concerned about racial discrimination affecting their sons' future outcomes compared to mothers of daughters. Mothers' future racial discrimination concerns were related to lower behavioral and academic expectations and, in turn, less parental monitoring, and rule enforcement. Further, Varner and Mandara (2014) found that African American mothers' lower academic expectations and more frequent conflict with boys partially mediated sex differences in youth's grade point average and standardized test scores—a gendered dimension given girls' higher overall academic achievement in comparison to boys'.

With respect to Mexican-origin families, McHale et al. (2005) found that cultural orientations moderated gendered *within-family* patterns of differential treatment (i.e., differential treatment of siblings). When parents were more enculturated in Mexican

culture, older sisters were assigned relatively more household tasks but granted fewer privileges as compared to their younger brothers, and older brothers were granted relatively more privileges and provided with more monetary resources than were older sisters. These sibling gender constellation effects were not significant, however, when parents reported more acculturation into Anglo culture.

More generally, a large literature shows that parents' differential treatment of siblings in domains such as warmth, temporal involvement and knowledge of activities is linked to depressive symptoms and externalizing behaviors, especially for the less favored sibling (McHale et al., 2012; Solmeyer & McHale, 2017). Most studies have not focused on sex differences, but studying a nationally representative sample of mixed-sex sibling dyads, Bissell-Havran et al. (2011) found that, controlling for their grade point averages, larger sex differences in mothers' education expectations favoring daughters over sons were linked to greater odds of sisters versus brothers' college attendance.

In sum, although gendered differential treatment seems to occur across racial and ethnic groups, findings from studies of African and Mexican American families suggest that parents may have different reasons for doing so—including reasons tied to the sociocultural contexts in which families are embedded. Notably, the sociocultural contexts of differential treatment and parents' reasons for differential treatment may moderate its implications. That is, although receiving less favorable treatment than a sibling is expected to have negative effects, in some sociocultural contexts these expected effects are mitigated. For example, in the case of African American families, although less parental warmth and more conflict relative to a sibling were linked to more depressive symptoms and risky behavior in youth overall, these negative effects disappeared when mothers engaged in high levels of cultural socialization and when families experienced high levels of financial stress (Solmeyer & McHale, 2017). These patterns may emerge when challenges promote family solidarity. Whereas cultural socialization may have served to promote youth's shared identity and thus reduce sibling competition, limited financial resources may mitigate siblings' negative reactions to differential treatment when youth appreciate the challenges their parents are facing to keep their families together. Future research should examine the role of sociocultural factors in parents' gendered differential treatment and its implications for youth gender development.

8.1.3 Parents' Role as Instructors

In their roles as instructors, parents can implicitly (e.g., through evaluative comments about individuals' gender-typed characteristics) and explicitly (e.g., directives about appropriate behaviors) communicate their gender beliefs, preferences, and values to their children (Gelman et al., 2004). In contrast to parents' gendered differential treatment, however, much less is known about the content of parents' instructions about gender and its influence on youth's gender development.

In studies with young children, researchers have evaluated parents' "gender talk" or comments to their children during a shared reading task in which child characters are shown in gender stereotypical and counter stereotypical activities (Endendijk et al., 2014; Friedman et al., 2007). Using this research design, results from a study with a sample of Dutch parents and their preschool aged children showed that both mothers and fathers indirectly communicated that certain activities were more appropriate for one sex than the other and they made more comments confirming gender stereotypes than comments that contradicted stereotypes (Endendijk et al., 2014). Associations between parents' "gender talk" and children's gender development, however, were not tested. A study of predominantly White, US adolescents and college aged students explored the content and frequency of gender ideologies youth recalled receiving from parents. Results showed that female participants reported that their parents communicated messages that tended to promote egalitarian gender roles. Seemingly counter-stereotypical, male participants also reported that their parents stressed the importance of being "nice" and "pleasant"—but they also received more messages about being "tough" as compared to their female counterparts. Participants' perceptions of their parents' messages were moderately related to their own gender beliefs (Epstein & Ward, 2011).

Longitudinal studies are needed to understand how the content of parents' instructions about gender change as youth enter and proceed through adolescence and into young adulthood. Within-family studies are also needed to examine if the content and frequency of instructions communicated by mothers and fathers vary for sons and daughters. Research also should be directed at whether and how parental instruction around gender is linked to other domains of gender development such as gendered skills and career aspirations. The current labor market in the USA and other western countries means that future opportunities for stereotypically masculine jobs such as in manufacturing will continue to decline, while traditionally feminine human service jobs (nursing; child and elder care) become increasingly prevalent. More generally, novel technologies and work opportunities will require a degree of flexibility in career identity that is likely incompatible with rigidly stereotypical gender norms. An important socialization goal for parents is to prepare their sons and daughters for this changing world of work, where gender has been a central factor. Another important domain for gender socialization is norms and values in the context of intimate relationships. These are topics of current public discussion as illuminated by the #MeToo movement. We know little about parents' gender socialization around such issues, but future research should target their direct instruction about gender appropriate behavior—such as the limits of men's power assertion and elevation of women's empowerment.

Consistent with the hypothesis that parents transmit their attitudes and values about gender roles to their children through instructions, research has found significant associations between parents' and children's gender attitudes. For example, in support of a social learning perspective, which highlights parents' roles as models for their children, research generally shows positive associations between parents' gendered cognitions (e.g., stereotypes, attitudes) and those of their children. Consistent with a meta-analysis of majority White samples (Tenenbaum & Leaper,

2002), two recent studies of African American and Mexican-origin two-parent families documented positive longitudinal linkages between mothers' and adolescents' gender attitudes (Lam et al., 2017; Updegraff et al., 2014). Another important direction is to examine how parents' gender socialization messages are linked to their socialization about other social categories such as race, ethnicity, and social class. Illuminating the intersection between gender and race, Lam et al. (2017), for example, found that, on occasions when African American mothers experienced more racial discrimination than usual, youth reported less traditional gender role attitudes than usual. Although replication of this finding is needed, it provides some support for the hypothesis that personal encounters with racism promote gender egalitarianism among African Americans (Hunter & Sellers, 1998). In this case, mother-child conversations about equality may help to explain the associations between their own racial discrimination experiences and youth's gender attitudes.

Studies linking parents and children's gender attitudes have reported moderation effects by parents' sex, with stronger effects for mothers' compared to fathers' gender attitudes (Tenenbaum & Leaper, 2002). For example, although mothers' attitudes were associated with those of their children (both boys and girls), fathers' gender attitudes were linked to those of Mexican-origin girls' but not boys' gender attitudes (Updegraff et al., 2014) and were unrelated to those of African American youth (Lam et al., 2017). Mothers' attitudes might be more strongly associated with youth's gender attitudes because of mothers' role as children's primary caregivers. Mothers' gender roles also may be more clearly depicted given they are generally highly involved in domestic activities but vary in their involvement in the world of work; in contrast, fathers' breadwinner role is salient in most two-parent families, and they are generally less involved in family activities such as caregiving and household tasks.

Although links between parents' gender attitudes and children's gender attitudes have been documented, the implications of parents' attitudes on children's gender development are less evident in other domains such as children's gendered play behaviors and preferences (Turner & Gervai, 1995; Wong & Yeung, 2019). Future research might therefore benefit from examining potential moderators of the associations between parents' values and attitudes and their gender socialization behaviors. As noted, although parents may hold particular gender attitudes, practical concerns such as economic necessities and parents' experiences outside the home may take precedence when it comes to their parenting practices (Pinto & Coltrane, 2009). As suggested, in some ethnic minority families, parents' gender attitudes might work together with sociocultural values and experiences given that both race and gender are marked by differentials in power and access to resources. Both race and gender, however, are multidimensional (Sellers et al., 1998; Skinner et al., 2018) and thus associations between the various dimensions of race and gender may not be consistent. For example, significant associations may not emerge between parents' racial discrimination experiences and youth's gendered interests or gendered occupational choices.

In sum, parental influences on youth's gender development are diverse, ranging from their influence tied to genetic factors to more active socialization processes

such as direct instructions about gender roles and behaviors. Consistent with earlier reviews on this topic (McHale et al., 2003), we note that most research focuses on parental roles as interactional partners, and less is known about parental influences via their roles as instructors and opportunity providers, particularly during adolescence. We focused on parents as agents of socialization; however, children are active in their own development and, thus, may also influence their parents' beliefs and behaviors. Rogers (2018), for example, found that some children resisted, challenged, and disrupted narratives that reinforced gender inequality that they experienced across different contexts, including in their families. Thus, longitudinal studies are needed to examine bidirectional relations between parents' and children's gendered qualities and behaviors; such studies should also examine changes in parents' gender socialization over time and the separate and joint associations between mothers' and fathers' influences and youth's gender development. As we discussed, a small but growing body of literature shows that parents respond to forces in the larger environment beyond their families and that their parenting behaviors are grounded in cultural beliefs and norms. Studies that explicitly examine the broader contexts in which families are embedded may therefore advance understanding of parental influences on gender development.

8.2 Interparental Relationships and Youth Gender Development

In their work and family roles, mothers and fathers in two-parent families can model gender-typed behaviors and create opportunities for different experiences with daughters and sons. In turn, these experiences can have implications for children's gender-typed skills, stereotype knowledge, sex-typed patterns of achievement, and career interests across childhood and adolescence (Halpern & Perry-Jenkins, 2016; Updegraff et al., 1996). Family structure—including whether parents are single or in a romantic relationship as well as the sex constellation of that relationship—is an additional factor that can underlie variation in family experiences and socialization, with implications for youth gender development. However, an ecological perspective encourages moving beyond such status, or "social address" variables, as markers of between-group differences to examine social and socialization *processes* across family structures (Bronfenbrenner & Morris, 2006).

Within families, differences in mothers' and fathers' behavior and involvement with their children can provide salient messages and models for youth about gender. In general, mothers have warmer relationships with their children than fathers (Maccoby, 1998; Skinner et al., 2019), and consistent with fathers' more traditional gender role attitudes compared to mothers, they spend less time with their children and are less involved in caretaking and more involved in play compared to mothers (Lamb & Lewis, 2010). Although parents serve as gender role models for their children in these ways, few studies have tested whether these gendered patterns in

mothers' versus fathers' roles with male and female children are related to youth's gender development, and extant findings reveal that the implications of mothers' and fathers' family gender roles are sometimes paradoxical. For example, adolescent boys' time spent with mothers was associated with declines in masculine activity interests such as sports over time, but more time with fathers was linked to stronger interests in *feminine* activities such as music and reading for both boys and girls in a sample of African American families (Skinner & McHale, 2018). Such findings alert us to the need to move beyond parents' biological sex to assess their gender-typed personal qualities. In this case, fathers who are more involved with their children may have some more stereotypically feminine qualities such as expressive personalities or feminine interests.

Turning to the interparental division of work roles, early studies of maternal employment showed that children with mothers who were employed were less stereotypical across various domains of gender development (Gold & Andres, 1978; Levy, 1989). Current research also draws attention to parents' domestic roles, which may be more accessible for children to model. Results from a recent longitudinal study of White, working-class women showed that, beyond mothers' gender attitudes, their time spent in childcare activities when their children were infants positively predicted children's stereotyped career preferences at age six (Halpern & Perry-Jenkins, 2016). Higher levels of paternal involvement in domestic duties also have been linked to girls' less traditional occupational aspirations and less traditional gender attitudes about domestic labor (Croft et al., 2014).

As we noted, however, the multidimensionality of gender means that spouses' domestic labor does not necessarily reflect their personal beliefs about gender roles. According to social exchange theory, the spouse with more socioeconomic resources is best able to "buy" him or herself out of household duties (Burgess & Huston, 1979). Consistent with this theory, the economic resources husbands versus wives bring to the family shape the way household duties are divided in studies of both Anglo and Mexican American families (Lam et al., 2012; Pinto & Ortiz, 2018). Thus, an important research direction is to study the implications of what parents practice in combination with what they preach.

Lam and colleagues, for example, classified Mexican American families into groups based on spouses' division of feminine household labor and their gender ideologies about work and family roles. Three patterns of family emerged: congruent traditional (traditional division of labor and attitudes), congruent egalitarian (egalitarian gender attitudes and relatively equal division of household labor), and incongruent (traditional division of labor and egalitarian attitudes) (Lam et al., 2012). A fourth category representing egalitarian division of labor and traditional gender attitudes was not evident. Youth in congruent egalitarian families reported more egalitarian gender attitudes compared to youth in congruent traditional families, but they did not differ from youth in the incongruent family group. These results suggest that parents' gender attitudes were more powerful than their practices in socializing youth attitudes. Further analyses, however, revealed that the gendered family activities of youth in congruent egalitarian families differed from those of the traditional and incongruent groups: Boys and girls in egalitarian families were more similar in

their time spent with mothers and fathers and time spent in household chores whereas more gender stereotypical patterns were evident in the other two groups. In this case, parents' gendered practices appeared to be more powerful than their "preaching" when it came to youth's daily activities.

Studying the longer-term implications of parents' beliefs and practices surrounding the division of labor in the family is an important direction for research. Also important is examining how youth understand the range of messages they receive from their parents about the family roles of women and men. The same family patterns of gendered division of labor may have different implications for youth gender development depending on other characteristics of the family ecology. For example, a son with a breadwinner mother whose father is unemployed because of limited economic opportunities may learn something different about gender as compared to a son whose parents have chosen a "stay-at-home" father lifestyle. How parents' home responsibilities are shared with their children should also be a focus of research, as children's family responsibilities may present unique opportunities for them to develop gender-typed skills and interests or, alternatively, to resist stereotypical norms.

Family structure including single, gay, and lesbian parents can provide or constrain opportunities for sex-typed patterns of family roles, relationships, and activities (McHale et al., 2003). Early discussions surrounding single parent families focused on the impact of father absence on children's development, with scholars suggesting that boys raised in "father absent" homes would fail to develop traditionally masculine behaviors, skills, and interests or become hypermasculine. Results from an early meta-analysis showed that preschool boys whose fathers were absent were less stereotypical in their toy and activity choices compared to boys living with their fathers but older boys with absent fathers were more stereotypical in overt behaviors such as aggression compared to boys growing up with fathers. Generally, non-significant differences were found for girls with and without a father in their home (Stevenson & Black, 1988). Although overall the number of single parent households in the USA has more than doubled since the 1960s, father absence is particularly salient for African American youth, close to 50% of whom reside in single parent, mother-headed households (U.S. Census Bureau, 2018). Consistent with some early predictions, one study found that African American adolescent boys from single mother homes reported lower levels of stereotypically masculine personality qualities, and that girls from father absent homes reported higher levels of those personality qualities compared to their counterparts who resided with both parents (Mandara et al., 2005). More recently, however, Boothroyd and Cross (2017) found no significant associations between absence of a resident father during childhood and masculinity scores (high scores on masculine personality qualities, high physical and verbal aggression, and low fear) during early adulthood in a sample of American and Australian young adults. As we suggested, an important research direction will be to identify the processes through which and conditions under which family structure give rise to gender-typed personalities and other aspects of gender development.

Family structure effects also have been studied with a focus on children with same-gender, gay and lesbian parents. Among young adults, both male and female children of lesbian parents were significantly less likely to report being attracted to the opposite sex and more likely to identify as sexual minorities (i.e., lesbian or bisexual) and to report same-sex sexual experience compared to a matched sample (Gartrell et al., 2019). However, most of the studies on family structure effects focus on children in early and middle childhood and find no differences in gendered personality traits, interests, and behaviors (gender-typed activity involvement) between children from same-sex parent families relative to children from mother-father families (Farr et al., 2018; Fedewa et al., 2015). Some studies also show that gender socialization processes are similar across family structure defined by parents of different sex constellations. For example, unequal division of labor by lesbian couples was positively related to preschool children's more gender stereotypical occupational aspirations as well as more stereotyped attitudes among daughters of lesbian mothers and children of gay fathers (Fulcher et al., 2008; Sumontha et al., 2017). Division of labor within these families, however, was not linked to children's gendered interests, occupation preferences, activities, or personality qualities (Sumontha et al., 2017). Currently, about 5% of same-sex couples in the USA are raising children under the age of 18, a number likely to increase with the legalization of same-sex marriage across the country (Lofquist, 2011). Longitudinal studies are needed to understand gender development among these children as they enter and proceed through adolescence and young adulthood. In doing so, it will be important to incorporate a focus on family processes to illuminate differences within as well as between family structure groups that may account for youth gender development.

In sum, an ecological perspective highlights the importance of moving beyond a focus on family structure as defined by the biological sex(es) of parents in the home to examine the role of interparental dynamics in youth's gender development. Prior research has targeted the interparental divisions of family labor as a key family process, but other more subtle power dynamics may matter—such as which parent makes decisions about how money is spent or about family rules for child behavior. Further, from a cultural ecological perspective, couple relationships are embedded in a sociocultural context, which may have implications for how couples interact, women's and men's family roles and responsibilities, and ultimately how these parental interactions are related to youth's gender development. More attention should be paid to the role of cultural values and connectedness in these processes. Finally, both ecological and family systems perspectives highlight the dynamic nature of families. Most research on the interparental subsystem has focused on married and cohabitating partners; however, among couples whose romantic relationship has ended, their changing relationship experiences may shape parenting behaviors and send important messages to children about gender. For example, Sharp and Ispa (2009) found that some low-income, African American women planned to socialize their daughters to be independent because of their own experiences of betrayal and consequences suffered from the irresponsible behaviors of their former partners. Research designs that include families from different family

structures are therefore needed to fully understand the ways in which interparental dynamics contribute to youth's gender development.

8.3 Siblings and Gender Development

Siblings are a fixture of family life. In the USA, for example, more children grow up in a family with a sibling than with a father (McHale et al., 2012), and children spend more of their out of school time with siblings than with any other type of social partner (Updegraff et al., 2005). Beyond the USA, siblings have long been the focus of research by cultural anthropologists who observe that cultures vary considerably in the groups of people—fathers, mothers, grandparents, peers—who populate children's daily lives, but siblings are always there (Weisner, 1993). Their ubiquity and longevity—sibling relationships are generally the longest lasting ones in most people's lives—mean that these relationships are central to understanding the family ecology of gender socialization and development. Yet, study of sibling influences including on gender development has lagged well behind research focused on other social agents and partners. As we review below, however, extant findings suggest that sibling influences may be a fruitful focus for research on gender development in childhood and adolescence. Toward illuminating the family ecology of gender development, in this section we highlight research consistent with an intersectionality perspective that illustrates how sociocultural factors and gender interact in youth's sibling experiences and development.

Along with an ecological perspective, siblings also are central to the story of family gender socialization from a family systems perspective. First, siblings can be thought of as building blocks of the family structure: Together, sibling sex constellation and sibship size allow for the emergence of distinctive family dynamics that have implications for gender dynamics. The (biological) sex constellation of the sibling dyad, for example, has implications for parents' decisions regarding additional pregnancies. In the USA, the most common parental preference is to have a child of each sex, and thus sibship sizes are larger when earlier born siblings are of the same sex (Tian & Morgan, 2015). Elsewhere around the world in cultures where son preferences prevail, family size may be smaller if earlier born offspring are boys, and elective abortions and infanticide are more common for females (Portner, 2015).

In turn, growing up within a family structure of a same- versus mixed-sex sibling constellation can provide distinctive opportunities for family gender socialization processes, though importantly these will vary based on family and larger contextual conditions, consistent with an ecological model. Mixed-sex sibling constellations, for example, can set the stage for gendered sibling roles that are distinguished in terms of responsibilities and privileges. Particularly in more traditional cultures, caregiving is the purview of older sisters, while authority and inheritance lie in the hands of eldest brothers (Hafford, 2010). In the USA, caregiving, especially by older sisters, was historically the norm and still is common in urban settings and among ethnic minority and immigrant families (Hafford, 2010; Valenzuela, 1999); when

youth grow up in families that include a child with a disability, sisters are more involved in caregiving and housework than brothers (McHale & Gamble, 1989). The brother role, in contrast, is imbued with status and privilege in traditional cultures. The eldest brother, in particular, is expected to be treated with deference and respect by his siblings but has corresponding responsibilities for them throughout life (Sung & Lee, 2013). These distinctive family roles not only provide opportunities for sisters and brothers to learn gendered, role-related knowledge and skills (e.g. child care, domestic tasks), but, as a body of research has shown, social comparisons with a sibling can have implications for youth's sense of self and identity development and, ultimately, for their goals for future adult roles (Bissell-Havran et al., 2011; Grotevant, 1978; Schachter et al., 1976). Youth with same-sex siblings, in contrast, may lack opportunities for (gendered) social comparisons, and in some families, may be pulled into nontraditional roles. In one study of White families, middle-childhood boys with brothers performed more traditional feminine household tasks (e.g., laundry; cleaning) than those with sisters (McHale & Crouter, 2003). But, values and attitudes make a difference. For example, as noted above, Mexican-origin parents who were more attuned to Mexican and less attuned to Anglo culture exhibited more sex-typed treatment of their children (McHale et al., 2005). On the other hand, democratic norms encourage parents to treat their children equally and limit gendered differential treatment in family contexts wherein egalitarianism is valued (McHale et al., 2003).

As noted, the sex constellation of earlier born offspring also can have implications for sibship size, which in turn has been implicated in the allocation of family resources. Some research suggests that youth from larger families are disadvantaged in their access to family capital, including material resources and parental time and attention, with potential negative implications for children's cognitive development and achievement (Steelman et al., 2002). In cultures characterized by son preference, such resource dilution is manifested in less nourishment, likelihood of vaccination, and fewer education opportunities for girls relative to boys (Santhya & Zavier, 2017; Singh & Patel, 2017). There is scant evidence of gendered resource dilution in contemporary US families, however. Instead, some findings show that sibships with a brother are associated with more father involvement: Divorce is less likely in families with sons, and fathers spend more time with their children, daughters included, when they have sons (Harris & Morgan, 1991). Note that this latter pattern may emerge from Western cultural norms that promote equal treatment of offspring. That is, sons may pull fathers into parenting, which then extends to daughters and exposes youth to less gender stereotypical parental roles. And, their time with offspring may ultimately have implications for fathers' gender development as suggested by research showing that fathers who have both sons and daughters held less stereotypical gender role attitudes than fathers with either just sons or just daughters (Endendijk et al., 2013).

Beyond these kinds of indirect effects, in their role as building blocks of the family, siblings also play a part in one another's gender development in the course of their daily interactions, including as social partners, models, gatekeepers to new experiences, coaches and advisors, and sometimes combatants. A body of literature,

for example, documents that siblings are salient role models and, indeed, some of the earliest research on siblings aimed to determine whether the biological sex of a sibling was linked to stereotypical gender development (Brim, 1958). Some of this work supported a social learning hypothesis that children with sisters—particularly those with older sisters—would develop more feminine qualities, and those with brothers, more masculine qualities (Rust et al., 2000). Although results are inconsistent, as elaborated below, boys with brothers have been shown to display more stereotypically masculine, aggressive, and health risk behaviors in childhood and adolescence, whereas having an older sister has been shown to protect both girls and boys from such activities (Samek et al., 2014). The role of sociocultural factors in such processes was evident in one study that compared the effects of friends' vs. siblings' substance abuse and found that sibling gender effects on risky behavior were stronger than friends' substance use effects for Black youth whereas the reverse was true for White youth (Rowan, 2016).

Consistent with an ecological perspective, a limitation of research that focuses exclusively on siblings' sex is that siblings' gendered qualities are not measured directly, and thus an important research direction is to examine links between siblings' gendered qualities. In keeping with a social learning hypothesis, a study of the longitudinal links between siblings' gendered personality qualities, daily activities, and attitudes in late childhood and early adolescence (McHale et al., 2001) revealed that siblings' gendered qualities were positively related beyond the effects of sex. Importantly, older siblings' qualities were more consistent positive predictors of younger siblings' qualities than the reverse, and the links between siblings' qualities emerged controlling for parents' gendered qualities—which were weaker and less consistent predictors of their children's gendered characteristics than were siblings' qualities. Such findings are consistent with the social learning tenet that higher status models, in this case, older siblings, are more likely to be imitated than lower status models.

More recent research highlights the distinctive and gendered developmental opportunities that brothers versus sisters can provide. Sister-sister pairs, for example, are higher in intimacy than other sibling dyads, potentially reinforcing this gender stereotypical quality in girls (Kim et al., 2006). Again, illustrating intersectionality between gender and culture, in Mexican-origin families, this pattern of intimacy between sisters is even more pronounced when sisters hold strong familism values—a cultural orientation that promotes close family ties and responsibilities. In contrast, in Korean families, distancing in mixed-sex dyads is pronounced, possibly due to Confucian norms that promote sons' connection to their families of origin and daughters' connections to the families of their husbands (Sung & Lee, 2013).

In contrast to the socialization of intimacy in sister-sister pairs, brothers, as noted, may promote more (gender stereotypical) aggressive and noncompliant behaviors in their siblings. Exposure to boys' normatively more frequent (i.e., gendered) risky behavior may underlie findings that companionship among brothers is linked to higher levels of substance use, but companionship with sisters, to lower levels (Samek et al., 2014). And, boys' higher levels of aggression may underlie the higher levels of sibling physical and sexual abuse reported by girls (Rapoza et al., 2010).

There is also evidence that sisters provide advice aimed at promoting healthful sexual behaviors whereas brothers are a source of pressure on boys to engage in sexual activities (Wallace et al., 2014). In our research, we have found that growing up with a sibling of the other sex may have positive implications for heterosexual romantic relationships, including adolescents' self-perceived romantic competence and sense of power in those relationships (Doughty et al., 2015).

In short, the sibling literature provides substantial evidence of the roles of siblings and sibling relationships in family gender socialization and development, but also draws attention to the importance of examining mediating processes (e.g., moving beyond sex to examine gendered characteristics and behaviors) and moderating conditions (e.g., family circumstances, sibling relationship characteristics) in efforts to understand sibling influences. This literature also draws attention to how gender and ethnicity—in the form of sociocultural values and practices—interact to shape the nature and sometimes the strength of sibling influences. More generally, this literature highlights that including siblings in research on family socialization of gender development provides novel insights into a range of family influences—from family structure characteristics to processes such as resource dilution, parents' differential treatment, sibling social comparison, and social learning processes—influences that may be obscured in research that targets only a single focal child within a family. Including a much neglected focus on siblings can serve as a fruitful direction for research on the role of families in gender development.

8.4 Conclusion

Families' roles in children's and adolescents' gender development include socialization processes grounded in the parent-child, interparental, and sibling subsystems. Importantly, although we have described gender socialization processes as operating within these three subsystems, they are interdependent. Thus, for example, the interparental division of child care activities involves both the parent-child and interparental subsystems, and sibling differential treatment involves both the sibling and parent-child subsystems. Research designs that capture gendered family processes across different subsystems and examine their interconnections and linkages to youth's gender development can further our understanding of how families operate as systems to influence gender development. Such an approach highlights the need for research that includes information from and about fathers and mothers, the multiple children, and others who comprise families including grandparents, aunts, and uncles who may play an important role in some cultures.

As we also have emphasized, both ecological and family systems highlight that family structures and processes are dynamic: Siblings enter the family through birth or adoption and many leave home for education and work opportunities; parents' employment and romantic relationship involvement also may change; and family members, including both children and parents, change in a host of ways across the life span—all of which may motivate and necessitate changes in family roles and

norms around gender. Longitudinal research is essential to capture such family changes and their links to youth gender development, and this work should be extended to illuminate gender development across the life span.

Finally, both ecological and family systems perspectives direct attention to the larger contexts within which families are embedded. In this review, we have emphasized the sociocultural contexts of family gender socialization. The socialization processes across the family subsystems we have considered are likely operative across racial/ethnic groups. Among some cultural groups, however, extended kin and others who are related to children in neither the biological nor legal senses are nonetheless an integral part of families. A direction for research is to examine the role of family socialization agents beyond parents and siblings such as grandparents in youth gender development. In addition, consistent with a cultural ecological perspective, the same socialization processes may have different impacts on youth's gender development depending on child characteristics as well as the sociocultural context in which these take place. From an intersectionality perspective, as well, sex and race/ethnicity, as well as other person characteristics can interact in ways that have implications for family gender socialization and youth's gender development. Notably, the racial socialization and gender socialization literatures have been largely separate. A more complete and nuanced understanding of human development, and gender development in particular, may emerge from studies that examine family socialization processes around these two salient aspects of individual identity.

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Chapter 9
Gender Stereotypes and Education

Lin Bian

Abstract Girls and women have matched boys and men in academic achievements. However, the gender disparity in representation favoring men over women persists in many careers and domains. This chapter focuses on the sociocultural factors shaping women's participation in the STEM domain and beyond. In particular, I highlight two classes of stereotypes that may contribute to this phenomenon: (1) stereotypes against women's and girls' intellectual abilities and (2) stereotypes about the culture of the field. Throughout the chapter, I introduce the two clusters of stereotypes, describe the early emergence of the gender stereotypes about intelligence, illustrate three potential mechanisms working against women's engagement, and discuss the means through which parents, educators, and society can counter these stereotypes as well as the downstream consequences. Overall, this chapter sheds light on the developmental roots of the gender imbalance across different fields and provides insights on potential interventions remedying this problem.

Keywords Gender imbalance · Education · Achievement · Stereotypes · STEM

Girls and women have matched, or even outperformed, boys and men in intellectual achievements. Girls demonstrate an advantage in school performance from kindergarten through twelfth grade (Voyer & Voyer, 2014) and make up more than half of the children in gifted programs (National Association for Gifted Children, 2015). Likewise, women graduate from college and earn doctoral degrees at higher rates than men (National Center for Education Statistics, 2017). Despite women's significant advancement in educational achievements, the gender disparity in representation favoring men over women persists in many prestigious and well-paying careers and professions, especially those in the domain of Science, Technology, Engineering and Mathematics ("STEM" domain; Chamberlain, 2016). According to UNESCO (2018), girls and women account for less than a third of scientists and researchers

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worldwide. In higher education in the United States, only 23% of PhDs in engineering and less than 20% of PhDs in computer science and physics were awarded to women in 2015 (National Science Foundation, 2016). Therefore, women still face multiple challenges that compromise their education and careers.

What are these challenges? Over the past few decades, multiple theoretical accounts have been offered, looking at biological or social mechanisms (e.g., Ceci et al., 2009; Halpern et al., 2007). Researchers on the biological end stress how men and women are inherently different in terms of their cognitive and socioemotional makeup, which significantly shapes men's and women's performance and career aspirations (e.g., Baron-Cohen, 2002; Geary, 2010; Hakim, 2006). One of the leading hypotheses explaining women's underrepresentation in the STEM domain suggests that, relative to men, women may lack the cognitive abilities (e.g., mathematical and spatial skills) that are necessary for success in these fields (e.g., Geary, 1996; Kell et al., 2013; Moore & Johnson, 2008; Quinn & Liben, 2008; Wai et al., 2009). In other words, this hypothesis argues that hormonal, genetic, or evolutionary forces predispose men to possess higher mathematical and spatial abilities than women (e.g., Geary, 2010; Lippa et al., 2010; Moore & Johnson, 2008; Quinn & Liben, 2008). Moreover, this gender difference is claimed to be more substantial in high-end samples consisting of talented people (e.g., Benbow & Stanley, 1980, 1983; Geary, 1996; Wai et al., 2010). Since many fields are highly selective, the overrepresentation of males in the right tail of the distribution is regarded as a plausible explanation for the greater number of males than females in these fields.

In contrast, researchers on the social end suggest that men's and women's cognitive abilities, academic performance, and career aspirations are shaped by a range of sociocultural factors (e.g., Bennett, 1996, 1997; Diekman et al., 2010; Guiso et al., 2008; Hyde et al., 1990; Kirkcaldy et al., 2007; Sugimoto et al., 2013; Milkman et al., 2012, 2015; Moss-Racusin et al., 2012; Pope & Sydnor, 2010; Sheltzer & Smith, 2014; Spelke, 2005; Tiedemann, 2000; Upson & Friedman, 2012; Wenneras & Wold, 1997). These social influences take a number of forms (for a review, see Ceci et al., 2009), including cultural beliefs (e.g., Guiso et al., 2008), societal expectations (e.g., Diekman et al., 2010), educational practices (e.g., Beilock et al., 2010; Eccles & Jacobs, 1986), and other environmental factors (e.g., Levine et al., 2005). The social and environmental factors ultimately contribute to the current gender imbalances in participation.

Although consensus has not yet been reached regarding the presumed gender differences in cognitive profiles, endorsing gendered beliefs about intelligence may contribute to women's underrepresentation in the STEM domain and beyond. I focus this chapter on the stereotypes against *women's intellectual abilities* (e.g., Ambady et al., 2001; Bian et al., 2017), one of the social factors that perpetuate the current gender disparities. Then, I will turn toward another class of stereotypes that concerns the *overall culture of a field*, including beliefs about its prototypical members, its work environment, and its values (e.g., Cheryan et al., 2015). Overall, I hope this review provides evidence showing that the two types of stereotypes are unified to exhibit a strong force against women's participation. Throughout the chapter, I will highlight the common practices that parents and teachers apply in their everyday

communications that may transmit these stereotypes to the next generation, and suggest potential interventions that could be implemented to counteract these beliefs, so as to remedy the gender imbalance.

9.1 Gender Stereotypes About Intellectual Abilities

Our culture presents a web of stereotypes and biases. A subset of stereotypes that may directly relate to gender imbalance is the assumption that women are not as intellectually capable as men ("ability stereotypes"). Possessing outstanding math abilities or general intelligence is believed to be a prerequisite for success in many fields such as STEM (e.g., Leslie et al., 2015; Meyer et al., 2015). Therefore, the stereotypes disadvantaging women's intelligence blocks their way from participating these fields. In the following sections, I present a selective review of the findings showing that these ability stereotypes pervade families and schools (the two major environmental factors influencing children's beliefs), emerge early in childhood, and exhibit detrimental consequences on girls' and women's engagement.

A great deal of research has shown that our culture holds a pervasive, negative stereotype against women's mathematical abilities (e.g., Ambady et al., 2001; Boucher et al., 2015; Kirkcaldy et al., 2007; Tiedemann, 2000). For example, men typically provide higher estimates of their own analytical and practical intelligence than women (Kirkcaldy et al., 2007), despite the fact that there are no mean-level differences between men and women on these dimensions (Aluja-Fabregat et al., 2000; Colom et al., 2002; Saggino et al., 2014). Parents and teachers, the two prominent social influences on children's development, internalize these stereotypes as well. For example, even though girls receive slightly higher grades in math at school than boys (Voyer & Voyer, 2014), parents of girls believed that their child was less capable of math than parents of boys (Eccles et al., 1990; Rammstedt & Rammsayer, 2000; Yee & Eccles, 1988), Likewise, a cross-cultural study found that mothers from Taiwan, Japan, and the United States believed that boys were better at math than girls (Lummis & Stevenson, 1990). These stereotypes extend into school contexts as well. Elementary school teachers perceived boys as more capable of logical thinking than girls, even in the absence of meaningful gender differences in math performance (Tiedemann, 2000). Additionally, these stereotypes guide teachers' attributions of students' math performance. For example, although kindergarten teachers acknowledged that there was no gender difference in math performance, they rated boys as more proficient in math than girls (e.g., Robinson-Cimpian et al., 2014). In the same study, teachers also believed that girls had to work harder to achieve a level of math performance comparable to boys'—without this extra effort, girls would fall behind.

Since both parents and teachers are biased when evaluating boys' and girls' math abilities, it is not surprising that this gender stereotype becomes entrenched in early childhood (Cvencek et al., 2011; Fredricks & Eccles, 2002). On explicit measures in which children had to indicate their math skills, girls provided lower ratings relative

to boys (Fredricks & Eccles, 2002). Findings from implicit measures provide converging evidence (e.g., Cvencek et al., 2011, 2015). Cvencek et al. (2011) developed a child-friendly Implicit Association Task, requiring children between 6 and 10 years of age to use two computer response keys to sort boy and girl characters, and math and reading words. This method capitalizes on the fact that pressing the same key to respond to items from two mentally associated categories is much faster than those from two unrelated categories. Children in second grade responded faster when "math" was paired with "boys" than with "girls," suggesting that the cultural stereotypes associating math with men begin to be assimilated in early elementary school. These findings have been replicated in other cultural contexts as well. In a sample of Singaporean elementary-school children, who had no gender differences in math achievements, both boys and girls tended to link math with boys than with girls on implicit and explicit measures (Cvencek et al., 2014, 2015).

These findings constitute evidence that the gender stereotypes about math abilities develop early in life and may discourage women's engagement in the STEM domain. However, limiting the content of the gender stereotypes to math abilities obscures a critical observation that women have made more inroads in some STEM fields (e.g., molecular biology) than others (e.g., physics; National Science Foundation, 2013). For example, in a recent report by the National Science Foundation (2013), about half of the PhD recipients in molecular biology and neuroscience were women. Moreover, academic fields that are typically not perceived as requiring a great amount of math abilities, such as those in the domain of social sciences and humanities, in fact exhibit at least as much variability in participation in senior levels by women as STEM fields do (National Science Foundation, 2013). For example, although women were awarded more than 70% of PhDs in art history and psychology, statistics collected by the U.S. National Center for Educational Statistics showed that women make up only 21% of full-time philosophy faculty (Division APAP, 2011).

This variation in women's representation, which cuts across the divide between STEM and non-STEM fields, prompts researchers to examine a broader and potentially more influential stereotype associating high intelligence with men more than with women (e.g., Bennett, 1996, 1997; Kirkcaldy et al., 2007; Tiedemann, 2000; Upson & Friedman, 2012). Even though the actual intelligence of men and women is not different (Aluja-Fabregat et al., 2000; Colom et al., 2002; Saggino et al., 2014), people tend to underestimate women's intelligence, while overestimating men's (e.g., Beloff, 1992; Furnham et al., 2002; Rammstedt & Rammsayer, 2000). For instance, research focusing on self-estimated intelligence indicates that women themselves had lower perceptions of their intelligence than men (104.84 vs. 110.15, respectively; Furnham et al., 2002). Similar patterns have been reported with samples tested in Hong Kong, in which women estimated their IQs lower than men estimated theirs, regardless of their actual levels of intelligence (Hamid & Lok, 1995).

These biases against women's intelligence have been found in parents and teachers. Stephens-Davidowitz (2014) tallied anonymous Google searches and

summarized that parents were two and a half times as likely to search "Is my son gifted?" as "Is my daughter gifted?" More generally, parents tended to make more intelligence-related searches about their boys than about their girls (Stephens-Davidowitz, 2014). In samples including English and Icelandic parents (Furnham & Valgeirsson, 2007), fathers provided higher estimates of their general intelligence than mothers, and both fathers and mothers provided higher estimates of their sons' general intelligence than their daughters'. Teachers hold distinct beliefs of their male and female students' intellectual abilities as well, which may set barriers for girls (e.g., Bianco et al., 2011). Bianco et al. (2011) introduced teachers to one of two hypothetical students (a male or a female student) and asked them whether they would be willing to refer the child to a gifted program. Despite the identical descriptions, teachers were significantly less willing to refer the female than the male student to talented programs.

Are young children susceptible to these gendered beliefs? Bian et al. (2017) investigated 5- to 7-year-old children's beliefs about which gender is "really, really smart"—a way of talking about high intelligence with young children. A group of children from the United States heard a short story about a really smart person, without receiving any clues to the person's gender. Then, children saw pictures of 2 men and 2 women, and guessed which one of them was the person featured in the story. In another task, children were shown several pictures featuring a man and a woman. Upon viewing each picture, children made a choice between the two individuals as a really smart person. At the age of 5, boys and girls tended to pick people of their own gender as being "really, really smart." However, starting at age 6, girls picked females as "really, really smart" less often than boys picked males, suggesting that children begin to assimilate the "brilliance = males" stereotypes in early elementary school years. These findings replicate in both White and non-White children (Jaxon et al., 2019), do not seem to vary as a function of parental education or household income, and have been extended to other cultures such as China (Bian et al., 2019). Bian et al. (2017) also showed children pictures of unfamiliar boys and girls and asked them to guess who achieved better grades in school. In this measure, 6- and 7-year-old children favored girls in their choices of high school achievers. These results align well with the gender difference advantaging girls in school marks (Voyer & Voyer, 2014); nevertheless, the idea that girls get better grades in school does not seem to buffer against children's endorsement of the gender stereotypes associating brilliance with men.

9.2 Stereotypes About the Culture of a Field

So far, we have reviewed evidence demonstrating the existence and early emergence of the stereotypes against women's and girls' intelligence. How do these gender stereotypes about abilities influence girls' and women's career choices? This question is best answered after taking into account another kind of stereotypes—beliefs about a field's culture. This class of stereotypes includes beliefs about the

characteristics of the field's typical members, its typical work environment, and the prototypical traits valued in the field (e.g., Cheryan et al., 2015, 2017). Take the STEM domain as an example. In general, the STEM domain is believed to embrace a masculine culture and predominately occupied by males (Cheryan et al., 2013b; Haines & Wallace, 2003; Knight, & Cunningham, 2004; Smith et al., 2005). These ideas take roots in early childhood (e.g., Miller et al., 2018; Rock & Shaw, 2000). For instance, when asked to draw a mathematician, although children in kindergarten and first grade tended to draw a female, second graders' drawings depicted males predominately (Rock & Shaw, 2000). Likewise, in a recent meta-analysis across 78 studies asking children to draw a scientist, researchers found that children became more likely to draw male scientists with age (Miller et al., 2018). Additionally, characteristics associated with the STEM domain are often incompatible with females' self-image (Cheryan et al., 2009; Diekman et al., 2010). For example, college students believe that computer scientists are nerdy and inept in social situations (Beyer et al., 2005; Cheryan et al., 2009, 2013b; Schott & Selwyn, 2000). Physicists are perceived as someone "in a white coat, surrounded by explosions, atoms splitting, and lightning all over the place" (McAdam, 1990, p. 104). Regarding perceptions of engineers, students in the elementary and middle school years indicate that they build and fix things (Fralick et al., 2009; Karatas et al., 2008; Knight & Cunningham, 2004). This masculine culture surrounding the subject signals to women that they do not belong, or that they would be less successful than their male counterparts.

Another feature that characterizes each discipline is the belief of which abilities are required for success (e.g., Leslie et al., 2015; Meyer et al., 2015). Some disciplines are more likely than others to endorse the idea that high-level success is a matter of raw intelligence rather than hard work and dedication. In philosophy, for example, there are widespread messages suggesting that success is largely determined by whether one possesses a spark of genius (e.g., Marshall, 2013). In a seminal study, Leslie, Cimpian et al. (2015) recruited academics from research universities across the United States and asked them to indicate whether a special aptitude, such as a spark of genius, is required to gain success in their respective field. The results suggested that academics of some fields (e.g., physics, philosophy, economics), more than others (e.g., microbiology, psychology, education), tended to believe that success relies on possessing high intellectual talents. These results were replicated with a more naturalist measure assessing a field's emphasis on brilliance (Storage et al., 2016). Specifically, Storage et al. (2016) tallied data on RateMyProfessors.com, a platform for students to provide anonymous reviews of college instructors. They found that descriptors expressing intellectual talents were used more often for male than for female instructors, another piece of evidence speaking to the existence of the gender stereotypes against women's intelligence. Moreover, the frequency of students' comments about brilliance varied across disciplines: These superlatives were used more often in mathematics and physics than in health science or education.

9.3 Links Between the Ability Stereotypes and Women's Representation

Encountering a field that embraces a culture inconsistent with one's self-concept is likely to discourage participation (e.g., Cheryan & Plaut, 2010; Niedenthal et al., 1985). In particular, fields with masculine cultures may be especially unwelcoming and inhospitable to women's engagement, because these cultural values are incongruent with women's self-concept shaped by ability stereotypes (Bian et al., 2017, 2018b) and gender norms (Eccles, 1987). This mismatch serves as an overarching factor that works against girls' representation in certain fields through at least three pathways. First, girls and women may be less confident about achieving success in fields valuing brilliance, resulting in weaker senses of belonging and stronger anxiety than their male counterparts, which may undermine their motivation to pursue these fields. Second, women may also experience stereotype threat, resulting in poor performance that ultimately confirms with what the gender stereotypes suggest and makes it more difficult for women to be accepted and valued than it would be for men. Third, even though women match with or even surpass their male counterparts in performance, the practitioners of these fields may hold low expectations of women's qualifications and competence, offering them few opportunities to begin with. In what follows, I will review evidence illustrating each of these mechanisms.

9.3.1 Motivation and Interests

One prominent mechanism against women's representation is the following: Notions associating high intellects with men highlight the incongruency between women's self-image and the culture of the fields emphasizing brilliance (e.g. Niedenthal et al., 1985; Setterlund & Niedenthal, 1993), which then undermines their motivation to participate (e.g., Jacobs et al., 2005). To elaborate, informed by the ability stereotypes, women are likely to perceive themselves as not possessing the traits valued by certain fields. This mismatch shatters women's confidence that they can achieve success in these fields (the so-called "self-efficacy"; Bandura, 1982, 1997; Eccles, 1994; Wigfield & Eccles, 2000), which then triggers their anxious feelings and raises concerns about belonging (Bian et al., 2018b). Anxiety and lack of belonging may ultimately exhibit a downstream negative effect on women's interest (e.g., Cheryan & Plaut, 2010; Cheryan et al., 2009, 2017; Dasgupta, 2011; Good et al., 2012; Hannover & Kessels, 2004; Walton & Cohen, 2007, 2011; Walton et al., 2012). For example, after interacting with a stereotypical computer scientist (e.g., a person who wore glasses and was a *Star Wars* fan), whether male or female, women lacked confidence that they would be able to succeed in computer science and became less interested in majoring it (Cheryan et al., 2011). This reaction was mediated by their feelings of dissimilarity to the field's prototypical members and a lack of sense of

belonging. Moreover, this negative effect persisted for up to two weeks after this brief initial exposure (Cheryan et al., 2013a).

Studies presenting "brilliance-oriented" contexts provide converging evidence (e.g., Bian et al., 2018b; Emerson & Murphy, 2015; Good et al., 2012; Smith et al., 2013). In a series of experiments, Bian et al. (2018b) provided college students and Mechanical Turk workers with a range of hypothetical educational and professional opportunities (e.g., major, internship, job). Some opportunities were described as requiring "a spark of genius," whereas others were described as requiring "excellent work ethics." Next, participants indicated to what extent they were willing to pursue these opportunities. Compared to men, women reported lower self-efficacy and consequently lower motivation toward the activities prizing superior intelligence. More importantly, women also reported that they felt less similar to the representative members in the "brilliance-oriented" fields than men, which partially explained why women were less enthusiastic about opportunities requiring intellects.

Children suffer from these detrimental effects as well. Bian et al. (2017) showed 5-, 6-, and 7-year-olds an unfamiliar game described as for children who are "really, really smart." Children then answered a number of questions indicating their interest to play this game. Five-year-old boys and girls were equally interested in this activity, but girls became less interested in it relative to boys at the age of 6 and 7. These results mirror the developmental trajectory of children's gendered beliefs about brilliance (Bian et al., 2017), suggesting that the "brilliance = males" stereotypes may guide children's activity choices. Indeed, girls who endorsed the stereotypes expressed lower interest in the "smart" activity than girls who disagreed. Moreover, when the game was framed as being for children who "try really, really hard," 6- and 7-year-old girls were just as interested in it as boys. Similarly, gender stereotypes about math abilities lead girls to make lower evaluations of their competence in math than boys do (Huang, 2013). Girls' low self-efficacy in turn reduces their interest in pursuing future math-intensive academic courses and occupations (Correll, 2001, 2004; Denissen et al., 2007; Eccles, 1994; Frome et al., 2006; Killen et al., 2006; Liben et al., 2001; Newcombe, 2007). Furthermore, the mismatch between children's self-concept and the required identity for a specific task undermines their persistence. Rhodes and colleagues (Rhodes et al., 2019) introduced 4- to 9-year-old children to science as an identity ("Let's be scientists!") or an action ("Let's do science!"). Children then completed a challenging science game. Girls who were asked to "be scientists" persisted less in the science game than did girls who had been asked to "do science," presumably because girls encounter a conflict between the portrayed identity and their own identity in the "be scientists" condition.

Overall, the stereotypes about the culture of a field shape girls' and women's career aspirations and choices. When women and girls encounter a field embracing a culture loaded heavily with masculine traits, they detect a mismatch between their self-image and the type of people who commonly work in these settings. This perceived mismatch diminishes girls' and women's self-efficacy, reduces their sense of belonging, increases their adverse emotional reactions, and ultimately pushes them away from the fields.

9.3.2 *Stereotype Threat*

Messages about the cultural values of a field not only influence women's motivation, but they may also act as situational cues to inform women's judgments about whether their gender group is likely to be welcome in the field. Imagine a girl is taking a test in a male-dominated program. She might fear that she would be misjudged based on her gender membership. This extra pressure is likely to result in performance decrements that confirm the stereotype against her gender group's intellectual competence. This example illustrates stereotype threat—a psychological threat that arises in situations activating negative stereotypes of a group (e.g., Davies et al., 2002; Emerson & Murphy, 2015; Murphy et al., 2007; Spencer et al., 1999; Steele, 2013). A great deal of research has shown that stereotype threat gives rise to anxious feelings (e.g., Murphy et al., 2007; Osborne, 2007), low sense of belonging (e.g., Good et al., 2012), and poor actual performance (Spencer et al., 2016). For example, Good et al. (2012) conducted a longitudinal study with female students studying calculus. They found that in classrooms in which people endorsed gender stereotypes about math abilities and believed that math abilities are unchangeable (a fixed mindset; see Dweck, 1999, 2006), the female students reported a lower sense of belonging and weaker intentions to take math courses after a semester (Good et al., 2012). Emerson and Murphy (2015) examined the effect of stereotype threat in working environments. In this study, women expected themselves to be judged on the basis of their gender category and thus expressed low trust when they imagined working in a company against the malleability of intelligence.

The threat of being stereotyped not only takes a toll on girls' and women's senses of belonging and interests, it also has a detrimental effect on their actual performance. For instance, Galdi et al. (2014) found that after coloring a picture of a boy successfully solving a math problem and a girl failing to do so, young girls performed worse than boys on the subsequent math test. In contrast, girls performed as well as boys after they colored a picture of a girl solving a math problem successfully and a boy failing to respond. These results underline an influence of the negative stereotype targeting girls' math ability, which was incidentally activated by the picture (even though perhaps the girls themselves were not consciously aware of its activation). Other studies similarly showed that 5- to 7-year-old girls' math performance decreased when their gender identity was made salient (e.g., Neuville & Croizet, 2007; Tomasetto et al., 2011). Thus, activating the social identity that is being negatively stereotyped in a domain leads to poor performance. In contrast, activating the social identity that is being positively stereotyped may buffer against this effect. In a landmark study by Shih et al. (1999), Asian American female participants' math performance was undermined when their gender identity was triggered, whereas their performance was improved when their racial identity was activated. The threat can also be reduced by deemphasizing the group differences that may show up in the test. For example, after reading that a math test did not show gender differences, women performed as well as men, whereas women who learned that the test showed gender differences underperformed (Spencer et al., 1999).

Taken together, findings on stereotype threat suggest settings emphasizing intellectual talents systematically underestimate women's and girls' true ability (for a review, see Walton & Spencer, 2009). To remedy this effect, creating environments that welcome a variety of values may unlock women's hidden abilities and allow them to achieve their full potential.

9.3.3 External Biases

A third potential mechanism involving the ability stereotypes that contributes to women's underrepresentation is the following: The ability stereotypes make women the targets of bias in fields prizing these abilities, which in turn creates an inhospitable environment for them and hinders their engagement. For example, because of the gender stereotypes about intellectual abilities, members of the "brilliance-oriented" fields may view women as less competent and exhibit biases against their participation (Bian et al., 2018a). The biases against women manifest in many forms, including providing women with fewer opportunities, lower salaries, and fewer accolades relative to men (e.g., Sugimoto et al., 2013; Milkman et al., 2012, 2015; Moss-Racusin et al., 2012; Sheltzer & Smith, 2014; Wenneras & Wold, 1997; but see Williams & Ceci, 2015, for inconsistent results).

For instance, when students contacted professors to discuss research opportunities, female students were less likely to get responses than their male counterparts, regardless of the gender of the faculty member (Milkman et al., 2012, 2015). When faculty members in biological and physical sciences were asked to evaluate the suitability of a male or a female applicant for a lab manager position, both male and female faculty rated the male applicant as more suited for the position, were more likely to offer him mentoring, and provided him a higher starting salary (Moss-Racusin et al., 2012). The female applicant was seen as less suited for the position, even though she was exactly as qualified as the male applicant and rated as more likable (Moss-Racusin et al., 2012). In two experiments eliciting people's referrals for job positions (Bian et al., 2018a), participants were presented with a description of the ideal candidates. One group of participants was told that the ideal candidates should "have a high IQ, superior reasoning skills, and a knack for big, bold ideas," whereas another group of participants was told that the ideal candidates should "be highly motivated, have an outstanding work ethic and a superior commitment to doing their work as well as possible." People who were asked to refer someone who is brilliant were much less likely to recommend a woman than did people who had been asked to refer someone who is diligent (40.5% and 52.5% female referrals, respectively).

Even after women surmount these initial challenges and obtain advanced degrees, they may still face discrimination when their academic productivity and the value of their research is being evaluated. For instance, Sugimoto et al. (2013) analyzed the scientific impact of all articles published between 2008 to 2012 across all disciplines, and revealed that articles were cited fewer times when women were in the most

prominent author positions than when men were. Moreover, according to the data from the peer review system of the Swedish Medical Research Council, females were less likely to be awarded postdoctoral fellowships, and were perceived as less competent than males who were, in fact, equally productive (Wenneras & Wold, 1997).

More strikingly, this bias has developmental roots in early childhood (Bian et al., 2018a). Five- to 7-year-olds were presented with unfamiliar team games. Half of the participants were told the games were for "really, really smart" children, while the other half were not provided any particular information about the games. Next, children selected three teammates among six unfamiliar children. In the initial selection rounds, they tended to choose teammates who were their own gender, which was consistent with the favoritism for ingroup members that children typically display when they choose friends (e.g., Dunham et al., 2011). In the third selection round, however, children were less likely to choose girls for the "smart" game: Girls were chosen as teammates for the "smart" game 37.6 percent of the time, versus 53.4 percent for the game not portrayed as for "really really smart" children. Boys and girls were equally likely to exhibit this bias. These findings suggest that these ability stereotypes against women's intelligence begin to influence children's attitudes as soon as they are acquired. Specifically, they bias children's evaluations of other girls' competence for activities said as requiring brilliance.

As outlined above, the current gender disparity is in part due to the unified force of the two types of stereotypes: the stereotypes against women's intellects and the stereotypes about the culture of a field. To promote girls' aspirations in pursuing all kinds of careers, strategies and interventions should focus on undermining the two clusters of stereotypical beliefs to alleviate their consequences. In the next section, I go on to discuss these strategies and interventions.

9.4 Changing Stereotypes About Abilities

Inoculating people from the negative ability stereotypes can promote girls' self-efficacy, allow them to reach actual levels of performance, and minimize the biases involved in the selection process. Prior research has suggested several potential ways of revising people's, especially women's, gendered beliefs about intellectual abilities.

The first, and most commonly used strategy, is to foster growth mindsets about intellectual abilities. In stark contrast with a fixed mindset, a growth mindset is the set of beliefs that one's abilities can be developed as a result of consistent dedication, effective learning strategies, and lots of mentoring and coaching (e.g., Dweck, 2006). One reason that the stereotypes about intellects are very powerful is because intellectual abilities are usually conceptualized as inherent and unchangeable. This fixed view of intelligence gives rise to tendencies to justify and perpetuate group inequalities: If one group is perceived as possessing lower intelligence than another group from the very beginning, this disadvantage is believed to be pre-determined,

cannot be changed, and should not be changed (e.g., Hussak & Cimpian, 2015; Roberts et al., 2017, 2018). However, revising students' concepts about brilliance by instilling growth mindsets may lead them to question the legitimacy of the current status quo. At the same time, knowing that intelligence is alterable is likely to motivate students to learn, practice, and reach out to mentors. Research with adolescents have found that growth mindset interventions effectively improve girls' math performance (Good et al., 2003). These effects may be more pronounced in students from disadvantaged groups who are particularly vulnerable to the ability stereotypes (Yeager et al., 2016).

Second, it is crucial to realize the influence of subtle linguistic cues on the transmission of stereotypes, which may teach us how to begin conversations with our children about social groups. One particular kind of language form that has received a lot of attention in cognitive, social, and developmental psychology is generic language, such as "boys have short hair," "zebras have stripes." Generic statements are powerful because they encourage essentialist beliefs, the beliefs that certain social categories mark fundamentally distinct kinds of people, which serve as the cognitive basis for stereotypes and biases (e.g., Allport, 1954; Bastian & Haslam, 2006; Mandalaywala et al., 2018). In a seminal series of experiments, Rhodes et al. (2012) found that parents who held essentialist beliefs were more likely to use generic statements to describe a novel social category (e.g., "Feppies eat flowers") in their conversations with their children. Consequently, children who had been exposed to generic statements tended to develop essentialist beliefs about the category. In contrast, parents who did not believe that category membership marks inherently different kinds of people were more likely to use non-generic language (e.g., "This feppy eats flowers"), and as a result, their children did not develop inherent beliefs about the social categories. To extrapolate these findings to the ability stereotypes, using non-generic language to describe individuals' achievements (e.g., "Tom does well on his math test.") as opposed to using generic language to describe performances as groups ("Boys do well on their math tests.") may block the transmission of the gender stereotypes about intelligence.

Relatedly, well-intentioned messages sometimes may backfire. For example, saying "girls are as good as boys at math" reinforces the gender bias it is intended to combat (Chestnut & Markman, 2018; Chestnut et al., 2021). On the surface, the sentence tries to convey that both genders are equal in their abilities. However, because of its grammatical structure, the sentence implies that being good at math is more natural for boys than girls. In Chestnut and Markman (2018), adults read a passage summarizing research that showed no gender differences in math skills. However, how the lack of gender difference was framed differed across conditions. One group of participants read "Girls do just as well as boys at math," whereas another group of participants read "Boys do just as well as girls at math." Next, adults were asked which gender they thought was naturally skilled at math. Of those who read "girls do just as well as boys at math," 71% chose boys as naturally skillful at math, but this pattern was reversed for those who read "boys do just as well as girls at math," in which only 32% picked boys. Thus, putting both boys and girls in the same position in the sentence (e.g., "boys and girls are equally good at math") as

opposed to comparing the two groups (e.g., "girls do just as well as boys at math") may undermine the gender biases about abilities.

Another primary strategy to inoculate girls against ability stereotypes is to present them with female role models who have achieved success in traditionally male-dominant fields (Dasgupta, 2011; Else-Quest et al., 2010). As reviewed above, women may shy always from the male-dominant fields because they lack confidence in their intellectual abilities. However, observing examples of women who have achieved success in these fields may promote girls' aspirations to enter the same fields by reinforcing their self-confidence. Meanwhile, presenting girls to female role models has the potential to lessen girls' concerns about being stereotyped on the basis of their gender, which in turn may increase their sense of belonging as well as their performance (e.g., Dasgupta, 2011). As illustrated in Stout et al. (2011), even brief interactions with female experts in the STEM fields enhances women's positive attitudes toward STEM and motivation to pursue STEM careers. In the domain of politics, women politicians' visibility on national news coverage is positively related to American adolescent girls' intention to be politically active (Campbell & Wolbrecht, 2006). In the same vein, girls and boys benefit from playing the role of a competent character (e.g., White et al., 2017). Past studies in developmental and clinical psychology demonstrate that impersonating a superhero is beneficial to children's task performance because it allows children to cognitively transform themselves into a competent character and behave in line with that character's power, even if they believe they themselves do not have this power (Karniol et al., 2011).

Although presenting role models is likely to inoculate girls from the negative stereotypes, figuring out the best ways to portray the role models is still challenging. As noted earlier, seeing oneself as similar to the successful role model may be motivating (e.g., Bian et al., 2018b), whereas feeling a mismatch between one's identity and that of the role model may backfire. For example, role models whose success seems extraordinary and unobtainable makes young students feel threatened rather than motivated (Betz & Sekaquaptewa, 2012). Therefore, highlighting the similarities between the target group (e.g., girls) and the role models seems necessary and important to consider in devising interventions.

9.5 Changing Stereotypes About the Culture of a Field

As outlined above, elements of the stereotypes about a field's culture include the representative people working in the field and the characteristics of the work they perform. Therefore, changing the beliefs about the field's culture requires alternations of these components. With respect to the beliefs about the prototypical members of a field, research by Cheryan and colleagues (e.g., Cheryan et al., 2017) suggests that presenting the diversity of the field's members is effective in updating these beliefs and ultimately boosts women's engagement. For example, women expressed greater aspirations for majoring in computer science after they

interacted with a non-stereotypical computer science major student who enjoyed listening to music and making friends (Cheryan et al., 2013a) than with a stereotypical student in computer science. Similarly, after having face-to-face interactions with several scientists from different fields, 13- to 15-year-old students revised their initial ideas of scientists from being "boring" and "nerdy" to "approachable" and "ordinary" (Woods-Townsend et al., 2016).

Similarly, emphasizing that science involves working with people and serves communal goals—goals that are often highly valued by women when considering occupations (Diekman & Eagly, 2008), may encourage women to participate. These values are also in line with the reality—as reported by National Academy of Engineering (2017), many scientists nowadays take collaborative approaches in their research activities to solve issues carrying significant societal impact. Portraying a scientist's job as involving teamwork and serving many communal purposes, as opposed to solving problems alone, prompted undergraduates to consider a career option in science (Clark et al., 2016; see also Brown et al., 2015). Even preschoolers were more engaged in group-based science activities than when they had to work on the problems alone (Master et al., 2017), suggesting that adding the collaborative component to science work makes the job of "being a scientist" more attractive to women and young girls.

9.6 Conclusion

The bulk of research reviewed in this chapter suggests that gender stereotypes about intellectual abilities and the stereotypes about the culture of a field work together to influence girls' career choices, leading them to shy away from certain areas that they may have chosen otherwise. By combating the two types of stereotypes through strategic communications and educational practices, boys and girls are likely to be put on a relatively equal playing field to freely pursue their career aspirations.

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Chapter 10
Gender-Based Discrimination in Childhood and Adolescence

Christia Spears Brown and Michelle J. Tam

Abstract Gender-based discrimination, which includes any distinction, exclusion, or restriction made on the basis of socially constructed gender roles and norms, or biological sex/gender, gender identity, gender expression, or presumed sexual orientation, is prevalent throughout the world and is often directed at children and adolescents. Because childhood and adolescence are particularly vulnerable periods of development, there can be long-term consequences of experiencing such discrimination. In this chapter, we describe gender-based discrimination as it affects children and adolescents, beginning with a focus on how the field has shifted historically and in conjunction with historical and legal changes. We then detail the different types of gender-based discrimination targeting children and adolescents: discrimination at home, school, and media that involves (a) direct or indirect biased interactions targeting individuals, (b) structural biases within institutions, and (c) cultural expressions of stereotypes and prejudice.

Keywords Gender discrimination · Sexual harassment · Adolescence · Childhood

Gender-based discrimination—defined by the World Health Organization (2011) as any distinction, exclusion, or restriction made on the basis of socially constructed gender roles and norms—represents a significant social problem throughout the world. It becomes increasingly problematic when one broadens the definition to include discrimination on the basis of biological sex/gender, gender identity, gender expression, or presumed sexual orientation. Childhood and adolescence are important periods for academic, physical, social, and identity development; when gender-based discrimination targets children and adolescents, the consequences can be recursive and long-term, and can harm academic choices and success, parent and peer relationships, and emotional and mental health (see Brown, 2017 for review). Additionally, with adolescence, as gender and sexuality norms become important,

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the effects of gender-based discrimination may be detrimental for healthy sexual relationships and positive attitudes about the body (e.g., Petersen & Hyde, 2013). In this chapter, we describe gender-based discrimination as it affects children and adolescents, beginning with a focus on how the field has shifted historically and in conjunction with historical and legal changes. We then detail the different types of gender-based discrimination targeting children and adolescents and what those discrimination experiences are across different developmental contexts. It is important to note that the majority of this academic work has been conducted in Westernized countries (e.g., the USA, Australia); however, some research has been conducted in other countries, and we will specifically identify these studies within the chapter.

10.1 Research on Gender Discrimination in Historical and Legal Context

The study of gender discrimination in children has followed the social and political movement for gender equality. In the USA, in 1961, Eleanor Roosevelt chaired the Presidential Commission on the Status of Women that had been created by President Kennedy. In 1963, the commission issued a report, entitled *American Women,* that documented widespread discrimination toward women and girls. They stated, "Girls hearing that most women find mathematics and science difficult, or that engineering and architecture are unusual occupations for a woman, are not led to test their interest by activity in these fields. Because too little is expected of them, many girls who graduate from high school intellectually able to do good college work do not go to college" (Presidential Commission on the Status of Women, 1963, p. 4).

During this same period, research was beginning to look at how boys and girls were differentially socialized by their parents. One of the first mentions of differential gender socialization was from the book, *Patterns of Child Rearing* (Sears et al., 1957). Specifically, the authors noted that parents withdrew love from girls in response to their aggressive behaviors, whereas they did not for boys. They further argued that relatively higher rates of aggression in boys and dependency in girls was a result of parents rewarding behaviors associated with the child's gender and punishing the behaviors deemed inappropriate for their gender. The book's sole female author, Eleanor Maccoby, continued to explore how gender socialization shaped children's development. Indeed, she edited one of the first books specifically about gender roles entitled *The Development of Sex Differences* (Maccoby, 1966).

Years later, in 2000, Maccoby wrote a reflection about the historical trends in the study of gender development. She pointed out that the early research on gender development was influenced by the American mid-century zeitgeist of behaviorism, and primarily examined children's gendered behaviors using a stimulus-response principle to assess how "sex-typed" behaviors were reinforced. This observation was empirically supported by a 2011 analysis of gender development research in the

journal *Sex Roles.* Zosuls et al. (2011b) documented that most of the research on gender development in the 1960s and 1970s (at least, the research published in *Sex Roles*) concentrated on parents' socialization of boys and girls through different expectations and attitudes toward their children. This approach was ultimately limited, however, because parent socialization practices could not fully explain the high degree of gender stereotypical behaviors among children (Lytton & Romney, 1991).

By the early 1970s, the second wave of the women's movement heralded international attention and critical legislative changes banning gender discrimination, particularly as it related to children in schools. In the USA, *Title IX* of the Education Amendments was passed in 1972 and the *Women's Educational Equity Act* was passed in 1974 to promote educational equity for American girls and women. In the UK, the similar *Sex Discrimination Act* of 1975 was passed. The United Nations issued their 1975 *Report of the World Conference of the International Women's Year*, noting that the worlds' governments should ensure, "that co-education be provided at all levels in order that girls and boys may have access to identical curricula and resources. . .so that they may be able to form a more realistic picture of each other; and that all curricula should be free of sex bias, and should include a critical analysis of sex-role stereotyping." (United Nations, 1976, p. 100).

These public policy and legal trends co-occurred (not coincidentally) with research trends that were also beginning to focus on how gender bias affected children's education (Zosuls et al., 2011b). Two classic examples of the time were *The school's role in the sex-role stereotyping of girls: A feminist review of the literature* by Levy (1972) and *Sexual discrimination in the elementary school* and *Are you guilty of teaching sex bias*? by Myra and David Sadker (1972). Research documented that boys—but never girls—were being asked to run audio-visual equipment; boys' sports were receiving more funding, space, and staff than girls' sports; and boys and girls were directed toward very different career paths by counselors and teachers (Boring, 1973). As Sadker and Sadker wrote in their most well-known book, *Failing at fairness: How America's schools cheat girls,* "From grade school through graduate school female students are more likely to be invisible members of classrooms. Teachers interact with males more frequently, ask them better questions, and give them more precise and helpful feedback. Over the course of years, the uneven distribution of teacher time, energy, attention, and talent, with boys getting the lion's share, takes its toll on girls" (2010, p. 1). Similar findings have been observed in other countries. In the UK, it was noted that "While girls are at school, there are already strong influences at work to restrict their opportunities." (Coote & Gill, 1974, p. 32). In China, Chen and Rao (2011) found that, as early as kindergarten, teachers convey traditional Chinese gender roles (which favor boys over girls) to students; for example, they interact more with boys than girls and let boys be first in line.

Despite this global attention on the gender discrimination affecting girls, the 1973 National Educational Association book, *Sex Role Stereotyping in the Schools*, was explicit about the importance (and limitations) of the new legislation, stating, "Ten

years ago sex discrimination was widespread and legal. Today it is widespread and illegal." (Boring, 1973, p. 19). In other words, although the new legislation had firmly positioned the differential treatment of boys and girls as discrimination that was inherently unfair, unjust, and illegal, it was clear from empirical studies that it was still common.

Although empirical studies clearly documented that gender discrimination was occurring in schools, and that parents treated their children differently based on gender, research documenting how children *themselves* perceive gender discrimination is more recent and sparse. For example, in the 1985 book, *Just a Bunch of Girls,* Lesley Holly interviewed British 10-year-old girls in which they stated, "Girls *can* play football but nobody's organized it, so the boys think they should be able to play it more." (p. 56), and "They are much stricter on the boys. They hardly do anything to us." (Holly, 1985, p. 58). Research largely ignored children's perceptions of and understanding of gender bias and discrimination until after 2000. Our own work is one of the first developmental studies to use the label of gender discrimination in reference to children (Brown & Bigler, 2004). This work found that children in elementary school, particularly late elementary school, perceived gender discrimination by a teacher toward a student when contextual information suggested it was a likely explanation, such as when the teacher had a history of gender-biased choices. These perceptions of gender discrimination were related to children's gender attitudes, as children with egalitarian gender attitudes were more likely to perceive gender discrimination than their more biased peers (Brown & Bigler, 2004).

In the 1990s, concepts of gender discrimination targeting children and adolescents moved beyond parents and teachers to include peer-to-peer sexual harassment. In 1991, Anita Hill entered the national conversation when, during his Senate confirmation hearings for the US Supreme Court, she detailed Judge Clarence Thomas' perpetration of workplace sexual harassment. This brought the conversation of sexual harassment to the international stage for the first time. Shortly following this, in 1993, the American Association of University Women conducted the first national survey to examine girls' and boys' experiences with sexual harassment in school (grades 8–11) and published their landmark publication *Hostile Hallways*. Sexual harassment is defined as "unwelcome conduct. . .such as touching of a sexual nature; making sexual comments, jokes, or gestures; displaying or distributing sexually explicit drawings, pictures, or written materials; calling students sexually charged names; spreading sexual rumors; rating students on sexual activity or performance; or circulating, showing, or creating e-mails or Web sites of a sexual nature" (Hill & Kearl, 2011, pg. 6). This research found that 85% of girls and 76% of boys experienced sexual harassment at schools. These trends culminated with the US Supreme Court revisiting the scope of the 1970s *Title IX* of the Education Amendments in the case of *Davis v. Monroe County Board of Education* (1999). In that case, the Supreme Court ruled that the gender discrimination banned under *Title IX* also included sexual harassment at schools. As Justice Sandra Day O'Connor wrote, school boards are liable when officials are "deliberately indifferent to sexual harassment, of which they have actual knowledge, that harassment is so

severe, pervasive, and objectively offensive that it can be said to deprive the victims of access to the educational opportunities or benefits provided by the school."

10.2 Types of Gender-Based Discrimination Affecting Children and Adolescents

The modern study of gender-based discrimination in children and adolescence reflects the complexity of discrimination. Gender-based discrimination as a social phenomenon is complicated because it can be either overt or subtle, and it can occur at multiple levels simultaneously (see Brown, 2017). For example, discrimination can be (a) direct or indirect biased interactions targeting individual children, (b) structural biases within institutions, or (c) cultural expressions of stereotypes and prejudice.

At the most proximal, individual-level, gender-based discrimination can stem from direct interactions with peers, teachers, and parents. These are the easiest forms of discrimination for children and adolescents to perceive, especially when they are overt and face-to-face. These types of discrimination can include exclusion, either from social interactions (e.g., being left out of peer groups) or from opportunities. It can also include unfair evaluations or expectations, such as being graded unfairly by a teacher or given extra chores by a parent. It can include explicit teasing for engaging in counter-stereotypical behaviors or activities (e.g., teasing a boy who takes ballet). At the most extreme, gender-based discrimination involves bullying and physical violence, and is especially likely to be directed toward LGBT teens (e.g., 44% of LGBT teens in the USA are physically harassed at school because of sexual orientation; Kosciw et al., 2008). At the subtler end of the spectrum, individual-level discrimination can include different expectations (e.g., attributing girls' positive performance to extra effort, rather than ability); behaviors reflecting the presumption that certain groups are deviant (e.g., when teachers assume boys are misbehaving and refer them to the office at rates higher than girls); or communications that exclude, negate, or nullify the thoughts and feelings of the target (Sue, 2010). This can include adolescent girls who report sexual harassment to teachers, but are told that the solution is to dress less provocatively.

Gender-based discrimination also occurs at the structural or institutional level. Structural discrimination within institutions refers to biases within institutional policies and practices that unfairly restrict the experiences and opportunities of a certain group of individuals (Dovidio et al., 2010). Importantly, structural discrimination can exist even in the absence of individual-level stereotypes or discrimination (i.e., there can be sexism without sexists). For example, policies that ban LGBTQ student organizations, that prevent youth from self-identifying their gender identity at school, or that require that transgender male students use the female restroom (or vice versa) perpetuate structural/institutional-level discrimination. Policies that segregate students into classes based on gender (e.g., carpentry classes for

boys or cooking classes for girls) or that require girls and boys to wear gender-specific uniforms also perpetuate structural/institutional-level discrimination.

Finally, there is cultural-level gender-based discrimination. Cultural discrimination is defined as broad, societal-level behaviors guided by "beliefs about the superiority of a dominant group's cultural heritage over those of other groups, and the expression of such beliefs in individual actions or institutional policies" (Dovidio et al., 2010, p. 11). Most simply, this includes cultural expressions of stereotypes and prejudice. One of the most common types of cultural-level gender-based discrimination that is examined is girls'/women's and boys'/men's representation in media and politics, including the underrepresentation of girls in children's literature and the sexual objectification of girls in media.

10.3 Gender-Based Discrimination Across Development and Contexts

Consistent with the history of the field detailed above, most research on gender-based discrimination focuses on boys' and girls' direct experiences in their two most important domains: home and school. Considerably less research has focused on structural and cultural discrimination as it relates to children and adolescents, although those fields are currently attracting greater scholarly attention. In the following section, we detail research on children and adolescents' experiences with individual-level discrimination, namely gender-based discrimination at home with parents, at school with teachers, and at school with peers; then discuss children's knowledge of structural discrimination and cultural discrimination. As detailed below, most of the research conducted on gender-based discrimination affecting children and adolescents documents gender differentiated treatment. Although more limited, when available, we also discuss children and adolescents' *perceptions* of such discrimination.

10.3.1 Gender-Based Discrimination at Home

Children experience gender-based discrimination at home, most often by their parents. This most often includes different socialization practices for sons and daughters (for a more detailed review, see Brown & Tam, 2019). Although research indicates that parents do not differ in how much warmth or control they show their children (e.g., Endendijk et al., 2016; Lytton & Romney, 1991), they do differ in their treatment of boys and girls with regard to toys and play. Parents tend to stereotype certain toys as masculine (e.g., tools and trucks) and certain toys as feminine (e.g., dolls and make-up) (e.g., Peretti & Sydney, 1984; Wood et al., 2002). Subsequently, parents provide their children with gender-typed toys,

regardless of their children's actual preferences, and encourage gender stereotypical play (Lytton & Romney, 1991; Wood et al., 2002). Fathers tend to be more rigid about gender-typed play than mothers, and gendered-play is often more strictly enforced with sons relative to daughters. For example, 44% of preschool boys said their fathers would say it was bad if they played with girl toys, whereas only 24% said the same about their mothers (Raag & Rackliff, 1998; Robinson & Morris, 1986).

Parents also often treat girls and boys differently in regard to household expectations. Girls tend to do more chores than boys, and chores are often distributed in gender-stereotypic ways. For example, girls report being in charge of domestic chores, while boys are assigned tasks such as home repair (Etaugh & Liss, 1992). Furthermore, girls may experience stricter rules than their brothers. For example, one boy stated, "My brothers get to go somewhere [and] they come late and don't get punished but when my sister comes late, she gets punished." (Brown et al., 2011, p. 467).

Beyond different play expectations and household assignments, parents can also socialize their children differently based on their stereotypes about their traits, interests, and abilities. This includes the differential socialization of stereotypical emotions, such as sadness and anger. For example, in general, parents are more likely to discuss emotions with their daughters, especially female-stereotyped emotions such as sadness (Fivush, 1991; van der Pol et al., 2015). In contrast, parents stereotype anger as masculine and discuss that more often with sons than daughters (Fivush, 1991; Maccoby, 1998; van der Pol et al., 2015). Consistently, parents have also been shown to be less surprised and concerned by—and punish less frequently—aggressive behavior from sons relative to daughters (Eisenberg et al., 1998; Hastings & Rubin, 1999; Maccoby, 1998).

Parents also socialize boys and girls differently in accordance with stereotypes about academic interests and abilities. Most explicitly, parents are twice as likely to discuss numbers with boys than girls, and three times as likely to explain science exhibits to sons than to daughters (Chang et al., 2011; Crowley et al., 2001). Further, when asked to complete a science task with their early adolescents, fathers of sons used more cognitively demanding language (e.g., asking conceptual questions, using scientific vocabulary) than fathers of daughters (Tenenbaum & Leaper, 2003). These differences seem to reflect parents' differential expectations about their children's STEM (science, technology, engineering, math) abilities. When asked about their children's science abilities, parents of daughters tend to report that (1) science is harder for their child, (2) science is not as important for their child, and (3) that their child is not as interested in science compared to parents of sons (Andre et al., 1999; Bhanot & Jovanovic, 2009; Tenenbaum & Leaper, 2003). Additionally, parents are more likely to attribute sons' success in mathematics to innate ability, but daughters' success in mathematics to hard work (Yee & Eccles, 1988). These stereotypical attitudes are noticed by children, and high school boys are more likely than girls to say that their parents exhibit science-supporting behaviors (e.g., "help you feel better when science is hard" or "look at science websites with you") (Simpkins et al., 2015). When asked explicitly about their perceptions of gender-based

discrimination, 15% and 12% of adolescent girls reported that their fathers and mothers, respectively, have made sexist statements about their STEM abilities (Leaper & Brown, 2008).

Lastly, children and adolescents who do not conform to gender stereotypes (i.e., who are not highly typical for their gender) also experience gender discrimination from parents. This gender typicality-based discrimination begins as early as preschool. For example, parents are generally accepting when girls play with boy toys such as tools, but they believe that only girls can play with girl toys like make-up (Campenni, 1999; Wood et al., 2002). Children are aware of these biases, and preschoolers report that their parents would prefer that they played with a same-gender toy versus a cross-gender toy (Freeman, 2007). This pressure from parents to conform to traditional gender norms persists across middle childhood and into adolescence (Corby et al., 2007; Egan & Perry, 2001). In extreme cases, parents may coerce their children into conforming to gender norms. For example, the more gender-nonconforming transgender youth are, the more likely they are to be verbally and physically abused by their parents (Grossman et al., 2005).

10.3.2 Gender-Based Discrimination at School

Most research on gender-based discrimination has focused on differential treatment by teachers or negative comments, teasing, harassment, and exclusion from peers at school.

10.3.2.1 Teachers

Teachers, like parents, have different perceptions of boys' and girls' STEM abilities. Teachers tend to underestimate girls' math abilities and state that boys are better at STEM subjects than girls (Hand et al., 2017; Robinson-Cimpian et al., 2014). Additionally, teachers tend to attribute girls' success in physics to hard work, whereas they attribute boys' success to inherent ability (Carlone, 2004). Girls are able to perceive these biases and report explicit cases of gender discrimination by teachers (e.g., "feeling as though you had to work harder than male students to be taken seriously" or "hearing negative comments about girls' and women's STEM abilities"; Robnett, 2016). In fact, nearly 23% of adolescent girls report hearing their teachers or coaches make sexist comments about their STEM abilities (Leaper & Brown, 2008). When one adolescent girl expressed her desire to get top marks in a high-level math course, the teacher responded, "Oh I think you have to have a boy brain to do that" (Francis et al., 2017, p. 164).

While teachers may believe that boys are better than girls at STEM subjects, they may also believe that boys have *less* potential for overall school success and are more likely to misbehave in class than girls (Mullola et al., 2012). When asked to rate their students across a multitude of domains, teachers report that boys are higher

in distractibility than girls, but are lower in persistence and educational competence than girls (Mullola et al., 2012). Teachers are also stricter with male versus female students, and boys are more likely to be punished or to receive disciplinary referrals at school than girls (Chen & Rao, 2011; Silva et al., 2015). For example, one boy noted, "My friend in middle school, the girl pulled down a boy's pants and she didn't get in trouble. If the boy did it, he would get in trouble," and another said, "One time I missed an assignment and I couldn't make it up. But then a girl comes and sweet-talked the teacher. He falls for it and gives her a make-up assignment" (Brown, et al., 2011, p. 467). This tendency to be stricter with boys than girls is especially pronounced for African American boys (Cogburn et al., 2011; Noguera, 2003).

Beyond the classroom, students also experience gender discrimination from teachers in the domain of athletics. Teachers tend to believe that boys are more inclined toward or skilled in athletics (Garrahy, 2001; Satina et al., 1998), and nearly 30% of adolescent girls report that their teachers/coaches have made sexist comments about their athletic abilities (Brown, et al., 2011; Leaper & Brown, 2008). Boys are also aware of this discrimination against girls, and one middle school boy noted, "My teacher in elementary school wouldn't let girls play dodgeball because they would get hit and cry" (Brown, et al., 2011, p. 467).

Lastly, children and adolescents who do not conform to gender norms also experience discrimination from teachers. For example, preschoolers who display cross-sex play behaviors (e.g., boys who play dress up) are often targets of teacher criticism (Fagot, 1977). Teachers also make discriminatory statements on the basis of gender identity and sexual orientation (Buston & Hart, 2001). In a study on sex-education classrooms, researchers observed several instances of overt homophobia from teachers, including teasing boys about being gay, making obscene jokes about lesbian sex with male students, and stating that vaginal intercourse is the only valid form of sex (Buston & Hart, 2001).

10.3.2.2 Peers

Along with teachers, peers play an important role in children and adolescents' school lives. Peers' treatment of each other varies by gender, and this can begin as early as preschool. For example, preschoolers spend significantly more time with same-sex than cross-sex peers (Martin & Fabes, 2001; Powlishta et al., 1993). This preference does not emerge until around 2 years of age, when children learn to label gender, and girls tend to show this gender preference before boys (Fagot & Leinbach, 1993; LaFreniere et al., 1984; Powlishta et al., 1993).

As children transition into middle childhood, this same-sex preference persists (Strough & Covatto, 2002; Zosuls et al., 2011a). Children this age also begin to internalize (i.e., believe or endorse) gender stereotypes. For example, when asked what being a boy/girl means to them and what they like about being a boy/girl, 61% of children gave gender-stereotypical answers (Rogers, 2020). One girl said, "because sometimes when I look at boys they're really nasty and—I don't really like boys' clothes. . .I like being a girl because girls are pretty," while another

answered, "They [boys] always get into fights, always talking bad about other people, getting in trouble in class for talking back to the teacher, um talking in class, being on their phones. . .some girls are bad but not as bad as the boys" (Rogers, 2020, p. 7). Only 13% of the children gave counter-stereotypical answers that explicitly challenged stereotypes (e.g., "People they say that boys can do more things than girls, I do not believe that at all. .. I prove them wrong"; Rogers, 2020, p. 6).

As childhood transitions into adolescence, girls, especially, begin to note peer bias against them in regard to sports and STEM (Brown et al., 2011; Leaper & Brown, 2008). For example, 58% of high school girls intending to major in STEM report gender bias (e.g., "feeling as though you had to work harder than male students to be taken seriously" or "hearing negative comments about girls' and women's STEM abilities") from male peers, and 28% report the same from female peers (Robnett, 2016). Adolescent girls also perceive peer discrimination in athletics, and 54% report hearing sexist comments about their athletic abilities from peers (Leaper & Brown, 2008). Additionally, while adolescents said that athletic ability was the most important predictor of boys' popularity, the same was not true for girls (Becker & Luthar, 2007; Shakib et al., 2011). Rather, physical attractiveness was the most important predictor of girls' popularity. This emphasis on girls' appearance coincides with puberty and may be aggravated by the sudden importance of sexual and romantic relationships (Galambos et al., 1990).

This high degree of gender segregation (e.g., preference for same-sex friends) decreases across middle school and into high school (Strough & Covatto, 2002), when sexual and romantic relationships increase in importance (Galambos et al., 1990). Unfortunately, this increased integration between boys and girls is accompanied by high rates of sexual harassment in high schools (Hill & Kearl, 2011). Various studies have examined the prevalence of sexual harassment in high schools, with up to 90% of girls and 79% of boys reporting being the target of some form of sexual harassment (AAUW, 2001; Hill & Kearl, 2011; Leaper & Brown, 2008). Girls are more likely to report being the target of sexual harassment, while boys are more likely to report being the perpetrator of sexual harassment (Ashbaughm & Cornell, 2008; Gruber & Fineran, 2016; Jewell et al., 2015).

Lastly, children and adolescents who do not conform to traditional gender norms are also likely to experience gender typicality-based discrimination by peers. This can begin as early as preschool, where individuals who display cross-sex play behaviors (e.g., girls who play outside in the sandbox, boys who play with dolls) are criticized or excluded by peers (Fagot, 1977). This continues into middle childhood. A study of 5–9-year-old children showed that boys gave "like" nominations to male peers who participated in sports, a stereotypically masculine activity, during recess and gave "dislike" nominations to male peers who participated in role-play, a stereotypically feminine activity (Braza et al., 2012). In a recent study with Chinese 4–9-year-olds, children gave more positive peer appraisals (e.g., preferred being friends with and shared more stickers with) gender-conforming rather than gender-nonconforming children in a series of vignettes (Kwan et al., 2020). This

pattern was especially pronounced among older children. Boys were more negatively evaluated for their non-conformity than were girls (Kwan et al., 2020).

As children enter adolescence, this social exclusion often evolves to include verbal and physical harassment from their peers. Adolescents who are highly atypical for their gender often face high rates of peer harassment that range from name-calling to, at the most extreme, being attacked with a weapon (Jewell & Brown, 2014; Kochel et al., 2012; Zosuls et al., 2016). Research suggests that these forms of gender discrimination are most pronounced for boys, who experience both stricter gender norms and harsher consequences for violating those norms than do girls (Carter & McCloskey, 1983; Jewell & Brown, 2014).

10.3.3 Structural Discrimination

Research on children's knowledge of structural discrimination is rather sparse. Most of that research has focused on children and adolescents' perceptions of gender discrimination in occupations and politics. For example, at a concrete level, when elementary school-age children were shown novel occupations performed by either a woman or man, they rated the jobs performed by women as lower in status (i.e., earn less money and are less important) than the identical jobs performed by men (Liben et al., 2001). This understanding does not seem to generalize to an understanding of broader occupational inequalities. Specifically, although women still make significantly less than men and are underrepresented in the upper echelon of corporations, children and adolescents do not perceive substantial status inequalities in the business world (Neff et al., 2007).

There is also research indicating that children, by elementary school, can perceive gender-based structural/institutional discrimination in politics. In the USA, in 2008, Bigler and colleagues (2008) found that 87% of children were aware that men are usually the US president. This decreased significantly in 2016 (following the campaign of the first female presidential candidate, Hillary Clinton), when 74% of children reported that "only men" are usually president (Patterson, et al., 2019). Surprisingly, only 65% of children knew that no woman has ever served as president of the USA. These rates did not differ by gender.

Children also perceived past structural/institutional discrimination. Specifically, half of the American children sampled believed that women were historically excluded by law from being president, and more than half of children perceived that the historical lack of female presidents was due to voter bias and discrimination (Bigler et al., 2008). Consistent with advances in cognitive development, knowledge of gender-based historical structural/institutional discrimination increased with age across middle childhood. Some children perceived *current* structural/institutional discrimination. One-quarter of children (erroneously) assumed that it was *currently* against the law (in 2007) for a woman to be president, and half believed that individual voters would be discriminatory (Bigler et al., 2008). There were differences across age groups, however. Among children under age nine, 35% assumed

that it was currently against the law for a woman to be president of the USA, whereas only 7% of children age nine or older did.

Interestingly, knowledge of structural inequalities was related to family socialization, specifically their family's support of presidential candidate Hillary Clinton (Patterson et al., 2019). For example, children from families with high support for Ms. Clinton were more likely to know that men are usually president than were children from families with lower levels of support for Ms. Clinton. Children were also largely unaware of the extent to which women are underrepresented in the US government and lacked knowledge of women in international leadership roles. More than half of children did not know that a woman has been the president of another country (Patterson et al., 2019).

With age, children seem to become increasingly aware of existing societal gender inequalities. Neff and colleagues found that by 13 years old, but not by 9 years old, children in the USA were aware of status and power inequalities in politics (Neff et al., 2007). Specifically, early adolescents perceived men to hold more power and influence in politics relative to women, and girls perceived this inequality more than boys. Perceptions of gender inequalities in politics increased with age, with late adolescents perceiving more inequality than middle adolescents, who perceived more than early adolescents.

10.3.4 Cultural Discrimination

Research has documented cultural-level gender-based discrimination targeting children and adolescents. For example, this is frequently documented in children's books and media. In general, there are differences in sheer representation of boys and girls, as boys are more likely to have a central role in books and more likely to be a part of the title of the book than girls (Tsao, 2008). Further, children's books often have stereotypical portrayals of boys and girls (Tsao, 2008). In a review of award-winning Canadian children's literature, analyses showed that children's books typically portrayed men as protectors, adventurers, and problem-solvers, whereas women were portrayed as homemakers (Taber & Woloshyn, 2011). When children are depicted in the story, they are also portrayed stereotypically. Girls are often shown completing domestic chores, while boys are typically portrayed as more active than girls (and active girls are considered "exceptions"), and girls are often dressed in skirts and dresses even when engaging in activities for which skirts and dresses are inappropriate (Tsao, 2008). A review of fifth grade books showed that male characters are overwhelmingly portrayed as competitive, aggressive, and argumentative (Evans & Davies, 2000). Even in books labeled by researchers and publishers as "nonsexist," although female characters may have masculine characteristics and roles, they typically also maintain traditional female gender roles; additionally, these books very rarely portray male characters with female characteristics and roles (Diekman & Murnen, 2004).

Cultural-level gender-based discrimination is also evident in the prevalence of sexualized depictions of girls in virtually all forms of media, such as magazines, video games, music videos, television shows, and movies (e.g., Conrad et al., 2009; Downs & Smith, 2010; Fabrianesi et al., 2008; Gerding & Signorielli, 2014; Hall et al., 2012). Children's television shows frequently portray girls as sexualized by wearing tight, revealing clothing (Lacroix, 2004). A recent study analyzed 10 of the most popular television shows among White and Latina US girls and found evidence of sexualization of female characters in everyone (McDade-Montez et al., 2017). Sexualized images of girls extend beyond media. One-quarter of girls' clothing is revealing or has sexually suggestive writing (Goodin et al., 2011), and popular dolls marketed to young girls wear leather miniskirts and thigh-high boots (see American Psychological Association, 2007). Although no known research has explicitly asked girls and boys about these gender-biased media images, this extensive media saturation does appear to lead girls to increasingly sexualize themselves. For example, research in Australia has shown that girls as young as 4 are already portraying sexualized behaviors, such as wearing makeup and having body image concerns (Tiggemann & Slater, 2014).

Although little research has asked children and adolescents about their explicit awareness of cultural discrimination, some adolescents may be aware of the links between cultural stereotypes and inequalities. In qualitative research with adolescents (Grossman & Porche, 2014), some girls are able to articulate the links between societal stereotypes and inequalities. For example, one girl noted: "Girls are told [by society], 'Oh girls are less interested in science.' So they're like, 'Well, I'm less interested in science.'" (Grossman & Porche, 2014, p. 711).

10.4 Conclusions

Despite great advances in gender equity over the past 40 years, gender-based discrimination is still prevalent in childhood and adolescence. This discrimination stems from peers, parents, teachers, and society. By early adolescence, children report being teased for not conforming to gender stereotypes or being gender atypical. Whereas boys are more frequently teased for violating masculinity norms, girls in middle childhood are more frequently teased for supposedly poor athletic ability, and by early adolescence, the majority of girls will report being the target of sexual harassment by their male peers. The teasing becomes particularly frequent and intense (often classified as bullying) if the adolescents are gay, lesbian, bisexual, or queer, and is most dangerous and pervasive if the adolescents are transgender. Teachers also, at times, make negative comments about children's abilities (particularly to girls), make generally negative comments (particularly to LGBT adolescents), and disproportionately punish boys for misbehaviors. Even parents hold differential standards for boys and girls and make discouraging comments about girls' STEM or athletic abilities. Many gender-atypical adolescents perceive parental pressure to be more gender stereotypical, and many LGBT

adolescents perceive their parents to reject them when they disclose their sexual orientation. Children are seemingly less aware of broader structural and cultural discrimination, although their knowledge seems to become more accurate with age.

Although considerable research has been conducted, there needs to be substantially more work on children and adolescents' gender-based discrimination. Much of the work on children's understanding of structural discrimination comes from a US context. We need more work in developmental psychology examining these processes in other regions of the world. This is especially true of the societies in which the lives of girls and gender-nonconforming youth remain highly oppressive (Rafferty, 2013). We also need a better understanding of the long-term effects of experiencing gender-based discrimination in childhood in combination with other forms of discrimination such as those based on individuals' race/ethnicity, appearance, religion, or socioeconomic status (Brown, 2017; Else-Quest & Hyde, 2016). Variations in gender norms related to cultural traditions may affect how and when bias is manifested across different ethnic groups, and individuals may be more likely to experience discrimination when they belong to more than one stigmatized group (e.g., Bucchianeri et al., 2013). Future research on children's intersectional identities is needed. As we strive for true gender equity worldwide, future researchers must be mindful of the ways in which gender bias has persisted, the ways in which gender bias has transformed over time, and the ways in which diverse individuals experience gender bias differently.

Spotlight Feature: Children's Appraisals of Peer Gender Nonconformity

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Many adults encourage boys to play with cars and girls to play with dolls, believing that children should engage in gender-conforming activities. Interestingly, when children possess positive traits, if these traits are gender-nonconforming (e.g., a boy being gentle, well-mannered, eager to soothe hurt feelings), adults tend to perceive them less positively (Coyle et al., 2016). Similar to adults, children's appraisals of gender-nonconforming peers are also less positive, and such appraisals are further complicated by several factors. One factor is the peers' gender, with gender-nonconforming boys being more negatively appraised than gender-nonconforming girls (Wallien et al., 2010). Second, compared to feminine characteristics, masculine characteristics are perceived as having higher status in society and higher status members tend to be avoidant of characteristics which are perceived as having lower status (Leaper, 1994). This might explain why boys who show feminine characteristics are usually perceived negatively. Third, there are different domains of gender nonconformity such as appearance, behaviors, traits, gender of playmates, and the appraisals depend on the combination of gender and domain of gender nonconformity. Boys with feminine appearance are perceived more negatively than girls with masculine appearance while girls who prefer masculine play activities are perceived more negatively than boys who prefer feminine play activities (Blakemore, 2003).

Apart from the above gender-related factors, age is another factor influencing children's appraisals of gender nonconformity. Research shows that children, especially younger children aged 5 to 6 years old, are rigid in abiding to the gender norms (Trautner et al., 2005). Some children even act as gender police to correct other children's gender-nonconforming behaviors. As children grow older, they begin to understand that both boys and girls can perform counter gender-stereotypical activities (Signorella et al., 1993). As a result of increasing gender-stereotypical knowledge and cognitive flexibility with age, children might become more accepting of gender-nonconforming peers. On the contrary, research found that older children tend to be less positive towards gender nonconformity than younger children (Carter & McCloskey, 1984). This suggests that children may not naturally grow out of their bias against gender nonconformity despite more advanced cognitive ability to understand the existence of diversity.

Bias against gender nonconformity may be a call for concern given that gender nonconformity is in fact common in the population. Although extreme gender nonconformity that constitutes gender dysphoria may be rare, research found that

around 20% of boys and 40% of girls of school age show at least ten gender-nonconforming behaviors (Sandberg et al., 1993; Yu & Winter, 2011). Gender nonconformity is associated with mental health risks, of which poor peer relations may be a key contributing factor (Cohen-Kettenis et al., 2003; Kuvalanka et al., 2017). If children's bias against gender nonconformity can be reduced, it is possible that the psychological well-being of gender-nonconforming children can be improved as well. Research have been conducted to explore ways to reduce gender-based bias. For example, Mundy-Shephard (2015) employed empathy, perspective taking and mere exposure in adolescents and young adults but the intervention could not successfully reduce bias against sexual minorities. Also, Coyle et al. (2016) showed that adults' appraisals of gender-nonconforming children became more positive if these children were portrayed to possess positive gender-nonconforming characteristics (e.g., an independent girl and a gentle boy). Some studies focused on children's appraisals but they emphasized appraisals of sexism (e.g., bias against one gender, usually women and girls) instead of gender nonconformity, for example, by training children to respond to others' sexist comments (Lamb et al., 2009).

A recent study developed an intervention to reduce children's bias against gender-nonconforming peers. This intervention of presenting positive and gender-conforming attributes of gender-nonconforming peers was successful in reducing bias against gender-nonconforming peers in Hong Kong children aged 8 to 9 years old (Kwan et al., 2020). It is suggested that by simply presenting the gender-nonconforming peers with a diverse range of traits (both gender-conforming and -nonconforming, and traits that would be considered positive such as performing well in school), children became more positive towards them. In fact, every individual, including gender-nonconforming individuals, possesses a diverse range of attributes. However, in our daily life, gender-nonconforming attributes can easily draw attention and children may hardly realize that gender-nonconforming children also share many attributes with them in common. By reminding children of the other attributes of gender-nonconforming children, bias was reduced in this study. Interestingly, although the intervention may be said to have worked by reminding children of the gender-conforming and generally positive attributes of the gender-nonconforming peers, it indirectly led the children to perceive those peers' gender-nonconforming behaviors as less wrong (or more right) and to be less aversive of engaging in those same activities. The findings from this intervention opened up a gateway to build a more tolerant future generation from a young age.

Interestingly, the same intervention was not successful in reducing bias against gender-nonconforming peers in Canadian participants (MacMullin et al., 2020). Cultural differences in processing contradictory information might provide a possible explanation. Previous research suggested that when receiving contradictory information, Chinese accept the contradiction and adjust their views by finding a "middle" position between the two opposing views, whereas Westerners are more likely to ignore the contradiction and become polarized in their original views (Peng & Nisbett, 1999). The intervention involves presenting opposing information (i.e., peers possessing both gender-conforming/positive attributes and gender-

nonconforming attributes). This may explain why only Hong Kong children adjusted their appraisals and became more positive towards gender-nonconforming peers. These suggested the importance of cultural consideration in devising interventions to reduce bias against gender nonconformity.

Different interventions in reducing bias against gender nonconformity in children can be explored in future studies. Meta-analysis of contact-based interventions suggested that both direct and indirect contact of individuals of different ethnicities showed some success in reducing ethnic bias (Lemmer & Wagner, 2015). Ethnicity and gender are both perceptually salient features and children tend to focus on these features when categorizing people into ingroup and outgroup members (Bigler & Liben, 2007). Intergroup contact theory suggested that interactions with outgroup members can lead to more positive attitude towards the outgroup members (Pettigrew & Tropp, 2011). Thus, future studies can explore whether interventions that enhance interactions between children of different gender expressions can potentially reduce bias against gender nonconformity.

There is increasing attention to gender nonconformity globally with research showing increasing prevalence rates in gender nonconformity (Zucker, 2017). Recent studies showed that perception and treatment of gender nonconformity might vary across cultures from early childhood. For example, Hong Kong children showed more consistent bias against gender nonconformity than Canadian children and were more receptive of the particular intervention (Kwan et al., 2020; MacMullin et al., 2020; Nabbijohn et al., 2020). It is worth exploring further how the expression, perception, and treatment of gender nonconformity differ across cultures.

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Chapter 11
Gender and Sexuality in Disorders/Differences of Sex Development

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Abstract Intersex conditions or disorders/differences of sex development (DSD) are conditions in which the development of chromosomal, gonadal and/or genital characteristics is atypical. Studies in individuals with DSD conditions may provide valuable insights on the roles played by sex chromosomes, sex hormones, sex anatomy and gender of rearing in the development of gender role and gender identity. An overview is given regarding various aspects that may be influenced in individuals with DSD conditions: play behaviour, activities, interests, cognitive functioning and brain development. Furthermore, we will highlight gender development across the DSD spectrum by describing the literature regarding gender identity and expression in individuals with DSD conditions. Gender dysphoria and gender change are more prevalent in individuals with DSD conditions. These findings have also been important in the debate around gender assignment in individuals born with ambiguous genitalia. In addition, we will describe sexual development, as sex-atypical physical appearance, hormone replacement therapy, past surgical interventions, and psychological issues may all affect sexuality. Recent developments show there is more room for gender diversity in society. A less binary approach to gender may also positively influence feelings regarding gender in variations of sex development.

Keywords Disorders of sex development · Differences of sex development · Intersex conditions · Gender role behaviour · Gender identity · Gender expression · Gender assignment · Gender dysphoria · Gender development · Sexual development

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In typical sexual differentiation, development of chromosomal, gonadal and anatomical characteristics are in line. Congenital conditions in which the development of these characteristics is atypical are labelled as intersex conditions or disorders/differences of sex development (DSD). There is a lot of debate with regard to terminology, and various terms are being preferred for various reasons by various stakeholders, while considered offensive by others (see Johnson et al., 2017; Miller et al., 2018). In this chapter, we will use DSD conditions, being aware of the difficulties regarding this terminology, but going with the term that is still widely used in both the medical and public arena that covers a wider range of conditions than intersex. In such conditions, genital sex may not correspond to gonadal or chromosomal sex. Gender (identity and role), in such cases, may be congruent with genital sex, but not with chromosomal or gonadal sex. In other cases, gender may be incongruent with genital sex.

In his work with children with DSD conditions, John Money proposed the distinction between sex and gender (Money, 1994). In addition, he introduced the concepts of gender role and gender identity, with gender role being the public expression of gender identity and gender identity the private manifestation of gender role. Studies in individuals with DSD conditions play a key role in attempts to understand the development of gender role and gender identity, as they often provide valuable insights on the role sex chromosomes, sex hormones, sex anatomy and nurture play (separately or in varying combinations).

In typical sexual differentiation, the male-typical pathway starts off with XY chromosomes. The sex determining region Y (SRY) gene on the Y chromosome induces the development of the testes, and the testes produce testosterone, which triggers the development of male genitalia. Generally, these persons are reared as males, live in the male gender role and have a male gender identity. In individuals with XX chromosomes, ovaries develop in the absence of the SRY gene. Without exposure to testosterone from the testes, the genitalia and body develop in the female-typical direction. With female rearing, and living in the female gender role, the majority of women have a female gender identity. In individuals with DSD conditions, sexual differentiation is atypical and steps in this cascade of events may turn out differently (see Table 11.1 for a description of some of the most prominent DSD conditions) (Hughes et al., 2006; Lee et al., 2006, 2016).

Sex hormones play a crucial role in sexual differentiation. For example, people with XY chromosomes and complete androgen insensitivity syndrome (CAIS) do have testes, but are insensitive to testosterone and their body further develops in the female direction (although developing no uterus and deep vagina due to regression of Müllerian structures). Although a condition named congenital adrenal hyperplasia (CAH) does not seem to affect sexual differentiation in XY individuals, the exposure to elevated levels of testosterone during prenatal development in individuals with XX chromosomes with this condition may result in virilised genitalia, but also more male-typical behaviour and interests. These latter outcomes are ascribed to prenatal effects of sex hormones on the sexual differentiation of the brain, and called organising effects (Bakker, 2019; Phoenix et al., 1959). Effects of sex hormones during life on the already organised neural system are referred to as activating effects.

Table 11.1 Some of the more prominent DSD conditions, adapted from Hughes et al. (2006) and Lee et al. (2006, 2016)

Type	Examples
Sex chromosome DSD	45,X (turner syndrome) 47,XXY (Klinefelter syndrome) 45,X/46,XY (mixed gonadal dysgenesis, ovotesticular DSD)
46,XY DSD	Conditions of gonadal (testicular) development (complete and partial gonadal dysgenesis, ovotesticular DSD) Conditions of androgen synthesis or action (complete and partial androgen insensitivity syndrome [CAIS and PAIS], 5α-RD-2 deficiency, 17β-HD deficiency) Other (severe hypospadias, cloacal extrophy)
46,XX DSD	Conditions of gonadal (ovarian) development (gonadal dysgenesis, ovotesticular DSD) Conditions of androgen excess (21-hydroxylase deficiency: Congenital adrenal hyperplasia [CAH]) Other (cloacal extrophy, vaginal atresia)

Animal studies have been used to study such organising and activating effects of sex hormones (e.g. Hines, 2009, p. 1869–1909). In humans, these effects are difficult to study in typical sexual differentiation, because chromosomal, gonadal, hormonal, genital, and gender development are generally in line. But such effects can be studied in individuals with DSD conditions, where sexual differentiation during prenatal development is atypical.

Neurobiological studies into sex differences have for long mainly focused on sex hormone effects (either induced early in development or by measuring sex hormone levels at the time of study), but more recently attention has been given to the effects of sex chromosomes and the direct effects of genes on sexual differentiation of brain and behaviour as well (McCarthy et al., 2012). It should be noted that every cell in the body carries sex chromosomes. In animal studies, the four core genotypes model has been developed to study direct effects of sex chromosomes. This model makes use of genetically modified mice and the fact that the SRY gene causes the development of testes: 1.) XX without SRY (ovaries); 2.) XY without SRY (ovaries); 3.) XY with SRY (testes); 4.) XX with SRY (testes). By comparing type 1 and 2, one can distinguish effects of sex chromosomes, because the groups differ by XX and XY, yet their gonadal type is the same. By comparing type 2 and 3, one can distinguish effects of gonadal type (with effects of hormones as produced by the gonads), because they are different and sex chromosomes are similar. A human model for sex chromosome effects is provided by XY women with CAIS: Similarities with control men (XY) would indicate dominant effects of sex chromosomes.

11.1 Play Behaviour, Activities and Interests

Sex differences in play behaviour have been consistently reported, with boys preferring toys like vehicles, engaging in rough and tumble and preferring other boys as playmates more than girls do (Davis & Hines, 2020; Hines, 2011a). With the

relatively large sex differences and early-life assessment during a period of hormonal rest (hormonal levels are low from several months after birth until the early stages of puberty), play behaviour offers an easy way to examine effects of prenatal hormones on this parameter of gender development. Multiple studies in girls with 46,XX CAH, who have been exposed to increased androgen levels prenatally, have reported that they show increased preferences for male-typical toys on average (Hines, 2011b). Effects have been found across various measures, such as observation and self-report (Berenbaum & Meyer-Bahlburg, 2015). Because these girls have a possibly life-threatening medical condition and are sometimes born with virilised genitalia, it has been argued that other aspects than the exposure to elevated androgen levels may have led to increased male-typical behaviour and interests (Steensma et al., 2013). Parental influence on sex-typical behaviour in girls with 46,XX CAH has been studied. In laboratory observations, parental encouragement of sex-typical toy play did not seem to override the preference for male-typical toys in girls with 46,XX CAH (Pasterski et al., 2005). A subsequent study (Wong et al., 2013) showed that parents reported encouraging more male-typical toy play in girls with 46,XX CAH, possibly as a response to their increased interest in male-typical toys. Studies of offspring from women with normal variability in testosterone during pregnancy also show an association between maternal T levels in amniotic fluid and male-typical play preferences in their daughters (Hines, 2011b), although this association has been called into question (Davis & Hines, 2020).

More recently, it has been found that girls with 46,XX CAH show changes in processes related to self-socialisation of gender-related behaviour with lower responsiveness to cues that certain objects are female-typical (labelling) and less imitation of female models choosing particular objects (modelling) (Hines et al., 2016). The authors suggest therefore that prenatal androgen exposure not only affects gender-related behaviour by permanent changes in the brain, but also by changing processes involved in self-socialisation of gendered behaviour.

More male-typical interests, activities and occupations have been reported in women with 46,XX CAH as well, thus suggesting that masculinised traits continue into adulthood (Wisniewski & Aston, 2015), where “masculine” refers to traits and behaviour that are on average more prevalent in boys and men. However, XX women with CAH reported more feminine/less masculine patterns of gender role with age and were indistinguishable from XY women with CAIS in adulthood in this latter study, suggesting that other factors may become more important with age in the expression of sex-(a)typical patterns. Girls and women with CAIS report female gender role from childhood to adulthood (Wisniewski & Aston, 2015). In a study in individuals with various 46,XY DSD conditions raised either male or female, gender role increasingly corresponded with assigned gender throughout development into adulthood (Pappas et al., 2008). Socialisation, learning and endocrine influences may all contribute to this development. Recalled childhood gender role behaviour and gender identity/gender dysphoria (i.e. psychological distress resulting from the incongruence between their experienced gender and sex-specific bodily appearance) were studied in individuals with various DSD conditions (46,XY DSD, 46,XX CAH) with either typical or atypical genitalia and that were raised either male or

female (Callens et al., 2016). The authors concluded that although prenatal androgen exposure was shown to have large effects on gendered preferences in play and activities, gender of rearing appears to predict contentedness with gender identity better (Callens et al., 2016).

11.2 Cognitive Functioning

Although there are often more differences within sexes than between sexes with regard to cognitive functioning (Hyde, 2014), there are some abilities that tend to show differences between men and women. Men generally outperform women on certain visuospatial tasks, whereas women are superior in verbal fluency tasks (Halpern, 2012). Girls with 46,XX CAH seem to have somewhat better spatial abilities than their unaffected sisters (Berenbaum et al., 2012) and women with the most severe form of 46,XX CAH (and highest expected exposure to prenatal androgen) had similar performance to control men (both healthy and with 46,XX CAH) on a spatial task (Mueller et al., 2008).

Theory of Mind (ToM), the ability to form ideas about and make sense of other's and one's own perspectives on situations and events, has been studied in individuals with DSD conditions as well (Khorashad et al., 2018a). Women are reported to outperform men on ToM measures (Baron-Cohen et al., 2001; Khorashad et al., 2015). Birth-assigned females with 46,XX CAH or with 5α-RD-2 (both groups are exposed to high levels of testosterone during prenatal development) and age-matched control men scored significantly lower on a Reading the Mind in the Eyes Test (RMET, a ToM task) compared with individuals with low prenatal testosterone exposure/effects (age-matched control women, women with CAIS). Also, current testosterone replacement was associated with lower Reading the Mind in the Eyes Test scores. These findings suggest that karyotype (sex chromosomes) affects ToM performance to a lesser extent than prenatal hormonal levels, because both control women with XX karyotype and women with CAIS with XY karyotype perform better than control men with XY karyotype and women with CAH with XX karyotype.

11.3 Brain Development

Neuroimaging studies in individuals with DSD conditions have mainly been performed in women with CAIS and 46,XX CAH. The aim of such studies in women with CAIS is to determine if certain brain measures are influenced by hormonal action and/or by chromosomal pattern. Similarities between women with CAIS and control men would suggest chromosomal influence, whereas similarities between women with CAIS and control women would indicate hormonal influence on these measures. With regard to structural measures in women with CAIS, it is

found that their white matter Fractional Anisotropy values (Diffusion Tensor Imaging) are more similar to those of control women and different from those of control men (Savic et al., 2017; van Hemmen et al., 2016), suggesting that structural connectivity is primarily under the influence of hormonal action. For Cortical Thickness (CTh) the findings are more mixed; CTh in parietal and occipital cortices and the left temporal cortex in women with CAIS is in the female range, whereas CTh in pre (motor cortex) and postcentral gyrus (somatosensory cortex) is in the male range (Savic et al., 2017). Interestingly, when multivariate pattern recognition is used, women with CAIS were more similar to control men using grey matter or multimodal information as classifier (van Hemmen, 2017, p. 102). In structural development of the brain, both sex hormones and sex chromosomes may thus play a role, with a more dominant role for sex hormones (primarily testosterone) on white matter measures and other measures moderated by sex hormone and sex chromosome effects.

In functional neuroimaging, patterns in women with CAIS do seem to be more in line with control women in activation while viewing sexually arousing stimuli (Hamann et al., 2014) and while performing a mental rotation task (van Hemmen et al., 2014). This similarity is generally assigned to the effects of sex hormones because, again, women with CAIS, being insensitive to testosterone, display a female-typical instead of a male-typical pattern. However, it should also be noted that these women generally live in the female role and socialisation effects can also play a role in these patterns.

Studies in individuals with CAH have mainly focused on the amygdala. Grey matter volume is larger in bilateral amygdalae in men compared with women (Ruigrok et al., 2014). Decreased amygdala volume was observed in boys with CAH and girls with CAH compared to controls (Merke et al., 2003; Rose et al., 2004). In functional MRI studies, amygdala activation to negative facial expressions in women with 46,XX CAH was more similar to control men (Ernst et al., 2007); hypoactivation of the amygdala was observed in adolescent girls with 46,XX CAH and hyperactivation of the amygdala in adolescent boys with CAH during an emotional memory task (Mazzone et al., 2011). As the amygdala is abundant with androgen and oestrogen receptors, these findings are often discussed in the light of the exposure to sex hormones, but the imbalance of glucocorticoids in individuals with CAH should also be taken into account (Bramble et al., 2017), because the imbalance in glucocorticoids also appears to reduce amygdala volume.

11.4 Gender

As aforementioned, measures of gender expression, gender role behaviour and a range of gender-related psychological domains (e.g. cognitive abilities, social interests and personality traits) have been associated with sex hormonal variances in individuals with DSD conditions (Berenbaum & Meyer-Bahlburg, 2015). Empirical research shows that in individuals with DSD conditions, chromosomal, but mostly

hormonal and physical variations of sex influence the development of gender role as well as identity (Berenbaum & Meyer-Bahlburg, 2015). Sex hormones, of which androgens most strongly, impact structural brain development in early life (organisational effects) as well as exert temporary functional effects (i.e. activational) during puberty and adolescence. Clinical findings generally conclude that exposure to androgens is associated with more male-typical behaviour and identification (Bakula et al., 2017; Khorashad et al., 2018b). In cross-condition comparisons, women with DSD conditions characterised by more androgen exposure, such as women with 46,XY 5α-reductase deficiency and 46,XX CAH, score more masculine than control women on pre-school activities for example.

Historically, many of the medical and psychological treatments of individuals with DSD conditions have been motivated to facilitate sex-typical (i.e. in line with the assigned gender) gender development. In a relatively small subgroup of individuals with DSD conditions, gender assignment at birth is challenging due to ambiguity of the new-born's genitalia (e.g. in strongly virilised children with 46,XX CAH, or in undervirilised children with 46,XY conditions with partial androgen availability and/or sensitivity). For some DSD conditions, gender identification later in life is fairly predictable, while in other DSD conditions, development of gender identity and expression is difficult to predict a priori (Bakula et al., 2017; Fisher et al., 2016). The current global consensus guideline states "Factors that influence gender assignment include the diagnosis, genital appearance, surgical options, need for life long replacement therapy, the potential for fertility, views of the family, and sometimes the circumstances relating to cultural practices.", highlighting the complexity of these decisions (Lee et al., 2016). Still, the topic of gender development reaches beyond the group with genital ambiguity at birth; a substantial group of individuals across the DSD spectrum faces issues with gender identity ambiguity, sex-atypical physical appearance and deviance from societal norms (e.g. Brunner et al., 2016; Kreukels et al., 2018).

11.4.1 Gender Identity and Expression

While gender identity refers to the self-identification as female, male, or another gender (e.g. genderqueer, non-binary), gender expression relates to the social manifestation of gender, including clothing, preferences in peers or activities and gender role behaviour. Gender expression is often measured as more masculine/male-typical versus more feminine/female-typical (Bakula et al., 2017; Cohen-Kettenis, 2010).

Most studies examining development of gender identity and expression have been conducted in individuals with CAH (Berenbaum et al., 2018; Pasterski et al., 2015) or with 46,XY conditions (Wisniewski, 2012). In women with CAH (46,XX), around 95% is observed to develop a female gender identity during childhood and adolescence (Bakula et al., 2017). In individuals with a 46,XY condition, including complete gonadal dysgenesis or CAIS, individuals with female appearance at birth

(due to absent androgen action) almost exclusively identify as female later in life (Kreukels et al., 2018; Wisniewski, 2012). In individuals with 46,XY and genital ambiguity (e.g. in partial gonadal dysgenesis or 5α-reductase deficiency) both male and female gender identity development have been described (Wisniewski, 2012). In both the 46,XX CAH and 46,XY groups, masculine identification is associated with virilisation at birth (Apóstolos et al., 2018; Chowdhury et al., 2014; Pasterski et al., 2015). Historically, many studies have taken a relatively binary approach to assessing gender identity at follow-up, resulting in the aforementioned fairly homogeneous groups (male vs. female). Recent studies, however, have shown great variability in gender identification in all DSD subgroups (Brunner et al., 2016; Kreukels et al., 2018), describing adults with DSD conditions identifying outside the binary spectrum (including identifying as open, inter, or other). This may partly be due to a more non-binary or/and qualitative approach of studying gender identity. Additionally, discrepancies between self-reported (larger gender variance) and clinician-reported gender identity outcomes (more binary) have been observed (Kreukels et al., 2018). This possibly directs towards some threshold for individuals with DSD conditions to disclose their non-binary gender identities to clinicians.

Studies on gender expression in individuals with DSD conditions show great variance within and between subgroups and controls (Callens et al., 2016; Jürgensen et al., 2013; Khorashad et al., 2018b). Yet, across studies, gender expression was shown to be substantially influenced by sex hormone (mostly androgens) exposure (Wisniewski, 2012), and possibly associated with genotype variations as well (Frisen et al., 2009). Khorashad et al. (2018b) observed that across the DSD spectrum, in individuals with conditions with more virilisation (regardless of karyotype), more male-typical pre-school behaviour was observed. For girls with 46,XX CAH, multiple studies have observed more male-typical peer- and activity-preferences, compared with girls without CAH and attributed this finding to the increased androgen exposure (e.g. Berenbaum et al., 2018; Pasterski et al., 2011). Little research on gender expression in individuals with 46,XY conditions has been conducted and findings vary per specific diagnosis and level of virilisation (Wisniewski, 2012).

Apart from hormonal exposure, several other factors have been studied in relation to development of gender expression in individuals with DSD conditions, including parental characteristics and surgical treatments (e.g. Khorashad et al., 2016), although smaller effect sizes of these factors are generally reported, as compared to those of hormonal effects. Parents can effectively influence children's gender development through parental modelling as well as actively reinforcing/discouraging gendered behaviour (Wisniewski & Sandberg, 2015). Parental attitudes were shown to impact the approach they take towards gender (a)typical behaviour in individuals with DSD conditions (Joseph et al., 2017; Khorashad et al., 2016). These studies from Iran and India both reported that conservative parental attitudes were strongly associated with negative and corrective approaches towards gender-atypical behaviour. Family views on males and females also influenced the likelihood of gender change later in life. The long-term effects of (early) genitoplasty surgery have not been studied in a controlled design; however, the few descriptive studies

available show both (1) a low incidence of gender reassignment or reverse surgery, and (2) relatively frequent feelings of abnormality, body image issues and sexual difficulties despite genital surgeries, which was reported across multiple DSD conditions (Callens et al., 2012; Lee et al., 2016; van de Grift et al., 2018). Regarding these persistent feelings of abnormality, surgical "normalisation" of genitalia may not secure binary gender identity development and could still result in individuals exploring alternative gender expressions.

11.4.2 Gender Assignment

In case of gender assignment in a new-born with genital ambiguity, recent consensus statements advocate a shared decision-making approach, taking long-term outcome data, clinical evaluation and parents' preferences into account (Lee et al., 2016). A recent study by Timmermans et al. (2019) revealed how clinical decision-making on gender assignment is a complex process in which both clinicians and parents anticipate the child's future gendered being, including sexual intimacy, fertility, gender dysphoria, stigma, and gonadal cancer risk (Timmermans et al., 2019). While much emphasis in clinical support for individuals (and their families) with DSD conditions is put on gender assignment and development, other scholars advocate for an approach beyond gender only, with more focus on psychosocial functioning and quality of life (Wisniewski & Sandberg, 2015).

As mentioned earlier, gender assignment is strongly influenced by long-term studies on development of gender identity and expression studied per clinical diagnosis, level of virilisation, genetic mutation, etc. (Chowdhury et al., 2014; Lee et al., 2016). Importantly, for many individuals with DSD conditions (including sex chromosomal DSD and conditions without genital ambiguity), gender assignment is not an issue, unless gender dysphoria is expressed later in life. While children with Klinefelter syndrome and (less severe) hypospadias without specific underlying genetic causes are generally assigned the male gender, children with CAIS, complete gonadal dysgenesis and individuals with 46,XX CAH are generally assigned as females. For conditions with partial virilisation (e.g. partial androgen insensitivity syndrome [PAIS] or partial gonadal dysgenesis) or more extensive genital ambiguity of other causes in individuals with 46,XY karyotype, the initial gender assignment can be either male or female. Similarly as in the attitudes towards gender-atypical behaviour, parental attitudes and sexism were shown to influence gender assignment in those with genital ambiguity (Joseph et al., 2017; Khorashad et al., 2016); parents favour male assignment in the context of the patriarchal societies they live in. Qualitative studies explored the experiences of parents with gender assignment and gendered upbringing of children with 46,XX CAH and observed that parents with virilised girls reported more fear of stigmatisation, complex surgical decisions and uncertainty pertaining to disclosing the condition, when compared with parents of children with 46,XX CAH reared as boys (Fleming et al., 2017). This finding could largely be attributed to the sex atypical bodies girls with 46,XX CAH may

have and pose parents for these specific difficulties. As a result, some families are advised to receive additional psychological counselling during childhood development. It is usually discouraged by both clinicians and most community stakeholders not to assign a gender to children and to raise children genderless (Lee et al., 2016). A fully genderless upbringing is generally considered practically impossible, as well as thought to complicate the processes of gender modelling and socialisation, although no studies on this topic have been performed.

11.4.3 Gender Dysphoria and Change

Some individuals may experience gender dysphoria and a subset of those may also change their gender socially, legally and/or medically. Although gender dysphoria and change are relatively infrequent in individuals with DSD conditions, it is more prevalent than in the general population (Furtado et al., 2012; Kreukels et al., 2018). Gender dysphoria is reported to be present in 8.5–20% of individuals with DSD conditions (lifetime prevalence varies per condition; Furtado et al., 2012), although reliable data are lacking given the heterogeneity in samples, definitions of gender dysphoria and measures used. In a recent large pan-European study surveying individuals across the DSD spectrum, the prevalence of gender dysphoria at follow-up in adulthood (mean age 32 years) was below 1% (measured by scores above 3SD on the Utrecht Gender Dysphoria Scale; Kreukels et al., 2018). In this study, gender variance (i.e. gender identification and/or behaviour other than male/female-typical societal norms) was seen in 3.6% (reported in all DSD groups, except women with Turner syndrome) and gender variant individuals scored poorer on psychological self-report outcomes such as higher gender dysphoria, lower self-esteem and higher levels of anxiety and depression, compared with gender-typical individuals. At follow-up in adulthood, around 5% of individuals with DSD conditions reported a gender change, ranging from 0% (sex chromosomal conditions) to 14% in 46,XX CAH and 16% in men with 46,XY DSD (Kreukels et al., 2018); of those, most gender changes took place before puberty (also observed by Jürgensen et al., 2010).

Gender dysphoria and cross-gender identification have been linked to specific clinical diagnoses as well as levels of virilisation. Highest numbers of gender dysphoria and change have been reported in 5α-reductase and 17β-hydroxylase deficiency, followed by PAIS and 46,XX CAH (Batista et al., 2018; Furtado et al., 2012). In girls with 46,XX CAH, androgen exposure is associated with more cross-gender identification, regardless of gender role behaviour, when compared with control girls (Pasterski et al., 2015). In the same line, women with 5α-reductase deficiency with the highest degree of virilisation at birth report the least gender conformity (based on satisfaction with gender identification) compared to their counterparts with lower virilisation (Nascimento et al., 2018). Moving away from the sex-binary, some individuals identify as gender variant or outside the binary: 1% of adults with DSD conditions reported to have an open, other or inter-gender

identity (Kreukels et al., 2018), while this may be an underestimation given the sampling and survey method. Qualitative studies further endorse the idea that many studies may have underestimated the levels of gender variance experiences within the DSD group. When speaking in-depth with this group, Brunner et al. (2016) found that although many individuals with CAIS usually live/identify as women, a substantial group (5 out of 11) did not feel typically female. This further puts the role of hormones into perspective; while testosterone exposure was observed to mediate gender-typical development, knowing to have chromosomes incongruent with the expressed gender, be infertile or have atypical physical characteristics may contribute to feelings of gender variance in individuals with DSD conditions. Furthermore, the concept of gender dysphoria may be less applicable in the presently more gender variant societies; although gender identity and (sex-specific) bodily characteristics may be incongruent, distress does not necessarily have to be present. It is important to differentiate clinical services: Those with varying identities and questions regarding self-understanding may benefit from supportive counselling, whereas those with gender-related distress and associated mental health issues may need more extensive psychological care. More research should be done to obtain a more differentiated non-normative view on experienced gender identity and expression in individuals with DSD conditions, using non-binary measures, and how these findings translate to affirmative healthcare across the lifespan.

11.5 Sexual Development in DSD

Sexuality, including adequate sexual function and good sexual well-being, is largely acknowledged as an important aspect of quality of life. In individuals with DSD conditions, sexuality may be influenced by sex-atypical physical appearance, sex hormone replacement therapy, past genital surgeries, as well as psychological issues such as doubts about identity, body image and self-esteem (Callens et al., 2020; Kreukels et al., 2019). Sexual development research in individuals with DSD conditions has focused largely on sexual orientation, sexual behaviour and sexual function (including sexuality-related anxieties) (Berenbaum & Meyer-Bahlburg, 2015; Cohen-Kettenis, 2010), whereas more data on sexual well-being and positive sexual traits have become available too (Dear et al., 2019; Schönbucher et al., 2012).

11.5.1 Sexual Orientation

Sexual orientation has been studied most in women with 46,XX CAH; the majority of women with CAH identifies as heterosexual, although same-sex attraction is relatively more frequent than in female controls (Cohen-Kettenis, 2010). Percentages of homosexual/bisexual women are reported in up to around 15% among women with 46,XX CAH, compared to <5% in control women (Gondim et al.,

2018; Jürgensen et al., 2013). Non-heterosexual orientation in women with 46,XX CAH is associated with more virilisation at birth (Gondim et al., 2018). Also, albeit studied in small samples, Frisen et al. (2009) also found evidence for differing likelihood of same-sex attraction over the different 46,XX CAH genetic mutations. Individuals with more "severe" genotypes reported more frequent non-heterosexual orientation, albeit individuals with milder CAH variants reported higher frequencies than reference values too.

In individuals with 46,XY DSD conditions, individuals without androgen effects (i.e. CAIS and complete gonadal dysgenesis) largely report heterosexual orientation (i.e. attraction to men) (Cohen-Kettenis, 2010), whereas up to half of the groups with DSD conditions with intermediate virilisation (between male-female-typical) reported non-heterosexual orientation (e.g. 5α-reductase and 17β-hydroxylase deficiency and PAIS; Batista et al., 2018; Schönbucher et al., 2010; Schönbucher et al., 2012). In a recent study, non-(exclusive) heterosexual orientation was reported across all DSD conditions (7.7–28.5%), including in individuals with sex chromosomal conditions; 21.5% in women with Turner syndrome and 17.5% in men with Klinefelter syndrome (Kreukels et al., 2019). Others have also observed that in women with 46,XY conditions with little androgen effects/exposure, sexual orientation is more variable than is usually presumed (Brunner et al., 2016). Altogether, whereas homosexual/bisexual orientations have mostly been observed in women with 46,XX CAH, non-exclusive heterosexual orientation is observed across the DSD spectrum, emphasising the need for an open non-normative approach by clinicians.

11.5.2 Sexual Behaviour and Function

Becoming sexually active is a part of entering adolescence. In adolescents with DSD conditions, sexual activity may be accompanied by hesitance, insecurities or even anxiety and avoidance (Cohen-Kettenis, 2010). A consistent finding in the literature is the phenomenon that individuals with DSD conditions have later romantic and sexual debuts, most likely as the result of postponing engaging in sexual encounters (Cohen-Kettenis, 2010; Sandberg et al., 2012). Also, a greater proportion of individuals of all DSD subgroups report not to be sexually active at all, when compared to control populations, although exact percentages vary (Callens et al., 2016; Kleinemeier et al., 2010; Schönbucher et al., 2010); among the DSD conditions, (adult) women with 46,XX CAH (46%; mean age 30) and Turner syndrome (53%; mean age 32) and men with a 46,XY DSD (59%; mean age 23) showed the highest percentage of sexual inactivity (Kreukels et al., 2019). Lower engagement was not only observed in sexual activity, but also in (later) first kiss and masturbation (Kleinemeier et al., 2010), and in lower general sexual interest (Schönbucher et al., 2010).

Sexual function may be impacted by both biological and psychosocial factors. Multiple studies have brought forward the substantial proportion of individuals with

DSD conditions having sexual dysfunction(s), both objectified through clinical levels of the Female Sexual Function Index (e.g. 66% in Callens et al., 2012, with poorest scores on the pain subscale) as well as on self-report incidences of sexual problems (e.g. an average number of 1.8 in Turner syndrome to 3.9 in 46,XY women) (Kreukels et al., 2019). In the latter study, both lack of sexual desire (mostly in non-virilised women with 46,XY), as well as excessive desire (mostly in Klinefelter syndrome), fear of sexual contact (mostly in all subgroups with 46,XY conditions), problems in reaching orgasm (more than 30% in women with 46,XX CAH, individuals with 46,XY DSD or Klinefelter syndrome) and pain (mostly in women with 46,XY) were reported by individuals. Sexual communication problems were observed as well (Schönbucher et al., 2010).

Several factors have been found to influence experienced sexual function, including genital appearance (Callens et al., 2016), hypogonadal hormone status (Vignozzi et al., 2010), decreased fertility (Cohen-Kettenis, 2010), prior genital surgery (Callens et al., 2016), body image, self-esteem and mental well-being (Kreukels et al., 2019; Weijenborg et al., 2019). On another note, surgery appears not to be the main determining factor. One study observed that a substantial share of women with DSD conditions were already sexually active prior to vaginal surgery (Dear et al., 2019). Also, other researchers found that sexual dysfunctions were prevalent in women with DSD conditions regardless of genital surgery (Callens et al., 2012). This has been confirmed in other studies finding that sexual function in individuals with DSD conditions is primarily determined by psychological factors, rather than biomedical factors (Ferlin et al., 2018).

11.5.3 Psychosexual Well-being

Over the course of time, the focus of sexuality research has somewhat shifted/broadened from sexual orientation and (dys)function to more positive aspects such as satisfaction and well-being. Satisfaction with sex life in individuals with 46,XY is around 50% (Schönbucher et al., 2010), which is impacted by sexual function and genital appearance, and is substantially lower than the 75% satisfaction rate reported in the general population (Dunn et al., 2000). Sexual satisfaction appears to be associated with the underlying DSD conditions (with women with Turner syndrome being least dissatisfied, when compared with the other DSD groups), sexual frequency (lower frequency and lower satisfaction were associated), not having a partner and higher levels of depressive symptoms (both negatively associated with sexual satisfaction) (Kreukels et al., 2019). Other factors that have been reported to be associated with sexual well-being and sexual quality of life in individuals with DSD conditions include having undergone genital surgery (Schönbucher et al., 2010, 2012), clinical diagnosis (Schönbucher et al., 2010, 2012), (genital) body image (van de Grift et al., 2018), sexual esteem (Dear et al., 2019; Schönbucher et al., 2012) and (self-)stigma (Meyer-Bahlburg et al., 2018).

Given the aforementioned long-term sexual issues and the extent to which psychosocial factors contribute, the consensus statement on treatment of individuals with DSD conditions states that psychosocial care by trained mental health professionals and a sexologist should be an integral part of care in order to support positive adaptation to having DSD conditions (Lee et al., 2016).

11.6 Conclusion: Sex and Gender as Continuum

Throughout history, individuals with DSD conditions have challenged the sex binary. While much of modern medicine has focused on supporting individuals with DSD conditions to comply with the sex binary (e.g. through psychological counselling or "normalising" genital surgeries), contemporary approaches increasingly view sex as a continuum with individuals with DSD conditions being somewhere on the scale between typical male and female (Ainsworth, 2015). Although parenting a child with sex ambiguity remains challenging, and there is little empirical evidence on how best to support families in a non-binary non-normative way, more societal and clinical openness towards less medicalised approaches to DSD has arisen. Similar developments are taking place for variation in gender identity and expression. Recent studies from Germany and Israel describing normative samples state that around 10–35% of individuals report (some) variance in their gender identity and/or expression (Becker et al., 2017; Joel et al., 2014). Possibly, this increasing gender diversity could pave the way for more societal accommodation towards sex variance as well.

Spotlight Feature: Testosterone, Science, and Sport

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Testosterone: 1, Women in Sport: 0

On May 1, 2019, the Court of Arbitration of Sports (CAS) handed down a political decision barring a number of women athletes from competing in the women category. When South African middle-distance runner Caster Semenya—a woman who won multiple Olympic medals and championships—tried to compete at the 2019 World Athletics Championships in Doha, Qatar, she was not allowed to participate with her fellow women because she refused to modify drastically her own physiology for no medical reason, but rather, to satisfy a policy from the International Association of Athletics Federations (IAAF), now World Athletics, based on the interpretation of data from studies of androgen levels in elite athletes which showed that women with free testosterone in the upper tertile (top third) performed better than women in the bottom tertile in a small number of events (Bermon & Garnier, 2017).

We know about sports authorities' policies on gender. We (a geneticist of sex development and a former athlete, now professor, prevented to compete because of her chromosomal constitution (Martínez-Patiño, 2005)) are both advisors to the International Olympic Committee (IOC) on questions of sex classifications in sports. The IOC is responsible for the organization of the Olympic Games while international sports federations (such as World Athletics) administer the rules and regulations of a sport. However, in order to become an Olympic sport, a sports federation must be recognized by the IOC, resulting in a high influence of the IOC on sports rules and regulations. We supported a compromise between a policy based on pure self-declaration of gender and a strict, genetically based definition of sex. We agreed with the use of a functional biological marker relevant to sport (Testosterone, or "T"), and the setting of the lower male-typical range of T (at the time considered to be about 10 nmol/L) as a threshold for allowing an athlete's participation in the female category for all events and regardless of their sex chromosomes. This guideline, adopted for the 2012 Games, was based on the perspective that T is a major factor in athletic performance and that a male-typical threshold would be a logical line of separation. Because the T threshold was high, it was inclusive of many athletes with a Difference of Sex Development (DSD). However, in 2016, Indian athlete Dutee Chand successfully challenged the guideline. In their ruling suspending the guidelines, the Court of Arbitration of Sports (CAS) explained that IAAF could not demonstrate that T accounts for the *entirety* of the 10–12% difference between male and female performance in athletics and requested IAAF to produce additional data to justify the guidelines. Two years later, IAAF produced

a new set of eligibility rules lowering the T limit to 5 nmol/L, applicable only to a small number of "restricted events," limited to distance running from 400 m to the mile. Yet, the major article on which this new policy is based (Bermon & Garnier, 2017) does not include the 1500 m nor the mile (both restricted), but includes hammer throw and pole vault, which were not restricted. In 2019, Caster Semenya challenged the new regulations, but this time, CAS upheld them.

There are two main issues with the new IAAF regulations and the CAS decision. First, rather than relying on scientific data, the guidelines are arbitrary. The basis for the IAAF rules is a single original article (Bermon & Garnier, 2017) that not only does not address the choice of a new T threshold level but has been heavily criticized by scientists due to methodological flaws (Pielke et al., 2018). Data allegedly included duplicated athletes (more than one track and field performance time per athlete), duplicated times (same time taken into account more than once for some athletes), and even phantom times (no athlete found with the reported time for the event). More importantly, there is no published evidence supporting if, as CAS claims, "female athletes with 46 XY DSD enjoy a significant performance advantage over other female athletes without such DSD." In addition, the choice of specific "restricted events" from 400 m to a mile is highly problematic, as there is little to no data relevant to 1500 m and the mile (a fact acknowledged by CAS, who still agreed to let IAAF include these two events as part of the guidelines). Also, the choice of restricted events may lead to the full absurdity of having the same athlete eligible as a woman for one event (e.g., 200 m) but not for another (e.g., 400 m). Finally, the rules apply to athletes with "sufficient androgen sensitivity for those levels of testosterone to have a material androgenising effect," yet there is no proposed accurate way to measure androgen sensitivity in the athletes affected by the policy. With so much at stake, a reasonable approach would be to resolve the scientific controversies first before relying entirely on questionable data to edict a rule. This would revert to the 2012 policy in which the testosterone threshold level was higher (10 nmol/L) and applied to all women in all disciplines, without discriminating against the biological cause of the androgen levels (Bermon & Garnier, 2017).

This brings us to the second, most disturbing consequence of the CAS ruling: the targeting of women with a Y chromosome. It took 3 decades (from 1968 to 1999) and multiple discriminatory rulings against women with a Y chromosome for sports authorities to remove sex chromosomes as the marker for eligibility in women's competition (Patiño et al., 2006). The regulations based on testosterone levels, introduced in 2012, were applied to all women regardless of their sex chromosome complement. Now the philosophy behind the policy is switching to accommodate the testosterone levels of most women with a common hyperandrogenic condition called Polycystic Ovary Syndrome (PCOS) who are all XX and for whom the upper limit is 4.8 nmol/L (99.99% one-sided confidence limit) (Handelsman et al., 2018; World Athletics, 2018). Interestingly, the rules read "These Regulations do not apply to any other conditions (including, without limitation, polycystic ovary syndrome), even if such conditions cause the individual to have blood testosterone levels above the normal female range." A woman with an XX karyotype and a PCOS condition resulting in a T level above 5 nmol/L (which has been reported) will be eligible while

a woman with an XY karyotype and the same T level will not, defying the logic of considering T as the major factor influencing athletic performance.

This new ruling throws us back to times when chromosomes would define who is a man and who is a woman for the purpose of sports, reminiscent of the exclusion from competitions of athletes such as one of us authors, Dr. Maria Patiño, based on sex chromosome constitution (Martínez-Patiño, 2005). This approach aligns with highly controversial attempts to redefine sex based only on the appearance of the genitals and, if disputed, on a genetic test (Green et al., 2018). Now that a growing number of countries (including top Olympic countries such as Germany and Australia) allow for non-binary gender on legal documents, the regulations appear out of step.

After decades of using scientific data to justify rules of eligibility for women in sports, with little to show in terms of improving fair participation in competitions, it is time for sports authorities to interpret cautiously the imperfect science of athletic performance and focus on the well-being and inclusion of an increasingly diverse population of athletes. In short, testosterone is being weaponized to achieve a policy result, rather than being considered with all its scientific complexity.

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Chapter 12
Sexuality Development in Childhood

Gu Li

Abstract Children's sexuality has been a taboo subject in many societies, but its existence is undeniable. A variety of sexual behaviors such as masturbation are evident starting in early childhood. Sexual games become frequent in middle childhood, especially among girls. Cross-cultural and cross-species evidence suggests that sexual desire emerges around middle childhood, along with adrenarche, which is the early phase of puberty. However, sexuality in childhood does not always signify sexual orientation in later developmental stages. In addition, different biosocial factors appear to contribute to the development of sexuality during childhood. Taking a developmental systems perspective, this chapter synthesizes existing evidence and points out areas for future research. The substantive gaps involve examining co-acting and bidirectional processes in sexuality development, focusing on sexual agency, and recording dynamic change. Transforming research methods and fostering societal recognition of children's sexuality may be critical for not only advancing research on sexuality development in childhood, but also improving children's well-being.

Keywords Child sexuality · Developmental systems · Sexuality development · Sexual desire · Sexual attraction · Sexual behavior · Sexual scripts · Sexual socialization · Sexualization

Little research in developmental science has focused on child sexuality. The primary reason for this long-standing neglect is that this topic is seen as taboo within many societies. People, parents in particular, often avoid discussing sexuality with children and forbid them from discussing sexuality with others; they are also often in denial about children's capability to have sexual feelings and fear that discussions about

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sexuality will ruin the innocence of a child (Jarkovská & Lamb, 2018). Societal objections towards child sexuality may reflect the view that sexuality is irrelevant and harmful to children; however, accumulating evidence suggests that although sexual intercourse is rare among children, they may engage in other types of sexual activities, such as kissing, cuddling, or playing with genitals (reviewed in Bancroft, 2003; de Graaf & Rademakers, 2006; Diamond et al., 2015; Sandfort & Rademakers, 2000). These normative early sexual experiences are an integral part of healthy development and can leave a lasting positive impact in later developmental periods (de Graaf & Rademakers, 2006; Diamond et al., 2015).

This chapter reviews normative sexuality development in childhood. Reviews of abnormal early sexual experiences, such as sexual abuse, can be found elsewhere (e.g., Devries et al., 2014; Friedman et al., 2011; Irish et al., 2010; Jumper, 1995; Klonsky & Moyer, 2008; Paolucci et al., 2001; Rind et al., 1998; Rind & Tromovitch, 1997; Stoltenborgh et al., 2011). I use "normative" to refer to the average or expected patterns of sexual feelings and experiences in a given developmental period and change over time, as well as individual differences underlying these patterns (Tolman & McClelland, 2011). By this definition, describing normative sexuality development in childhood involves identifying common and differential manifestations, prevalence, timing, stability and change, and contexts of sexual feelings and behaviors as well as examining developmental antecedents and consequences of sexual feelings and behaviors.

12.1 Theoretical Overview

This review utilizes the developmental systems perspective to examine normative sexuality development. The developmental systems perspective goes beyond the "nature-nurture" debate and asserts that both factors play a role in life-span development. Specifically, this perspective conceptualizes development as involving multiple processes—biological, psychological, and social—that interact with each other and with their embedding contexts to influence development at all times (Overton & Molenaar, 2015). The core features of developmental systems include co-acting processes that interact with and reciprocally influence each other; nonlinear development driven by a system's self-organization and self-regulation; and dynamic change at multiple time scales and multiple levels of development. It has been argued that the developmental systems approach will generate the most comprehensive knowledge about the development of living systems (Overton & Molenaar, 2015).

Applying the developmental systems theories to sexuality development, it is important to recognize that more than one factor influences a child's sexual motives, urges, feelings, decisions, behaviors, and identity at a time. It is also simplistic to assume that nature (such as genes) sets down the blueprint and nurture (such as parenting) then adds details to it. Recent advances in epigenetics suggest that the environment can sometimes regulate genetic expression (Zhang & Meaney, 2010).

In addition, the premise of nonlinear development suggests that researchers should abolish linear-stage models, which incorrectly assume that there is emerging sexual abilities (e.g., kissing), which gradually evolve into full-blown sexual abilities (e.g., having sexual intercourse). For example, instead of studying how people reach the "endpoint" of having sexual intercourse through a sequence of developmental milestones, researchers should examine a full spectrum of sexual behaviors at all developmental periods, not only because a mere touch by a close friend can trigger adult-like sexual arousal and feelings in children and young adolescents (Lamb, 2002, 2006; Way, 2011), but also because these sexual activities do not always follow the linear order from kissing to coitus over time (Li & Davis, 2020). Finally, the focus on dynamic change across multiple time scales and at multiple levels calls for employing dynamic systems models to describe change in sexuality at the molecular, cellular, organic, individual, interpersonal, and sociocultural levels (Diamond et al., 2015).

Despite the promise of the developmental systems approach, however, few studies in sex research have adopted it. Existing studies on normative sexuality development in childhood have: predominantly considered only one, and seldom two, factors contributing to sexuality development in the same study; centered on milestones, instead of nonlinear differential trajectories, of sexuality development; or have not intensively studied quantitative and qualitative change in sexuality development (Diamond et al., 2015). This review critically evaluates existing evidence, highlights studies in greater detail that are particularly relevant to the developmental systems approach, and identifies gaps from the developmental systems perspective.

12.2 Methodological Concerns

Researchers have used two types of methods to study sexuality development in childhood: indirect measurements and direct measurements (reviewed in de Graaf & Rademakers, 2011). Studies using indirect measures often rely on observations by parents or caregivers (de Graaf & Rademakers, 2011), and the most popular instruments are the Child Sexual Behavior Inventory (Friedrich et al., 1991) and the Child Behavior Checklist (Achenbach, 1991; Meyer-Bahlburg & Steel, 2003). The advantages of this method are (1) the researchers can relatively easily obtain a large sample of parents and caregivers, (2) there are fewer ethical concerns than asking sensitive questions to minors, and (3) there is no need to consider the minors' language development or sexual knowledge as in direct measurements. However, the information from parents or caregivers is probably biased, because they can only observe children's overt sexual behaviors and cannot access behaviors that are intentionally hidden from them, especially by older children. Moreover, parents or caregivers may dismiss some of children's sexual activities as "just play," ignoring the different manifestations of sexuality in childhood than in adulthood (Lamb, 2002, 2006).

Another commonly employed indirect measurement concerns using adults' recall of early sexual experiences. This method is useful in assessing observable sexual behaviors and unobservable sexual feelings in early developmental stages, without the constraint of obtaining parental consent, which is required in interviews with children. However, self-recall may be subject to memory distortion (e.g., Bremner et al., 2000; Offer et al., 2000) and, similar to parental reports, may be biased from reconstructions of past experience (Lamb, 2002, 2006).

Direct measurements overcome many limitations of indirect measurements; however, they are less popular because research proposals aiming to investigate sexuality from children's perspectives are often rejected by institutional research ethics review boards (Ceci et al., 1985; Fendrich, 2009), despite the fact that most children report positive feelings and have no strong adverse reactions after participating in a study on sexuality, and that when discomfort is reported, it is often not associated with the study content (O'Sullivan, 2003). In studies that use direct measurements, children are interviewed or surveyed about their sexual cognition, sexual feelings, and sexual behavior. While interviews and surveys are perhaps the most suitable ways to study sexuality from the child's perspective, some children may find it difficult to understand or to answer the questions (e.g., Calzo & Blashill, 2018; O'Sullivan, 2003). In addition, children may respond in a socially desirable manner, thus biasing the findings (O'Sullivan, 2003). Certain techniques may enhance the disclosure of sensitive information, including information about sexual experience. For example, computer-assisted interviews (e.g., presenting prerecorded questions in a computer program to avoid direct participant-interviewer interactions) were found to increase reporting of sexual behavior among adolescents (Turner et al., 1998), which have been applied to children (e.g., Calzo & Blashill, 2018; Waylen et al., 2010). It has also been recommended to design age-appropriate questions and to use visual techniques (e.g., drawings, cartoons, and videos) when interviewing children about sensitive information (Lamb et al., 2008).

In summary, there is no golden method for studying child sexuality, and both indirect and direct measurements are imperfect but informative. Also, these methods complement each other. In toddlerhood, when the subjects of study are still developing their language skills and sexual knowledge, reports of explicit sexual behaviors from parents and other caregivers would be most useful. However, as children grow and learn about the taboo of sexuality, they are increasingly likely to hide their sexual experiences from parents and caregivers. At this point, direct interviews adopting well-designed structures, formats, and questions to prompt honest and elaborated disclosure of sensitive information can become more useful. Finally, a retrospective approach may be used in older children and adolescents, especially to examine sexual feelings in early developmental stages, but this method may become less reliable in adults due to the possibility of memory distortion and biased reevaluation of experiences.

12.3 Child Sexuality

12.3.1 Solitary Sexual Behavior

Childhood solitary sexual activities take place in many forms, including masturbating (with hands or objects), rubbing the body against objects such as furniture, and touching one's own private parts (either in public or at home; Davies et al., 2000; Friedrich et al., 1998; Larsson et al., 2000; Larsson & Svedin, 2002a; Schoentjes et al., 1999; Thigpen, 2009). Among these behaviors, masturbation is viewed as a symbolic event for sexuality development and is the most commonly studied by researchers, although other solitary sexual activities among children have been frequently reported in both retrospective and observational studies (Davies et al., 2000; Friedrich et al., 1998; Larsson et al., 2000; Larsson & Svedin, 2002a; Schoentjes et al., 1999; Thigpen, 2009). Previous research has found that repetitive self-fondling of genitalia appears early in life, even *in utero* (Giorgi & Siccardi, 1996; Meizner, 1987), but rhythmic stimulation, the defining characteristic of adult-like masturbation, first emerges at around 2–3 years old (Kinsey et al., 1953; Martinson, 1994). Other adult-like physiological responses of masturbation have also been observed in children, including a blushed face, thickened breaths, heavy sweating, and blurry eyes (Leung & Robson, 1993). Orgasms are sometimes achieved, but not always (Larsson & Svedin, 2002a).

Around 40–60% of adults recalled having had masturbated in childhood (Bancroft, 2003), and up to 83% of young adults reported having had any type of solitary sexual behavior before adolescence (Larsson & Svedin, 2002a). More boys than girls tend to masturbate, a gender difference that has been repeatedly found across studies (e.g., Friedrich et al., 1991, 1998; Gagnon, 1985; Haugaard & Tilly, 1988; Larsson & Svedin, 2002a). However, the exact prevalence rates vary by study method. For example, parents tend to systematically report a higher prevalence of solitary sexual behavior among children, including masturbation, than do teachers (Larsson & Svedin, 2002b). This finding suggests children may engage in solitary sexual behavior more frequently at home than at school, perhaps because they have less free time alone at school or because their parents have more opportunity to observe them in the home. Furthermore, the frequency of children's solitary sexual behavior decreases from early to late childhood in parental reports (Friedrich et al., 1991, 1998; Gagnon, 1985; Schoentjes et al., 1999), whereas this frequency grows over time in adults' self-recall (Kinsey et al., 1948; Kinsey et al., 1953; Larsson & Svedin, 2002a). The declining solitary sexual behavior among older children found in parental reports may reflect children's increasing desire and capacity to hide their sexual behavior from parents. In contrast, the upward trend found in adults' self-recall is more consistent with children's growing sexual interests (Goldman & Goldman, 1982).

More recent findings from parental reports have revealed racial/ethnic differences in solitary sexual behavior. Studies of racial/ethnic differences have relied on comparison to a normative sample reported on by Friedrich et al. (1998), which

included 280 3- to 6-year-old children from day care programs in Los Angeles County in the USA. For example, African American children were reported by parents to have substantially lower prevalence rates of solitary sexual behavior, especially masturbation (Thigpen, 2009), than the children in the normative sample in Friedrich et al., which parallels the racial difference observed in adults (Laumann et al., 2000). In addition, the rates of masturbation with hands and of touching private parts when at home were found to be lower among Latino children than among those children from Friedrich et al.'s normative sample (Kenny & Wurtele, 2013).

Outside the USA, caregivers in Western and Northern Europe tend to observe more masturbatory and other solitary sexual behaviors in their children than do caregivers in the USA, and this difference is more pronounced in boys (de Graaf & Rademakers, 2006; Goldman & Goldman, 1982; Larsson et al., 2000). Such difference may be attributed to the more liberal attitudes towards sexuality among parents in children's immediate environment, the more progressive and comprehensive sexuality education programs in primary and secondary schools, and the more liberal sociocultural environment in Western and Northern Europe than in the USA (Larsson et al., 2000). However, because caregivers in European countries may be more willing to report sexual behaviors in children than caregivers in the USA, the evidence regarding racial/ethnic and cultural differences in children's solitary sexual behavior could be considered inconclusive.

From the developmental systems perspective, past research on the prevalence of children's solitary sexual behavior is ill-equipped to inform its process. To describe the process, researchers should also examine children's motivation, emotion, bodily awareness, sensation and perception, as well as the contexts in which nonpartnered sexual activity takes place. For example, the increase in masturbation from toddlerhood to late childhood (Kinsey et al., 1948, 1953; Larsson & Svedin, 2002a) may result from the increasing awareness of the distinct sensations in different body parts over time (e.g., growing recognition of masturbation as pleasant, exciting, and stimulating; Larsson & Svedin, 2002a), which may in turn reinforce the differentiation of bodily sensations. This bidirectional process may be fueled by hormonal changes during puberty (Fortenberry, 2013) but also thwarted by parental and peer disapproval (Gagnon, 1985; Papadopoulos et al., 2000). It is likely through such complex interactions between nature and nurture that children develop adult-like experience of masturbation.

Yet, despite the resemblance of physiological responses of childhood masturbation to those of adulthood masturbation, such as thickened breaths and sweating (Leung & Robson, 1993), masturbation in children seldom involves sexual fantasies or sexual attraction as in adults (Leitenberg & Henning, 1995; McClintock & Herdt, 1996). As such, the motives for self-stimulation may differ between children and adults. Without sexual fantasies or sexual attraction, children may not interpret masturbation as "sexual" like adults do. It is important, therefore, to examine the systems and processes that facilitate the transition from masturbating for physical pleasure to masturbating for sexual desire (see Sect. 12.4.3).

12.3.2 Partnered Sexual Behavior

Similar to the research on solitary sexual behavior, studies on partnered sexual behavior in children have predominantly aimed at documenting its prevalence. Overall, fewer children engage in partnered sexual behavior than in solitary sexual behavior. However, the reported prevalence rates differ widely by the type of partnered sexual behavior, study method, race/ethnicity, and culture, making it difficult to infer the true rates in the population.

Reviewing data from eight retrospective studies in the USA, Australia, Sweden, and Spain, de Graaf and Rademakers (2006) found that over 61% of men and over 55% of women recalled having had sexual experiences with others in childhood. Notably, these seemingly high rates included activities without direct genital contact, such as flirting. Based on a retrospective survey of adult women, Lamb and Coakley (1993) summarized six types of partnered sexual activities among children (ranked by popularity): (1) having fantasy sexual play (such as role-playing of adult sex or love scenes; comprising 29.6% of all children), (2) category "other" (18.4%), (3) playing doctor (16.3%), (4) exposing body parts to another person (15.3%), (5) experimenting in stimulation of one's own or another person's body parts (14.3%), and (6) kissing (6.1%). These categories and their popularity ranking have been largely confirmed in other retrospective studies of both women and men (Haugaard, 1996; Haugaard & Tilly, 1988; Larsson & Svedin, 2002a). However, the popularity ranking differs in parents' versus teachers' and daycare professionals' reports, with "playing doctor," "exposing body parts," or "Kiss Chase games" being listed as the most popular (Cacciatore et al., 2020; Davies et al., 2000; Fitzpatrick et al., 1995; Friedrich et al., 1991, 1998, 2000; Kenny & Wurtele, 2013; Larsson & Svedin, 2002b; Larsson et al., 2000; Sandfort & Cohen-Kettenis, 2000; Sandnabba et al., 2003; Schoentjes et al., 1999; Thigpen, 2009), probably because children hide the other sexual activities to avoid disapproval from adults.

Some adults may consider children's sexual activities as "trivial" compared to oral sex or sexual intercourse; however, this is a false assumption. Past research has suggested that a move as "trivial" as a touch on the hand can illicit physiological and emotional arousal in children that is similar to adults' sexual experience. For example, when asked about their feelings in "doctor games" with same-sex friends, some girls and women described their experience as "very thrilling," "titillating and fun," "intoxicating," "very arousing," and "sexually excit[ing]" (Lamb, 2004). Another study interviewing children aged 8 to 9 years found that 77% of them considered head and shoulders as "pleasant" body parts, while only 23% considered genitals, bottom, and anus as "pleasant" body parts; in addition, 58% and 32% of children rated head and shoulders as "exciting," respectively (Rademakers et al., 2000). These findings suggest that unlike adults, whose erotic feelings are centered around genitalia, children's erotic feelings are not limited to this area. Thus, due to the unique manifestations of children's sexuality, "trivial" sexual activities in childhood and early adolescence are sometimes more predictive than "serious" sexual activities of developmental outcomes. For example, a population-based longitudinal

study used 82 sexual behaviors with a wide range of intensity from ages 11 to 15 years to predict sexual identity at age 15 years; it was found that sexual behaviors of low-to-moderate intensity (e.g., kissing or touching body parts) were more salient in predicting sexual identity than sexual behaviors of high intensity (e.g., having sexual intercourse; Li & Davis, 2020).

Similar to masturbation, the occurrence versus nonoccurrence of partnered sexual activities in childhood has little influence, positive or negative, on later sexuality development, including timing of first sexual intercourse, number of lifetime intercourse partners, sexual satisfaction, sexual dysfunction, or sexual arousability (Leitenberg et al., 1989, 1993). Studies that went beyond documenting prevalence and frequency have examined children's feelings about the sexual contact, the contexts in which sexual activities take place (e.g., mutual or nonconsensual, with a best friend or not), and the characteristics of the sexual partners (e.g., age and sex of sexual partners; Haugaard & Tilly, 1988; Lamb, 2004; Lamb & Coakley, 1993; Larsson & Svedin, 2002a). However, much attention has been devoted to studying coercion in partnered sexual activities, as well as strategies to restrict childhood sexual games, such as "doctor games" (see this chapter's Spotlight Feature). These concerns are valid given that children often lack the cognitive and affective capacity to make rational judgments and decisions for themselves and for others (Jarkovská & Lamb, 2018). Nevertheless, it is important to recognize that childhood sexual experience is overall positive for most people (Lamb, 2004; Lamb & Coakley, 1993; Larsson & Svedin, 2002a), and that when properly supervised, childhood sexual games could provide a safe context for children to gain sexual knowledge and could have a long-term positive impact on children's sexuality development.

12.3.3 Sexual Desire

Compared to sexual behavior, fewer studies have investigated children's sexual desire, defined as "an interest in sexual objects or activities" or "a wish, need, or drive to seek out sexual objects or to engage in sexual activities" (Regan, 1998, p. 141). Sexual desire has been conceptualized as involving several components, including sexual thoughts (e.g., sexual fantasies), sexual attraction (e.g., finding someone sexually appealing), and sexual interests in other people (Fortenberry, 2013). As a subjective experience, sexual desire is best measured by self-reports. Alternatively, a few observable behaviors such as "talk[ing] about sex acts" and "[being] very interested in the opposite gender" measured in the Child Sexual Behavior Inventory may indicate sexual interests (Friedrich et al., 1991). However, it is incorrect to assume that all sexual behaviors are driven solely by sexual desire, because people have sex for other reasons as well, such as curiosity, boredom, stress reduction, and conflict resolution (Meston & Buss, 2007). In other words, sexual desire alone is sufficient but not necessary to motivate sexual behavior.

It is, therefore, comprehensible that children's sexual behavior typically does not accompany sexual desire, even among older children. This possibility is exemplified

by the low prevalence of sexual desire in children. Surveying 119 boys and 116 girls aged 8 to 11 years, Cameron and Biber (1973) found that 4% of children reported that sex "had been the focus of their thought in the past 5 min," which did not vary by gender or time or context of the interview. Another study found that 6% and 0% of Spanish boys and girls aged 9 to 10 years reported sexual fantasies, respectively, and 2% or fewer of boys and girls reported interests in sexual intercourse (Arnal & Llario, 2006, as cited in Fortenberry, 2013). A retrospective study similarly found that 3.9% of men and 2.8% of women recalled thinking a lot about sex between ages 6 and 10 years (Larsson & Svedin, 2002a). Sexual desire is rarer among younger children, according to caregivers' reports that there is a lower prevalence of younger than older children showing explicit interests in sex (e.g., Friedrich et al., 1998, 2000; Sandnabba et al., 2003; Schoentjes et al., 1999; Thigpen, 2009). Notably, these rates are substantially lower than those of partnered sexual experiences in the same age group (de Graaf & Rademakers, 2006), suggesting that sexual desire emerges after sexual behavior.

That many young children likely engage in sexual activities in the absence of sexual desire suggests that young children can be aroused by physical stimulations but without the motivation to seek out sexual encounters and/or the capacity to experience sexual fantasies or sexual attraction. The cause of this dissociation has been attributed to two independent systems governing human sexuality: sexual arousability (i.e., the capacity to become sexually aroused) and sexual proceptivity (i.e., the motivation to have sex) (Diamond, 2007; Wallen, 2001). Sexual arousability is hormone independent and, therefore, children can experience sexual arousal even though they have low levels of endogenous androgens and estrogens; in contrast, sexual proceptivity is hormone dependent and, therefore, children's sexual desire increases with the elevation of endogenous androgens and estrogens during puberty (Diamond, 2007; Wallen, 2001; see also Sect. 12.5.1).

Whereas past research has supported the link between the frequency of sexual desire and steroid hormones (Campbell et al., 2005; McClintock & Herdt, 1996; Udry et al., 1986), limited studies have examined the influence of social factors. In addition, few retrospective studies have investigated the intensity or the content of sexual fantasies in childhood, let alone studies taking children's perspectives. Missing these pieces of information prohibits researchers from revealing the interactions between biological, psychological, and social systems in shaping children's sexual desire, or the association between early sexual desire and later sexuality development. For example, does the sex of partners in children's sexual fantasies predict their sexual orientation in adulthood? And is this relation magnified by the salience of children's sexual fantasies?

12.3.4 Sexual Orientation

Sexual orientation is defined as a multidimensional construct, primarily comprising (1) the gender(s) of people to whom an individual experience sexual or romantic

attraction, (2) the gender(s) of people with whom an individual has sexual behavior, and (3) the sexual identity label an individual uses to describe these sexual experiences (Institute of Medicine, 2011; Klein et al., 1985). Most studies on children's sexual orientation have used retrospective reports from adolescents or adults, especially from those who self-identify as lesbian, gay, and bisexual (LGB). These studies suggest that sexual orientation may manifest in children's sexual attraction: LGB individuals on average have first same-sex sexual attraction at age 10 and heterosexual individuals on average experience first other-sex sexual attraction at the same time, which coincides with pubertal onset (Herdt & McClintock, 2000; McClintock & Herdt, 1996).

While this finding seems to support the idea that sexual orientation is predetermined early in development and steadily unfolds with puberty, accumulating evidence suggests that early sexual experiences do not always align with later sexual orientation. Specifically, some studies have found that over half of lesbian women and over one third of gay men reported that their first sexual attraction was towards the other sex rather than the same sex (Katz-Wise et al., 2017; Rosario et al., 1996). In addition, rather than simultaneously experiencing first sexual attraction to both sexes, self-identified bisexual and mostly heterosexual individuals recall that same-sex sexual attraction emerged years after pubertal onset, following the debut of other-sex attraction, which also illustrates an incongruence of first sexual attraction and future sexual orientation (Calzo et al., 2011; Katz-Wise et al., 2017). Moreover, some self-identified completely heterosexual women and men may experience same-sex sexual attraction or sexual behavior in early adolescence but not in emerging adulthood (Li & Davis, 2020; Savin-Williams & Joyner, 2014a), which again corroborates the nonlinear development of sexual orientation.

Together, the above findings suggest that sexual experiences in childhood and adolescence probably are not reliable indicators of sexual orientation in adulthood. Specifically, the lack of (or the presence of) same-sex attraction during early stages of development may not always suggest heterosexual orientations (or LGB orientations) in adulthood. The causes of this early incongruence are subject to different speculations. Some researchers propose that untruthful reports have contributed to the inconsistency. For example, heterosexual "jokesters" may report having early same-sex sexual attraction to mislead the researchers (Savin-Williams & Joyner, 2014a, 2014b; cf. Katz-Wise et al., 2015; Li et al., 2014), and LGB individuals may report having early other-sex sexual experiences due to internalized homophobia (Xu et al., 2017a, 2017b); however, the speculation of untruthful reports cannot fully explain the disappearance of same-sex sexuality among heterosexual individuals in later years (Li & Davis, 2020; Savin-Williams & Joyner, 2014a). Another explanation for the early incongruence may be that the findings are subject to retrospective bias, given that most studies on the developmental trajectories of sexual orientation have been retrospective (cf. Li & Davis, 2020; Savin-Williams & Joyner, 2014a); however, retrospective bias should not have prompted heterosexual adults to recall same-sex sexuality in younger ages, considering the prevailing heteronormative pressure. Yet a final explanation of the early incongruence is that some unknown

developmental systems processes have led sexual experiences to become more congruent with sexual orientation over time (Diamond et al., 2017).

To date, only two studies have examined child sexual orientation using children's contemporaneous reports. These studies both suggest that sexual experiences in childhood may not be reliable precursors of sexual orientation in adulthood. The first study examined a social-cognitive component of sexual orientation—heterosexual questioning, defined as having doubts about heterosexual lifestyles (Carver et al., 2004). Carver and colleagues asked participants aged 9 to 13 years about their expectations of entering a heterosexual marriage and forming a traditional heterosexual family. Younger boys reported higher levels of heterosexual questioning than older boys, whereas younger girls reported similar levels of heterosexual questioning as older girls. Therefore, heterosexual boys appear to be increasingly certain about their sexual identity from childhood to early adolescence, probably reflecting that many boys increasingly have regular other-sex attraction and other-sex sexual activities from early adolescence (Carver et al., 2003). However, heterosexual girls may continue to be less certain of their sexual identity in early adolescence than heterosexual boys, perhaps due to having fluid sexual experiences (Baumeister, 2000; Diamond, 2008).

The second study examining child sexual orientation used data from the Adolescent Brain Cognitive Development Study, a US-representative cohort study (Calzo & Blashill, 2018). This study found that 0.2% of children aged 9 to 10 years self-identified as gay or bisexual, and another 0.6% of children thought that they might be. These proportions were substantially smaller than what was found in adolescents and adults (Savin-Williams & Vrangalova, 2013), suggesting that more children would identify as LGB later in development. However, this study also found that 23.7% of children did not understand sexual identity labels such as "gay" or "bisexual" (Calzo & Blashill, 2018) and, therefore, sexual identity may not be a reliable indicator of child sexual orientation. Asking about other dimensions of sexual orientation, such as sexual or romantic attraction and a full spectrum of sexual activities, may offer new insights into children's sexual orientation (e.g., Li & Davis, 2020; Li & Hines, 2016; McClelland et al., 2016).

In summary, children's sexual and romantic attraction, sexual behaviors, and sexual identity may be fluid and ambiguous. Consequently, sexuality in childhood is probably not as revealing of sexual orientation as later sexuality. A key question that follows is whether this increasing consistency between sexual orientation and other components of sexuality from childhood to adulthood reflects a change in the other components of sexuality, a change in sexual orientation, or both. To distinguish between these explanations, researchers may usefully employ the dynamic systems approach, which is a variation of developmental systems theories (Diamond et al., 2017; Farr et al., 2014). According to the dynamic systems theory, sexual attraction and sexual behaviors with different genders can be conceptualized as time-varying phenomena, which change in intensity and frequency day to day, and sexual orientation can be conceptualized as an "attractor" to which these time-varying sexual experiences return at an equilibrium state. Measuring these variations in an intensive longitudinal design (Bolger & Laurenceau, 2013) and conducting

statistical analyses suitable for the dynamic systems approach, such as multilevel modeling (Diamond et al., 2017), researchers can separate the "attractor" from variability; and, by comparing these models across developmental periods, researchers can compare changes in sexual orientation and other aspects of sexuality to determine why they become more consistent over time.

12.4 Biosocial Influences on Sexuality Development

12.4.1 Adrenarche

Adrenarche refers to the "awakening of adrenal gland," which on average occurs in middle childhood (around 6- to 8-years-old) and is marked by the upsurge of adrenal androgens such as dehydroepiandrosterone (DHEA), dehydroepiandrosterone sulfate (DHEAS), and androstenedione (Dorn & Biro, 2011; McClintock & Herdt, 1996). The increased adrenal androgen levels lead to the growth of pubic hair. In contrast, gonadarche occurs approximately two years after adrenarche and is marked by the maturation of gonadal glands, accelerating the production of gonadal hormones including testosterone and estradiol (Dorn & Biro, 2011; Sperling, 2014, p. 485). Consequently, ovaries and testes grow, as well as breasts and genitalia.

Adrenarche and gonadarche are considered related yet distinct components of puberty. However, adrenarche should be more relevant to children's sexual proceptivity, because adrenarche typically proceeds, and gonadarche typically follows, the onset of sexual attraction (McClintock & Herdt, 1996). The causal relation between adrenarche and sexual proceptivity has been established in randomized clinical trials in adult women, which have found that DHEA and its metabolite testosterone improve sexual desire and sexual arousal (Buster et al., 2005; Goldstat et al., 2003; Hackbert & Heiman, 2002). The link between adrenarche and sexual proceptivity appears to hold universally: A cross-cultural study in New Guinea and the USA found that sexual attraction and other proceptive sexual experiences emerge around age 10 years in different cultures, shortly after the onset of adrenarche (Herdt & McClintock, 2000). Thus, worldwide, adrenarche appears to prepare children for their first sexual attractions and sexual fantasies. However, the content of sexual attraction and sexual fantasies, as well as their manifestations in proceptive sexual activities, may be regulated by sociocultural factors, as reviewed below.

12.4.2 Intimate Peer Relationships

Unlike adolescents, who often initiate other-sex sexual activities in a romantic relationship (Carver et al., 2003; Collins et al., 2009), most children engage in sexual activities with friends (Haugaard & Tilly, 1988; Larsson & Svedin, 2002a). And, due to sex segregation in childhood (reviewed in Mehta & Strough, 2009), children are

more likely to have same-sex sexual activities than adolescents and adults. For example, in a retrospective study, 83% of the high-school students who had mutual sexual experiences in childhood shared them with a friend (Larsson & Svedin, 2002a). In the same study, 45% of adolescent boys and 71% of adolescent girls who had reciprocal sexual contact during childhood had it with a same-sex peer, exceeding the prevalence of same-sex sexual activities in adolescence and adulthood by a large degree (Li & Davis, 2020; Twenge et al., 2016).

Notably, same-sex sexual behavior in childhood does not always imply a same-sex sexual orientation. As noted in Sect. 12.3.4, heterosexual, bisexual, and lesbian/gay individuals may all engage in same-sex sexual activities, and it can be misleading to predict someone's future sexual identity from their sexual activities in middle childhood and early adolescence (Li & Davis, 2020). In fact, many girls alternate between feminine and masculine gender roles to mimic heterosexual relationships when playing sexual games, and if they experience sexual arousal during same-sex play, they sometimes feel guilty and see themselves as "boylike" (Lamb, 2004). Among boys, same-sex sexual games often involve the display of masculinity, power, and status, such as using sex to "conquer" the play partners (reviewed in Lamb & Plocha, 2014). These stories suggest that children's sexual play is guided by gender roles and heteronormative social norms, instead of by sexual orientation.

Although most children manage to maintain heterosexuality despite having engaged in same-sex sexual games, other children progress to develop same-sex sexual attraction and adopt an LGB identity (McClelland et al., 2016). These diverging trajectories lead to the intriguing question about the causes of such divergence. Biological factors such as genes, maternal immune responses, and prenatal hormone exposure may predispose some individuals to same-sex sexuality (Bailey et al., 2016; Swift-Gallant et al., 2019). Alternatively, emerging evidence has suggested that increasing societal acceptance towards same-sex sexuality is associated with its increasing prevalence over the past decades (Copen et al., 2016; Mercer et al., 2013; Phillips et al., 2019; Richters et al., 2014; Twenge et al., 2016; Wienke & Whaley, 2015). Consequently, it can be speculated that for some contemporary children, sexual play with same-sex peers provides a context not only for gender role development but also for sexual identity exploration, thereby leading to an earlier recognition and disclosure of an LGB identity than in the past (Russell & Fish, 2019).

In addition to gender roles and sexual orientation, another frequently studied topic on children's sexual relationships is sexual coercion and its consequences. Sexual coercion manifests in many forms, ranging from physical coercion such as forcing, bullying, or threatening, to psychological coercion such as persuading, manipulating, or tricking (Diamond et al., 2015). Sexual abuse is increasingly acknowledged as a severe form of sexual coercion, although some researchers adopt a narrow definition of sexual abuse and only include coercive relationships that involve a large difference in age, maturational status, and/or power between the abused child and the abuser (reviewed in Devries et al., 2014; Finkelhor, 1984; Irish et al., 2010; Jumper, 1995; Klonsky & Moyer, 2008; Paolucci et al., 2001; Rind et al., 1998; Friedman et al., 2011; Rind & Tromovitch, 1997; Stoltenborgh et al.,

2011). Between children of a similar age, sexual coercion is more likely to happen to girls and racial/ethnic minority individuals, and the coercive child is more likely to be a friend than an acquaintance or a family member and to be a boy than a girl (Haugaard & Tilly, 1988; Larsson & Svedin, 2002a). Sexual coercion from another child is on average associated with more negative responses in the coerced child (Haugaard & Tilly, 1988). However, the majority of adults who had coercive sexual experiences with a peer in childhood reported little short- or long-term effects on their well-being (Larsson & Svedin, 2002a). This latter finding warrants more research; perhaps the severity, frequency, and length of sexual coercion episodes explain variations in the well-being of the coerced children. Alternatively, individual characteristics, such as affect dysregulation and sexual anxiety, may partly explain the differences in sexuality outcomes associated with sexual coercion and other childhood trauma (Bigras et al., 2017). Nevertheless, the general consensus among researchers is that the dynamics and atmosphere of sexual encounters (e.g., whether these encounters are mutually initiated; whether sexual coercion is involved; whether these encounters take place in a close relationship) have a larger impact on children's future outcomes than the type of sexual activities (e.g., involving genital contact or not; Diamond et al., 2015; Lamb & Plocha, 2014).

Cross-species evidence further suggests that social deprivation of peer interactions in early life may result in persisting deficits in sexual behavior. For example, one study found that juvenile male rhesus monkeys who were given 0.5-hour periods of peer interaction at age one year showed reduced or diminished foot-clasp mounts to peers, which is an index of adult sexual behavior in male monkeys, compared to those who were given 24-hour access to peers at the same age (Wallen et al., 1981). The same study also found that early peer deprivation led to increased threat and withdrawal behaviors to peers (Wallen et al., 1981). In another study, male rhesus monkeys who were partially or completely forbidden to interact with sexually receptive females showed no mounting behavior and other social behaviors such as grooming and threat (Missakian, 1969). These findings raise the possibility that peer interactions in childhood, either with the same sex or the other sex, may be essential for the development of later sexual behaviors. However, this hypothesis has not been tested in humans, and the mechanism is unclear. Given that other social behaviors were also affected by early peer deprivation in male rhesus monkeys, it is possible that the deficits in sexual behavior may be part of broader deficits in socioemotional development due to early adversity.

12.4.3 Parental Influences

Parents are the second most common source of sexuality information for children, after friends (Morawska et al., 2015). However, children's sexual communication with parents has received much more scholarly attention than that with friends (Lamb & Plocha, 2014). Whereas most parents find it critical to talk to their preadolescent children about sex, in practice many parents do not do so (Wilson

et al., 2010). The commonly cited barrier is that parents worry their child is too young (Jarkovská & Lamb, 2018; Pariera, 2016; Wilson et al., 2010). In contrast, promoters of parent-child sexual communication include parents' self-efficacy and comfort in having those conversations, knowledge about sexuality, and open attitudes towards sexuality education, as well as a close parent-child relationship (Byers et al., 2008; Morawska et al., 2015; Pariera, 2016; Pluhar et al., 2008; Wilson et al., 2010). In addition, parents, especially mothers, are more likely to talk to daughters and to older children about sex, perhaps respectively reflecting parents' intention to avoid adverse consequences of having sexual intercourse for daughters, such as unplanned pregnancy, and to protect their young children's innocence (Byers et al., 2008; Pluhar et al., 2008). In addition, parents with a lower socioeconomic status or a religious background tend to have less sexual communication with their children, although the findings have been inconsistent (Gagnon, 1985; Gordon et al., 1990; Pluhar et al., 2008).

The topics of parent-child sexual communication vary widely. In one study, parents ranked preventing sexual abuse as the most important topic, followed by promoting children's self-acceptance and self-esteem, and maintaining a positive body image; responding to children's masturbation and to child nudity were ranked among the least important topics (Morawska et al., 2015). Other topics include sexual health, puberty, reproduction, sexual anatomy, and gender roles and sexual orientation (Martin, 2009; Morawska et al., 2015; Pluhar et al., 2006). In general, parents find it easier to discuss reproductive and sexual health with children than sexual experiences (e.g., orgasm, masturbation, sexual pleasure; Ritchwood et al., 2018), which may explain parents' struggles when being confronted with their children masturbating or viewing pornography (Gagnon, 1985; Rothman et al. 2017).

The effects of parent-child sexual communication are influenced by the communication process. Some parents choose to postpone or avoid the conversation, or to wait for their children to bring up the topic (Pluhar et al., 2006; Wilson et al., 2010). However, starting the discussions before children are in school, creating opportunities to talk, and taking a step-by-step strategy are associated with better communication quality (Gordon et al., 1990; Pluhar et al., 2006; Wilson et al., 2010). Other factors that were found to enhance communication quality include building connections with the children, being empathic, creating a comfortable atmosphere, taking an interactive approach rather than a didactic approach, using storytelling, and using body language (Pluhar & Kuriloff, 2004). These effective practices often reflect an open, supportive, responsive, and authoritative parenting style, which has been linked to many benefits in children and adolescents, including more knowledge of sexual anatomy and reproductive and sexual health, delayed sexual intercourse, safer sexual behaviors, and higher sexual self-efficacy (de Graaf et al., 2011; Gordon et al., 1990). In contrast, when parents adopt untrusting, intimidating, or antagonistic approaches or focus on persuading children into sexual abstinence, their children are more likely to hide information from parents, and the conversations often end in vain (O'Sullivan et al., 2001).

12.4.4 Media

Traditional media (e.g., television, magazine, advertising) and the Internet are also primary sources of sexual information for contemporary children. In a recent survey of 557 parents, approximately 62% and 19% of parents reported that their children between ages 3 and 10 years obtained information on sexuality from the traditional media and the Internet, respectively (Morawska et al., 2015). The rise of social media sites, smartphones, and tablets has captured wide attention from caregivers, educators, and researchers, guarding against direct exposure of children to sexually explicit material, online sexual exploitation, problematic sexual scripts, and inappropriate sexualization of children (AAP Council on Communications and Media, 2016; Holloway et al., 2013; Pew Research Center, 2020). These concerns are rooted in empirical research—primarily based on young people—revealing the adverse influences of the media on their sexuality development. Similar impacts are expected on preadolescent children, because children are more vulnerable than young people due to immature cognitive, affective, and social capacities (Jarkovská & Lamb, 2018).

Specifically, children are at risk of being exposed to online pornography. In a US-representative sample of children and adolescents, 16% of girls and 17% of boys aged 10 to 11 years reported unwanted exposure to online pornography in the past 12 months, and another 1% of girls and boys aged 10–11 years reported wanted exposure to online pornography in the past 12 months (Wolak et al., 2007). A UK-based study estimated that 4% of children aged 9 to 10 years and 5% of children aged 11 to 12 years had seen sexual images on the Internet during the past 12 months (Ringrose et al., 2012). Another retrospective study on Swedish high school students found that 13% of girls and 22% of boys recalled viewing pornography at ages 6 to 10 years and 23% of girls and 57% of boys recalled viewing pornography at ages 11 to 12 years (Larsson & Svedin, 2002a). Being exposed to online sexual content was related to more sexually promiscuous behaviors (Braun-Courville & Rojas, 2009), more victimization experiences and unwanted online sexual solicitation, and increased withdrawal or depression (Wolak et al., 2007); however, the causal direction has not been established due to the lack of longitudinal studies.

Sending and receiving text messages that contain sexual content ("sexting") is another risk for children. A meta-analysis synthesizing 12 studies on children and adolescents found that 10–16% of them reported some type(s) of sexting behavior; these prevalence estimates were greater in nonrandom samples than in random samples (Klettke et al., 2014). Sexting appears to be more common among adolescents, African-American individuals, and sexual and gender minority individuals (Klettke et al., 2014). Girls send more sexts than boys and boys receive more sexts than girls, but the gender differences are inconsistent across studies (Klettke et al., 2014). Sexting often involves coercive messages, with threats being more likely to come from peers than from a complete stranger (Klettke et al., 2014; Ringrose et al., 2012). Previous studies have found that both receiving and sending sexts relate to increased sexual activities (reviewed in Klettke et al., 2014), which was replicated in

a longitudinal study of adolescents finding that sending a sext was associated with a higher odds of being sexually active (but not with risky sexual behaviors) one year later (Temple & Choi, 2014). However, it remains possible that some third variables, such as peer pressure and sensation-seeking, underlie this link. In addition, there is a lack of studies investigating the prevalence, predictors, and consequences of sexting among preadolescent children.

In addition to online pornography and sexting, children may also be inadvertently exposed to sexual content via traditional media. It was estimated that 81% of films and 82% of TV programs in the USA contain sexual content (Bleakley et al., 2014; Fisher et al., 2004). Although the film rating systems in America and some other countries have reduced the risks of unwanted exposure of sexual content to children and young people, the risks remain when there is insufficient parental monitoring (Collier et al., 2016). The negative association between sexual media exposure and sexuality development in children and young people is consistent and robust: A recent meta-analysis reviewing 59 studies totaling 48,471 participants found that increased exposure to nonpornographic sexual content in traditional media is associated with more permissive sexual attitudes, peer sexual norms, and acceptance of rape myths, as well as more general and risky sexual behavior and an earlier age of sexual initiation (Coyne et al., 2019). Coyne et al. also found that the negative impacts of sexual media exposure were stronger among adolescents than emerging adults and among men than women, but were consistent across racial/ethnic groups. The moderation analysis of age in this meta-analysis did not compare preadolescent children to other age groups, because it only identified one study involving a preadolescent sample; this single study ($N = 3{,}553$) reported that high exposure to rap music (which often contains sexually explicit lyrics) in 5th grade was associated with a higher odds of engaging in sexual behavior in 7th grade, defined as having had oral sex, anal sex, or sexual intercourse (Johnson, 2013).

Perhaps a more prevailing impact of the media on preadolescent children is the sexualization of children, especially of girls. Sexualization is defined as having one or more of the following characteristics: evaluating a person exclusively by their sexual appeal, equating physical attractiveness to sexual attractiveness, treating a person as a sexual object, and/or inappropriately imposing sexuality upon another person (APA Task Force on the Sexualization of Girls, 2007). As mentioned in the previous paragraph, rap music culture provides an example of sexualization in which sexual scripts are encapsulated in the lyrics, prescribing sexual and gender norms for children and adolescents (Johnson, 2013). Another example is the propagation of heteronormative sexual scripts in American children's TV programs, which uphold heterosexual relationships and depict sexual objectification of girls, self-objectification among girls, and ego-boosting among boys (Kirsch & Murnen, 2015). The negative consequences of exposure to sexualizing media among girls include body dissatisfaction, low self-esteem, and depression (APA Task Force on the Sexualization of Girls, 2007). Self-objectification in (adolescent) girls is associated with body shame and anxiety, low self-awareness, low sexual self-efficacy, low sexual satisfaction, and an early initiation of sexual intercourse (reviewed in Daniels et al., 2020). In summary, both traditional media and the Internet may influence

children's and young people's sexuality development through direct or indirect exposure to inappropriate content, but more research is needed on children.

12.5 Future Research

The central premises of the developmental systems theory are multiple co-acting processes and reciprocal influences, self-organization and self-regulation, and dynamic change (Overton & Molenaar, 2015). Under this framework, there are many more questions unanswered than answered about normative sexuality development in childhood. Below, I highlight three important areas of research and illustrate how developmental systems theory can be employed to answer them. Because the progress of research on child sexuality is hampered by sociocultural taboos, I also discuss how recent innovations in research methods in child development may help circumvent these constraints.

12.5.1 Sexual Arousability and Sexual Proceptivity

Sexual arousability and sexual proceptivity are two hypothetical co-acting processes that mobilize partnered sexual activities (Diamond, 2007). Sexual arousability has been used to explain sexual fluidity, which refers to context-dependent, hour-to-hour and day-to-day variations in the frequency, intensity, and direction of sexual attraction and sexual desire, whereas sexual proceptivity has been used to explain hormone-driven, persisting sexual attraction and sexual desire that are directed towards one or more specific persons or genders (Diamond et al., 2017; Farr et al., 2014; see also Sect. 12.5.1). Sexual arousability and sexual proceptivity are also relevant to sexual desire and arousal disorders in clinical settings (Brotto et al., 2010).

In the context of child development, it is clear that children have the capacity to experience sexual arousal starting from a young age, considering children's adult-like physiological responses during masturbation (Kinsey et al., 1953; Leung & Robson, 1993; Martinson, 1994). In the meantime, children do not appear to have strong sexual proceptivity, given the absence of sexual attraction until around age 10 years (Herdt & McClintock, 2000; McClintock & Herdt, 1996), as well as the low prevalence of partnered sexual activities among children compared to the prevalence among adolescents and adults (e.g., Friedrich et al., 1998; Schoentjes et al., 1999). One critical question then arises: Does frequent activation of the sexual arousability system lead to an advanced development in the sexual proceptivity system? For example, do children who participate in sexual activities in early to middle childhood out of curiosity experience sexual attraction earlier than children who do not engage in sexual activities? If yes, what are the underlying processes?

According to the developmental systems perspective, one possible process is the reciprocal association between sexual arousal and hormones. Because sexual arousal often accompanies changes in hormone levels, including the elevation of androgens, children who frequently experience sexual arousal may have high levels of circulating androgens, which may lead to early maturation of adrenal glands through a feedback loop in the hypothalamic-pituitary-gonadal axis (Byrne et al., 2017). Consequently, adrenarche commences early, triggering sexual attraction and activating the sexual proceptivity system, which then feeds into the frequent activation of sexual arousability system, thus completing the loop. Therefore, sexuality development can be conceptualized as involving bidirectional interactions between multiple systems—in this example a hormone-mediated loop between the sexual arousability and sexual proceptivity systems.

12.5.2 Sexual Agency and Sexual Scripts

Agency, including self-organization and self-regulation, is another feature of a developmental system. However, children's sexual agency has been rarely studied. It is widely yet incorrectly assumed that because children have immature self-regulatory systems, they do not exercise sexual reasoning or decision-making (reviewed in Jarkovská & Lamb, 2018). Yet, studies on sexualizing media and sexual scripts have suggested that children do regulate their own sexual behaviors, with their self-regulations being heavily influenced by sexual scripts (APA Task Force on the Sexualization of Girls, 2007).

For example, girls switch between feminine and masculine gender roles in same-sex sexual play to mimic heterosexual relationships that they learn from parents, media, and society (Kirsch & Murnen, 2015; Martin, 2009), and girls who have sexual arousal in these games often feel shame and question their heterosexuality (Lamb, 2004). In contrast, children and young people raised by same-sex mothers report having more same-sex sexual and romantic relationships than their counterparts raised in single-mother families or than an age- and gender-matched sample from a general population (Gartrell et al., 2019). Although genetic heritage of sexual orientation cannot be ruled out from these findings, Golombok and Tasker (1996) also found a positive relation between lesbian mothers' openness to same-sex relationships and children's same-sex sexual interests, suggesting that creating an inclusive environment may encourage children to explore their sexuality more freely in a heteronormative society. Fostering children's sexual agency is important in this case because, as children and youth "come out" (disclose a nonheterosexual identity to others) more often and at an earlier age nowadays than before, to be able to fully embrace sexual diversity is critical for their mental health (Russell & Fish, 2019). Therefore, one fruitful future direction could be to develop educational, social, and psychological interventions to reduce sexual scripts that prescribe fixed gender and sexual norms and to encourage sexual agency in children.

12.5.3 Sexual Fluidity

The third feature of a developmental system is dynamic change across time. This feature is evident in sexuality development. For example, adults with a female gender identity or a bisexual identity report high levels of day-to-day variability in sexual attraction towards different genders (Diamond et al., 2017); and, over a longer timescale, adolescents and adults also report changes in sexual attraction, sexual behavior, and sexual identity (Elkington et al., 2020; Mock & Eibach, 2012; Ott et al., 2011; Savin-Williams & Ream, 2007; Savin-Williams et al., 2012). Such dynamic change may indicate another understudied dimension of human sexuality—sexual fluidity—which may be having evolutionary foundations (Baumeister, 2000).

Sexual fluidity has been suggested to be most prominent during sensitive periods of development such as middle childhood and adolescence, when the brain undergoes active reorganization (Byrne et al., 2017; Del Giudice, 2014; Sisk, 2016). However, few studies have been conducted on sexual fluidity in childhood. In addition to describing sexual fluidity in childhood, such as how sexual attraction varies on different time scales and across social contexts; how sexual attraction, sexual behavior, and sexual identity are interrelated; and how sexuality development spreads from one domain to another—it may also be fruitful to examine whether these different manifestations converge to indicate a person's underlying sexual fluidity. Furthermore, researchers could usefully investigate factors contributing to sexual fluidity, e.g., sexual scripts, intimate relationships, and testosterone (Baumeister, 2000; Diamond, 2008; Peplau, 2001). To answer these questions, more longitudinal studies should be conducted on sexuality development, starting from childhood to adolescence and beyond. In addition, future studies may usefully integrate an intensive longitudinal design (Bolger & Laurenceau, 2013) to examine moment-to-moment variations in sexuality. This research could be especially informative when it focuses on sensitive developmental periods such as adrenarche.

12.5.4 Nonintrusive Measures

Prior research in children's sexuality development has been constrained by cultural taboos, which prevent researchers from asking children directly about their sexuality. Analyzing adults' self-recall and caregivers' report circumvent these taboos, but each method has inherent limitations, which increase measurement error (see Sect. 12.2). Therefore, it is useful to develop nonintrusive techniques to retrieve sexuality profiles from children directly.

One promising method is to study pupil dilation, eye movements, or viewing time as indicators of sexual attraction, which has been validated in adult samples (Lippa, 2012; Rieger et al., 2015; Rieger & Savin-Williams, 2012). When adapting these measures to children, however, there are two challenges. First, sexually explicit materials, which have been commonly used to study adult sexuality, cannot be

applied to children due to ethical and legal concerns. Instead, photos, illustrations, or videos of nonnude models may serve as an alternative (Lippa, 2012, 2017; Watts et al., 2017). Another possibility is to study children's eye movements in naturalistic settings using wearable eye-tracking glasses, for example, at a swimming pool; a prolonged eye fixation on one person may indicate sexual interests in that person. Inherited from the first challenge, the second challenge concerns the validity of using nonexplicit materials to study children's sexual attraction, because eye movements (and to a lesser extent, pupil dilation) towards attractive models may also be driven by social comparison processes (e.g., admiring someone's body shape; Xu et al., 2017a, 2017b). Therefore, future research should first validate these materials and procedures in children before using them to assess children's sexual attraction and should control for confounding factors such as social comparison when applicable.

Another candidate technique could be to record ambient sounds of children's lives, using the electronically activated recorder (EAR) methodology (Mehl, 2017). EAR is a smartphone app that turns on intermittently for a briefly period to audio record naturalistic conversations and activities. The recordings have been processed to analyze social interactions (e.g., staying alone, talking to another person, talking in a group), activities (e.g., entertainment or socializing), mood (e.g., crying and laughing), and language use (e.g., words indicating positive and negative emotions; Mehl, 2006). Given the ecological validity of the EAR method (Mehl, 2017), it has the potential to be adapted to study real-life sexual communication between parents and children as well as among peers.

In summary, the methods reviewed in this section provide tools for making naturalistic observations without exposing children to potentially harmful materials. These methods should be viewed as complements, but not replacements for existing subjective measures. While parents may be more likely to say yes to using these nonintrusive, nonexplicit measures to study their child(ren)'s sexuality development than using self-report measures, the ultimate barrier is the sociocultural norm that denies children's sexuality and insists on children's innocence (Jarkovská & Lamb, 2018). Therefore, a long-standing task for the studies of child sexuality is to challenge the myths of childhood innocence and alter people's view towards promoting healthy and developmentally appropriate sexual learning in order to achieve long-term well-being for children (Jarkovská & Lamb, 2018).

12.6 Conclusion

This chapter adopts a developmental systems perspective to examine normative sexuality development during childhood. In contrary to common beliefs, abundant evidence suggests that children have the capacity for sexual pleasure. Children as young as age two years may engage in solitary or partnered sexual activities, driven first by nonsexual motives such as curiosity and then increasingly by sexual desire and sexual attraction from middle childhood and early adolescence. Same-sex sexual games are common among children, especially girls, but sexual experiences in

childhood cannot always reliably predict future sexual orientation. Many biosocial factors have been shown to influence children's sexuality development, including adrenarche, intimate relationships, and sexual scripts delivered through the media. However, not enough attention has been devoted to understanding how these biosocial factors interact with each other to influence sexuality development, or how sexuality development in turn influences these biosocial factors. Answering these questions will require researchers to develop or apply new methods to observe children's experiences from their own perspectives and to integrate longitudinal research methods. Nevertheless, the bigger obstacle confronting researchers who wish to study children's sexuality may be the widespread belief of child innocence, but only by investing more efforts and resources into this field can researchers, parents, practitioners, and policy makers begin to challenge this false belief and begin to truly protect children's vulnerability.

Spotlight Feature: Doctor Games

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"Doctor games" are play situations children may engage in prior to the age of 12, where two or more children undress and examine or otherwise play with their bodies, especially the genitals and the bottom. They look at and/or touch each other. The children may also kiss each other, or lick the skin—at times, the genitals. They may get on top of each other, simulating intercourse. Finally, they may insert objects into the vagina/rectum. The framework of the games may be a visit to the doctor, but other play themes are as likely to inspire the games. These may also simply take the form of "I'll Show You Mine If You Show Me Yours" (Friedrich, 2007; Lamb & Coakley, 1993; Leander et al., 2018).

Sexual games among children are pervasive throughout Western and non-Western cultures. They are observed by parents, childcare staff, and researchers, and are retrospectively reported by adults, in various cultures (e.g., Ford & Beach, 1951; Lamb & Coakley, 1993; Larsson & Svedin, 2001; Leander et al., 2018; Lopez Sanchez et al., 2002; Miragoli et al., 2017; Okami et al., 1997; Reynolds et al., 2003; Sandfort & Cohen-Kettenis, 2000; Schoentjes et al., 1999). Furthermore, all great apes display sociosexual patterns during infant and juvenile life (Dixson, 2012).

The ubiquitous character of doctor games establishes them as expected, developmentally appropriate sexual behavior in children (Dixson, 2012; Friedrich, 2007); however, their role in sexual development is understudied. One theory is that these are sexual rehearsal games, a safe venue for children to learn about sex (Dixson, 2012; Josephs, 2015). Research on the role of play in general in child development supports this theory. It indicates that children's play, ubiquitous in human societies, has evolved to develop and train future behavior in a safe environment (Buchsbaum et al., 2012; Lillard, 2017; Steen & Owens, 2001), and that while playing, children acquire generic knowledge (Sutherland & Friedman, 2013) and cognitive and social skills (Buchsbaum et al., 2012; Lillard et al., 2013; Lillard, 2017). Seen through this lens, doctor games may be considered opportunities for children to develop and practice sexual behaviors and interactions to acquire an experience of intimacy, boundaries, and the thrill of sexuality, and finally, to gain knowledge about genital differences and the human body in general.

How and how much children play doctor games is influenced by their acceptance in a given context, and views on doctor games vary, depending on culture and historical period (e.g., Ford & Beach, 1951; Larsson et al., 2000; Reynolds et al., 2003). There was a significant shift in views of doctor games in Western societies at the end of the 1900s, beginning in the English-speaking countries in the late 1980s. The new view of doctor games focused heavily on abnormal sexual behaviors in children and the idea that children could sexually abuse each other (Dicataldo, 2009; Leander et al., 2018; Levine, 2002; Okami, 1992; Tobin, 1997, 2004, 2009). It was largely influenced by the great attention to sexual abuse that began in the USA in the

1970s, leading to an interest in children's sexuality beginning in the 1980s, as children with "sexual behavior problems" were considered sexual abuse victims who repeated the abusive behavior and were future sex offenders—stereotypes that have proven inaccurate for the majority of these children (Carpentier et al., 2006; Chaffin et al., 2006; Friedrich, 2007; Letourneau et al., 2008).

Leander et al. (2018) showed how the abovementioned shift in culture emerged in childcare institutions in Denmark, a sexually permissive society. Their study revealed that before the millennium, doctor games were generally tolerated at Danish childcare institutions, and it was usual for children to bathe naked in the summer. Today, however, the majority of institutions forbid undressing and nudity—partly to keep children from playing doctor—and many institutions have explicit rules against these games. They either forbid doctor games or allow them with certain restrictions. The most common restriction is that children must remain dressed—all their clothes, or their underwear—while playing; other restrictions are that children may play doctor from the waist and up, or look at each other, but not touch. As a result of staff's efforts to ensure that children obey the rules, there tends to be increased surveillance of children; for instance, some institutions forbid blanket forts, or install windows to supervise children's play. Danish childcare facilities try to reassure parents, who they report as uneasy about children's nudity and doctor games, but most professionals share parents' concerns that doctor games risk being transgressive.

A new discourse on these games that has gained ground in Danish childcare institutions since the millennium reflects a significant focus on the risk of children overstepping each other's "boundaries" during these games, and many Danish childcare institutions teach children to feel and respect boundaries. The new discourse reveals that, at worst, doctor games are viewed as "abusive," and some children as "offenders." However, other childcare professionals express concern that the new rules suppress children's sexuality, and will harm them in the long run, whereas many try to balance things, for instance, by not shaming the children when interfering in the games. Another reason that Danish childcare staff restrict children's doctor games is that they fear false allegations of child sexual abuse (CSA) (Leander et al., 2018), a fear that also restricts normal physical contact between staff and children, which underscores how profoundly the child's body has become associated with CSA (Leander et al., 2019).

Much research indicates that in Western cultures, both parents and childcare professionals lack education on children's developmentally appropriate sexuality (e.g., Balter et al., 2018; Martin, 2014). Current research on children's sexual games and professionals' education on this subject focus largely on problematic sexual behavior and CSA prevention (e.g., Balter et al., 2018; Reynolds et al., 2003). However, the rarity of problematic sexual behavior among children (Chaffin et al., 2006; Elkovitch et al., 2009) does not support this principal focus on risk, in theory or in institutional practice, and the ubiquity of doctor games contradicts their current problematization and persistent strong association with CSA in Western cultures. The consequence of these disproportions is not only that the developmental appropriateness of doctor games is overshadowed, curtailing them, but also that young

children, such as preschoolers playing doctor in daycare, risk serious consequences, for example, stigmatization as sex offenders, reports to the authorities, investigations, and suspicion of abuse of these children in another context (Chaffin et al., 2006; Chaffin & Bonner, 1998; Dicataldo, 2009; Martin, 2014; Silovsky, 2009; Tobin, 2009).

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Chapter 13
Sexual Pleasure in Adolescence: A Developmental Sexual Embodiment Perspective

J. Dennis Fortenberry and Devon J. Hensel

Abstract Sexual pleasure is a meaningful linkage of physical sensations of sexual contact with affective interpretations of those sensations, and is a key milestone of sexual development during adolescence. However, sexual pleasure is not simply cerebral assessment of sexual outcome but instead rests in the ways each specific body generates sensation in the context of social, cultural, interpersonal, and intrapersonal meaning. The understanding of sexual pleasure during adolescence is enlarged through assessment of sexual embodiment from consideration of diverse bodies—those associated with spina bifida, autism spectrum, and gender dysphoria. The objective of this chapter is to contribute to a framework for understanding the development of sexual pleasure during adolescence.

Keywords Sexual pleasure · Adolescent · Embodiment

The motivating question of this chapter is "what is the ontogeny of sexual pleasure during adolescent sexuality development?" Adolescence—considered here as a sociocultural framing for the physiologic, cognitive, and social changes associated with the second decade of life—is marked by sex and sexuality in almost all aspects. Our approach to addressing the ontogeny of pleasure is rooted in inquisitive skepticism about pleasure as an innate or even essential element of sexual experience, in a long-standing awareness of the contradictions of sexual pleasure in young people's sexual development, and in an interrogation of the meaning and function of sexual pleasure through an examination of youth's sexual embodiments, with focus on bodies traditionally considered sexually disabled. Our goal is to reposition sexual

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pleasure into an inclusive, developmentally relevant framework that illuminates the nuances of pleasure experiences and their contributions to sexual well-being.

13.1 Framing Sexual Pleasure in the Context of Adolescent Sexual Development

Hedonia; *euphoria*; *delight*; *ecstasy*. These synonyms of pleasure highlight the positive value given to the social, cultural, sensory, and affective experiences of [adult] sexual pleasure. Although sexual pleasure is a core element of the health-relevant concept of subjective well-being (Maddux, 2018), its relevance to the well-being of young people is infrequently addressed (Espinosa-Hernández et al., 2017; Nogueira Avelar e Silva et al., 2018). One imperfect definition of sexual pleasure—among many—has two components: stimulation of sensory receptors in the skin of erogenous zones, plus an interpretation of those sensory inputs as both pleasurable *and* sexual (Abramson & Pinkerton, 2002). One asks, then, *how* and *when* this union of experience and meaning occurs in accord with the dynamics of adolescent development. Sexual pleasure is often privileged as the single most powerful motivating factor for sexual behavior, but sexual pleasure does not appear to be an automatic and easily identifiable experience of sex during adolescents' sexual development (Hull, 2008). Potentially antithetical experiences such as pain, anxiety, disgust, dysphoria, stigma, and shame are sufficiently integral aspects of sexual learning to qualify as definitional elements—in addition to pleasure—of adolescents' sexual experience. This perspective challenges an easy, sex-positive assumption that pleasure is the truest experience of sex, while non-pleasure experiences are invalid, showing sexual immaturity, incompetence, victimization, disorder, dysfunction, or even failure (Spencer & Vencill, 2017).

All of this suggests the importance of a broader perspective on sexual pleasure during adolescence, allowing for a developmentally nuanced interrogation of the constitution of sexual pleasure during adolescence (Higgins & Hirsch, 2007). An element of this broader perspective is exploring the developmental origins and trajectories of sexual pleasure without assuming these experiences simply map adults' expectations of sexual pleasure. These "adult" expectations are often based on the surveillance and control of adolescent sexuality, typically by over-emphasis of partnered, genital sexual modes (e.g., genital-genital, oral-genital, anal-genital) and under-emphasis of more accessible (to adolescents) non-partnered genital experiences (e.g., masturbation), and partnered, non-genital behaviors (e.g., dancing, kissing) that are more characteristic of youth's earliest potentially pleasurable sexual experiences (Arbeit, 2014; Fortenberry, 2014; Harden, 2014). Inclusion of solo and non-genital sexual behaviors in considerations of adolescent sexual development—shifting emphasis away from partnered genital activities only—counterbalances ideas that adolescents are "too young" for sexual activity (Dixon-Mueller, 2008).

13.1.1 Elements of Adolescent Sexual Pleasure Development

As a starting place, we selectively review three root elements of adolescents' sexual pleasure development: generic pleasure expectations about sex; development of neurosensory and neurocognitive capacities for sexual pleasure; and sexual socialization influences from parents and schooling. This review provides a starting point distinguishing adolescent from adult sexual pleasure, while hopefully connecting them.

Pleasure expectations about sex (in the context of corollary experiences such as pain, anxiety, shame, etc. that are not overruled by pleasure) represent early gendered social and cultural schema that guide initial sexual decision-making, pleasure assessments of sexual experiences, accrued sexual learning, and engagement in subsequent sexual experiences (Fortenberry, 2014). An impetus for this chapter was the relative lack of emphasis on pleasure in many young people's narratives of first and early sexual experiences. Pleasure is not absent, of course, in young people's sexual experiences (Thompson, 1990). However, in many young people's sexual narratives, emphasis is placed on relationship qualities such as love and intimacy, or negative experiences such as confusion, surprise, pain, and discomfort (Higgins et al., 2010; Higgins & Wang, 2015; Ott et al., 2012). It seems reasonable to say, then, that pleasure—if experienced at all—is neither accidental nor trivial as an element of sexual development.

13.1.2 Development of Sexual Pleasure Expectations in Adolescents

Sexual pleasure expectations develop as a function of source of pleasure (self or partner), the accrual of experiences, and the timing of sexual experiences relative to peers (Horne & Zimmer-Gembeck, 2005; Zimmer-Gembeck et al., 2011; Zimmer-Gembeck & French, 2016). For example, young women (at about age 18 years) without partnered genital sexual experiences feel less entitlement to sexual pleasure from a partner, and less efficacious in achieving sexual pleasure, compared to young women with previous partnered sexual experiences (Horne & Zimmer-Gembeck, 2005). Pleasure expectations among both young men and young women increase over time, except among those without sexual experiences of any kind (Zimmer-Gembeck et al., 2011; Zimmer-Gembeck & French, 2016).

13.1.3 Neurocognitive Development of Sexual Pleasure in Adolescents

The developmental neurocognition of sexual pleasure in adolescence encompasses issues too detailed to comprehensively address in this review. Neurosensory

pathways, key brain networks associated with reward and reward sensitivity, and diverse neurohormonal changes associated with adrenarche and puberty are all critical elements that engage the connection of pleasure and sexuality with even more complex issues of romantic-sexual relationship formation and sexual well-being (Byrne et al., 2017; Suleiman et al., 2017). For example, stimulation of specific types of nerves—C-tactile nerves—is associated with pleasurable responses to touch, especially erotic touch (Bendas et al., 2017). Developmentally, pleasurable interpretations of C-tactile nerve fiber stimulation become more likely from childhood through adolescence into adulthood (Croy et al., 2019). Another aspect of neurocognitive development is the appearance of sexual/erotic responses to visual stimuli such as nude or sexual images during and after puberty (Alho et al., 2015; Nummenmaa et al., 2012).

The neuroscience of pleasure allows (again, largely through studies of adults) understanding of how sensory experiences are linked to specific interpretations to generate a self-conscious appreciation of sexual pleasure. While it seems likely that the fundamental neural architecture of sexual pleasure in young people differs from that of older people, the ways in which brain networks explicitly link sexual stimuli and pleasure are less clear (Georgiadis & Kringelbach, 2012; Platek & Singh, 2010). Three related but distinct brain systems likely coordinate this linkage: *liking* reflects core reactions to hedonic impact, generated in relatively restricted areas of the limbic system; *wanting* is generated by diffuse brain motivational systems to assess reward salience of potential incentives; and *reward learning* reflecting associations of specific sensory inputs with specific cognitive representations (Georgiadis & Kringelbach, 2012). Sexual learning occurs at any point during sequences of sexual behaviors and rewards, with stronger wanting processes during earlier desire and arousal phases, and stronger liking processes in later phases ultimately associated with orgasm (Kringelbach & Berridge, 2017).

13.1.4 Sexual Socialization Influences on Sexual Pleasure in Adolescents

A final topic of relevance to pleasure development is key sexual socialization influences: parent/family influences, and sexuality education (Beckett et al., 2010). Three aspects of parenting—support, control, and knowledge—relate to adolescents' pleasurable sexual experiences, albeit in different ways. For example, direct parental communication of sexual norms oriented toward love and respect is associated with adolescents' positive attitudes toward sexual behavior as well as less rapid acquisition of sexual behaviors during adolescence (Overbeek et al., 2018). Parental support is associated with increased likelihood of sexual satisfaction, comfort, and intimacy, while high levels of parental control are associated with lower levels of pleasure and higher levels of guilt (de Graaf et al., 2011). Parental

support and closeness may be especially important in pleasurable early sexual experiences of sexual and gender minority youth (Durwood et al., 2017).

Sexual pleasure is nearly absent in sexuality education where outcomes are typically focused on anatomy, reproductive physiology, consent, and prevention of pregnancy and diseases (Ingham, 2005). Embodiment itself is often addressed through social meaning attached to perspectives of puberty as a process of reproductive maturation rather than sexual embodiments of pleasure and identity (Diorio & Munro, 2003). Absence of pleasure dialogues in sexuality education is based on distrust of the capacity of young people to appropriately balance potentially adverse consequences of partnered sexual interactions with the pleasures of sexual interaction (Allen & Carmody, 2012; Macintyre et al., 2015).

13.2 The Development of Sexual Embodiment During Adolescence

Sexual embodiment is a core concept for this discussion of the ontogeny of sexual pleasure in adolescence, particularly as we interrogate the processes and meanings of sexual pleasure through a "diverse bodies" perspective (see Sect. 13.3 on diverse bodies, below). "Embodiment" is conceptualized as the ways specific bodies create sensations associated with pleasure and other affective responses (Overton, 2008; Tolman et al., 2014). Embodiment allows consideration of how young people's developing and intrinsically inexperienced sexual bodies define and shape sexual pleasures (Arnfred, 2014; Marshall, 2016). Gender (Tolman et al., 2014), sexualized objectification of the body transformations of puberty (Vandenbosch & Eggermont, 2014), social regimentation of body display and movement (Jaimangal-Jones et al., 2015), sexualized social geographies, and the sexual geographies of bodies themselves—for example, in school dress codes (Reddy-Best & Choi, 2019)—are all influences on embodiment. We discuss below the ways particular types of bodies may particularly affect the embodiment of sexual pleasure. Sexual embodiment in turn allows consideration of young people's "sexual habitus" relative to sexual embodiment, sexual experiences, and affective responses to those experiences (Coffin, 2018; Williams et al., 2013). This may also include the concept of "body-sensorial knowledge"—a term developed to capture the experiences of one's sexuality in relation to one's social context (Arnfred, 2014). Additional issues of embodiment are considered in more detail below.

13.2.1 Sexual Pleasure Domains in Adolescents' Sexual Experiences

Within the core conceptual model of sexual embodiment, we pose four youth-centric foci of sexual embodiment: a sexual social focus (e.g., solitary and partnered

pleasure experiences); a behavioral focus (e.g., specific sexual actions and interactions); an affective focus (e.g., trust, intimacy, partner pleasure, self-expression), and an experiential focus (e.g., wantedness, desire, arousal, shame, disgust) that allows a summative assessment of experiences (e.g., pleasurable, unpleasurable, both, neither) (Goldey et al., 2016). The social focus characterizes pleasure by its interpersonal location and its timing in relation to a sexual event (e.g., before, during, after, throughout). The behavioral focus allows consideration of "pleasure anatomies" (e.g., diverse combinations of lips, mouth, clitoris, vulva, penis, anus, fingers, and more), and pleasure contexts (e.g., relationships, sexual timings and spaces, arousal, intensity). The affective focus addresses trust, love, intimacy, comfort, and connectedness with self and others. The experiential focus addresses a panoply of sensations such the *frisson* of sexual touch, smells, tastes, visions, orgasm (Higgins et al., 2010; Higgins & Wang, 2015; Opperman et al., 2014). For the purposes of this chapter, five key sexual pleasure domains are addressed that may be particularly accessible and relevant to adolescents: dancing, kissing, masturbation, sexting, and various forms of genital sex: genital and erotic touch, genital-genital sex, oral-genital sex, and anus-genital sex. The position of each of these developmentally relevant pleasure domains is summarized below.

13.2.1.1 Dance and Music

Dance is both a partnered non-genital sexual behavior and a social structure for interactions with partners and potential partners (Pearson, 2018). Dance represents physical action integrated with cognitive and affective processes within social and cultural contexts that contributes to an embodied sense of self (Muro & Artero, 2017). Dance and other athletic actions share personal and public demonstration of physicality, and as a form of sexual display and erotic arousal (Gard, 2003). Viewing dance can also be a source of sexualized pleasure (Hanna, 2010). Music typically accompanies dance and contributes to general arousal that may be associated with sexual attraction and arousal (Marin et al., 2017). Televised or online music videos—an accessible source of sexual learning and socialization for young people—provide spectator views on diverse, sexualized movements and interactions, and serves as models for sexual embodiment that may foster sexual pleasure (Austin, 2016; Karsay et al., 2019).

13.2.1.2 Kissing

Kissing is used here as a shorthand designation for more complex sets of oral sexual interactions that may include tongue-to-tongue contact. Kissing is partnered non-genital sexual behavior that generally precedes genital sexual behaviors such as genital touching, oral-genital sex, or genital-genital sex (Welsh et al., 2005; Williams et al., 2008). Kissing is common—although not universal—among diverse groups (including same-sex attracted youth) (Choukas-Bradley et al., 2015;

Jankowiak et al., 2015) and may be a first non-genital, intimate partnered sexual experience (Choukas-Bradley et al., 2015; Smiler et al., 2011). Intimacy may be an important issue in decisions about kissing: In a nationally representative US sample ages 14 years and older, the proportion reporting kissing is no different by age group but kissing was avoided as too intimate more often among younger than older age groups (Herbenick et al., 2018).

Greater sexual valence is sometimes given to "open" versus "closed" mouth kissing although this distinction is often ignored in research addressing youth kissing (Jakobsen, 1997; Williams et al., 2008). Kissing may be an essential experience contributing to a kind of sexual "competence" as sexual involvements increase (Suvivuo et al., 2010). Kissing may be viewed as pleasurable because of associations with multiple elements of partnered sexual events, perhaps as a "sufficient sexual stimulus" for development of sexual desire, for initiation and maintenance of arousal, and as part of a set of intimacy behaviors toward the end of sexual events (Herbenick et al., 2018; Meana, 2010; Moore et al., 2017). Pleasure (using the phrase "it feels good" as a proxy for an experience of pleasure) is among the most highly rated reasons for kissing among adults (Moore et al., 2017) and pleasure (along with excitement and arousal) appears in young people's narratives of early kissing experiences (Welsh et al., 2005). Among adolescents, moreover, kissing is more likely to be seen as pleasurable in itself, on par with coitus (Bay-Cheng et al., 2009) as well as a developmental milestone typically preceding other partnered sexual experiences (Choukas-Bradley et al., 2015; Smiler et al., 2011).

13.2.1.3 Masturbation

Masturbation is a common genital sexual behavior although with notable gender differences (Driemeyer et al., 2017; Robbins et al., 2011). Masturbation is considered here as a non-partnered, primarily genital and anal, sexual behavior that is prototypical of sexual pleasure during early adolescence, although more commonly among young men than young women (Robbins et al., 2011). Self-reports of pleasure associated with masturbation include descriptions of discovery and practice as well as associated with sexual fantasies, often beginning as young as ages 9–10 years (Arnal & Llario, 2006). Retrospective pleasure descriptions associated with masturbation are age-graded, with 13% and 22% of 10-year-old boys and girls recalling pleasure, compared to 54% and 42% among those aged 11–12 years (Larsson & Svedin, 2002). Other descriptors in this same study included related positive experiences described as "good/fine," as well as negative reactions such as "scared, bad, unpleasant, didn't like." The idea that sexually explicit materials are integral to young people's early pleasure experiences is based on the significant exposure to such materials from early adolescence, with pleasure associated with the novelty of these erotic material, and associated sexual arousal, masturbation, and orgasm (Callister et al., 2012).

13.2.1.4 Sexting

Sexting is a largely twenty-first century technological infrastructure for partnered non-genital sexual interaction, where sexualized texts and images are shared with partners (Ševčíková et al., 2018; Ybarra & Mitchell, 2014). Sexting is a common (although not ubiquitous) electronically mediated partnered sexual interaction, with complex motivations and outcomes that are sometimes but not always sexual (Drouin & Tobin, 2014). Sexting is associated with a number of consequential aspects of adolescents' sexuality development (for example, earlier onset of partnered sexual behaviors, higher rates of condomless sex, social stigma, ostracization, and insecure attachment), but it is unclear whether other elements such as sexual pleasure have been addressed. Sexting is a commonplace sexual interaction in many young people's romantic relationships (Temple & Choi, 2014).

No research directly links sexual pleasure with sexting, other than through association with other partnered non-coital and coital sexual behaviors (Temple & Choi, 2014). However, about 45% of youth from the Netherlands evaluated recent sexting experiences as "a lot of fun" and only 10% reported the experience as unpleasant or very unpleasant (Naezer, 2018). Among college-aged youth—sexting may serve as an embodiment of sexuality reflecting body surveillance and shame as well as comfort with observed nudity (Liong & Cheng, 2019). Moreover, other potentially pleasurable activities such as pornography and music video use are associated (among young men) with sexting (Van Ouytsel et al., 2014).

13.2.1.5 Partnered Genital Behaviors

Genital touching, oral-genital, genital-genital, and anus-genital are common among youth's definitions of sex (Bersamin et al., 2007; Scott et al., 2018). One or more of these behaviors may predominate a given sexual encounter; young people's partnered genital "sexual repertoire" is often a combination of genital touching, oral-genital, and genital-genital behaviors, with less frequent inclusion of anus-genital behaviors even among young men with same-sex partners (Haydon et al., 2012).

Genital and other erotic touch: Genital touch is an important element of acquisition of young people's sexual experience, contributing to self-understandings of being "sexually experienced," and often preceding genital-genital experiences by months or years (Smiler et al., 2011; Williams et al., 2008). Partnered genital touch remains commonly named—even in scientific writings—as "petting," or "light" sexual activity, perhaps trivializing its sexual relevance, reflecting the priority given to penis-vagina sex in much of adolescent sexuality research, and contributing to diversity of ideas about whether genital touch is actually sex (Bersamin et al., 2007; Scott et al., 2018). Touch—especially of the genitals but on almost any part of the body—creates sensations interpreted as both pleasurable and sexually arousing (Nummenmaa et al., 2016). This is especially true for partnered touch, where—

except for genitals—arousal is much stronger through touch by a partner than during solo masturbation (Philippsohn & Hartmann, 2009). Youth's body maps of erotic touch have not been established although there are clear age-associated changes—from childhood into adolescence—in body sensations associated with affective responses such as happiness or disgust (Hietanen et al., 2016).

Oral-genital sex: Oral-genital sex is a "first" (compared to penis-vagina or penis-anus sex) partnered sexual experience for 45% of American youth (Halpern & Haydon, 2012). Cunnilingus is associated with agency and entitlement to pleasure (Fava & Bay-Cheng, 2012) and is as predictive of sexual pleasure as coitus (Bay-Cheng et al., 2009). Many pleasure narratives of early sexual experiences emphasize oral-genital sex (given, received, or both) rather than genital-genital sex (Fahs & Frank, 2014).

Genital-genital sex and anus-genital sex: Genital-genital sex typically focuses on penis-vagina or penis-anus interaction, but could also include penis-vulva, penis-penis, or vulva-vulva contact (scissoring). Descriptions of first penis-vagina sex or penis-anus sex often reference pleasure (Arrington-Sanders et al., 2016; Opperman et al., 2014), but as consistently focus on lack of pleasure, anxiety, accomplishment, relationship affirmation, gifting a partner, and "getting it over with" (Arrington-Sanders et al., 2016; Wight et al., 2008). Pain, in particular, is a sexual narrative for many young women, in association with first experiences of penis-vagina or penis-anus sex, or as a repetitive experience of partnered sex (Elmerstig & Thomtén, 2016; Štulhofer & Ajduković, 2013; Tanner et al., 2009). Although sexual pleasure is an ideal quality of equitable relationships for contemporary young people, genital-genital sex—especially penis-vagina sex—is associated with unfulfilled expectations for pleasure, especially through orgasm (Elmerstig et al., 2017; Suvivuo et al., 2010). Skills for communication and action related to sexual pleasure are absent or insecure (Saliares et al., 2017) and lack of pleasure is a reason for avoiding partnered sex for some young people (Byers et al., 2016).

13.3 Sexual Pleasure, Diverse Bodies, and Sexual Embodiment in Adolescents

Much of the research literature addressing sexuality among people with diverse bodies is based on an assumption that sexuality is never experienced, is innately limited or dysfunctional, or is completely lost if once experienced (Shildrick, 2007). A focus on sexual embodiment among people with diverse bodies—avoiding the use of a "able-bodied/disabled" dichotomy—reflects diverse pleasure experiences based on that embodiment, without lumping those experiences under a single pre-established label (Loeser et al., 2018). We now explore sexual pleasure and sexual embodiment in adolescence as reflected by three not-uncommon types of bodies: *spina bifida*; *autism spectrum*; and *gender dysphoria*. These three types of bodies—alternative versions of "normal"—addresses different ways by which

sexual pleasure might be embodied through capacity, anticipation, experience, and expression, and each provides an alternative to assumptions of sexual pleasure as primarily built from models of "normality" defined by genital contact and orgasm (McPhillips et al., 2001). We recognize that each of these diverse bodies has interpersonal, social, and cultural contexts that overlap in terms of diagnostic and disability categories with real-world consequences in terms of health and well-being (O'Dell et al., 2016), but these diagnostic specificities are unnecessary for this exploration of sexual embodiment and sexual pleasure.

13.3.1 Spina Bifida

Spina bifida is one of the most common occurring birth defects in the United States (Bowman et al., 2001; Parker et al., 2010) and focuses attention of sexual pleasure in the context of limited sensory and motor capacity associated with the genitals and lower body; central nervous system networks associated with sexual pleasure are presumably functional. Spina bifida is a condition marked by varying degrees of neurocognitive and learning challenges, altered lower body and genital motor and sensory function, urinary/fecal incontinence, and sexual functions such as anorgasmia (Liptak et al., 2013; Roach et al., 2011). Life expectancy over the past four decades has substantially increased, and up to 85% of people with spina bifida live into adulthood (Shin et al., 2012). This means that many youth learn to manage spina bifida-associated health challenges as well as related issues such as the need for personal assistance, technical aids, and adapted environments in the context of sexuality and sex (Linstow et al., 2014). These challenges also script sociocultural assumptions about whether individuals with spina bifida "can" enjoy sex, and whether they "should" experience sexual pleasure (Campbell, 2017).

Perhaps because of ongoing support needs (Tisdall, 2001) or delay in achieving "adult" statuses (e.g., independent finances or housing) (Hendey & Pascall, 2001), young people with spina bifida are commonly viewed to be childlike and asexual, and in need of protection from sexual coercion (Berman et al., 1999; Murphy & Elias, 2006). As a result, parents and medical care professionals are often skeptical of the ability of youth with spina bifida to participate in and enjoy sex (Esmail et al., 2010; Neufeld et al., 2002). However, sexual pleasure clearly is a central aspect of quality of life for people with spina bifida, and youth with spina bifida nearly universally report sexual interest and desire for satisfying sex lives (Berman et al., 1999; Dorner, 1977; Sawyer & Roberts, 1999). A majority of such young men and women aged 18 years and older have experienced masturbation, as well as partnered sexual behaviors including genital touching, oral-genital, and penis-vagina sex (Hensel et al., 2018). In the remainder of this section, we detail how the two key "embodied" aspects of sexuality—genital sensation and sexual function, as well as physical mobility—are organized and experienced by adolescents with spina bifida.

Genital sensation refers to both the location within the genital region that is with or without feeling, as well as the extent of sensation when present. The ability to feel

at least some genital topography has important implications for arousal, participation in both solitary and partnered sexual behavior, and sexual function. *Sexual function* includes a variety of phenomena (motivation, arousal, lubrication, erectile capacity, orgasm, ejaculation) occurring in a hormonally defined environment (De Vylder et al., 2004). Location in higher levels of the spinal cord is typically associated with less genital sensation and more reported sexual dysfunction in both men and women (Gatti et al., 2009). Nearly all adolescents with spina bifida report at least some genital sensation, and 40% of young women and 60% of young men have experienced orgasm (Sawyer & Roberts, 1999). Genital sensation may be quite variable. For example, most young men lack feeling in the penis, but may have at least some sensation in the groin area and are capable of achieving erection with ejaculation (Sandler et al., 1996). Some young women retain vulvar sensation, and achieve orgasm through clitoral or vaginal stimulation (Carvalho et al., 2012). For young people with reduced or absent genital sensation, sexual pleasure is often linked to "lighter" adolescent behaviors such as hand holding, kissing, or body touching (Holland-Hall & Quint, 2017).

Physical mobility issues such as decreased ambulation capacity, muscle weakness, and orthopedic problems also impede sexual pleasure through capacity to achieve or maintain desired sexual positions (Amjadi et al., 2017) or through muscle spasticity, spasms or contractures occurring during sex (Murphy & Young, 2005). Sexual pleasure may be compromised through the lack of sexual spontaneity (e.g., the need to plan what types of sex will be successful) or the reduced privacy for individuals with a caregiver (McCabe & Taleporos, 2003). Youth who use mobility-related equipment (e.g., a walker, brace, or wheelchair) may also have challenges associated with sexual pleasure (Jackson & Sipski, 2005). Embodied sexuality for these young people thus includes creative solutions for positioning, accommodations, or alternatives that account for mobility equipment, as well as emphasize non-genital associated arousals (sight, sound, smell or thought) associated with pleasure (Murphy & Young, 2005).

13.3.2 Autism Spectrum

Autism spectrum is associated with a collection of neurocognitive states that influence interest in sexual interaction and interpretation of those interactions as pleasurable (Dewinter et al., 2015). Social anhedonia is common if not definitional of autism spectrum (Novacek et al., 2016), although it is unclear how puberty and adolescent development affect social reward processing in individuals with autism spectrum (Chevallier et al., 2012; Clements et al., 2018). Interpersonal stimulus processing such as differentiation of pleasure smiles from non-pleasure smiles may be especially relevant in interpretation of partner responses during sex (Blampied et al., 2010). Tactile skin sensory information processing characteristics that may change pleasure experiences are mediated by C-tactile-targeted touch (Kaiser et al., 2016) and tactile defensiveness to various locations of touch may also differentiate

pleasure experiences of youth with and without autism spectrum (Cascio et al., 2016). Solitary sexual experiences such as masturbation appears relatively common, but many autism spectrum youth report little sexual interest/arousal/behavior of any kind, and are more likely (than comparable youth without autism spectrum) to identify as asexual (Hellemans et al., 2007). Neurocognitive processing pathways may also influence sexual experiences of people with autism spectrum through interpreting interpersonal attractions as sexual, or recognizing body responses to touch as signs of sexual arousal (Dewinter et al., 2013; Rosqvist, 2014).

The developmental phenomenology of sexuality in adolescents with autism spectrum substantiates sexual self-perception based on feelings of attraction and bodily feeling of pleasure in ways that differ from, as well as resemble, those of people without autism spectrum (Fernandes et al., 2016; Pecora et al., 2016). Relevant to the "liking and wanting" aspects of sexual pleasure as a neurocognitive reward, young adult women with autism spectrum report less desire for sexual activity (compared to women without autism spectrum), but this is largely due to less desire for partnered sexual activity, with comparable levels of desire for masturbation (Bush, 2018). Kissing, genital touch, oral-genital sex, penis-vagina sex, and orgasm as partnered sexual activities are less common (but never absent, or even rare) among autism spectrum young people than among young people without autism spectrum (Bush, 2018; Dewinter et al., 2016). Pleasure narratives of youth with autism spectrum include pleasure terms such as "it felt good. . ." but express relative lack of sexual interest/arousal, and identification of asexuality (Dewinter et al., 2013, 2017).

Changing social and professional perspectives on autism spectrum—and "disability" in general—makes unclear the degree to which current understanding of sexuality in autism spectrum are due to perceptions of sexual expressions among autism spectrum people as interpersonally aberrant, potentially threatening, and subject to suppression (Loeser et al., 2018). As we come into new understandings of autism spectrum, we can address the ways characteristic patterns of perceptual and motor function in autism spectrum—both low and high sensitivity to stimuli, motor dyscoordination, delayed behavioral timing in interpersonal interaction, and pain associated with some types of touch—can generate pleasure (or not) in solitary or partnered sexual interactions (De Jaegher, 2013).

13.3.3 Gender Dysphoria

Gender dysphoria is a distressing sense of incongruence of one's experienced and birth-assigned sex, often associated with dysphoria for chest and genitals as well as characteristics such as body hair, voice, and body shape (Becker et al., 2018). While not all people with gender dysphoria identify as transgender or gender non-binary (and not all transgender and gender non-binary youth experience gender dysphoria), almost all describe a profound mismatch of the experienced/desired body and the physical body. In contrast to adults, body modification technologies for youth with

gender dysphoria are limited through near total restriction of genital and chest affirmation surgery, widespread use of puberty blockers that stop body changes associated with puberty and limit sexuality development during early- and middle-adolescence (without reducing gender dysphoria), and varying access to gender-affirming hormone therapy until age 16 years or older (Hembree et al., 2017).

The sexual experiences of youth with gender dysphoria are insufficiently described, and none of the existing studies are population-based or longitudinal. Clinically referred youth with gender dysphoria report experiences of crushes, falling in love, and involvement in romantic relationships, although in somewhat lower proportions than comparison groups of youth without gender dysphoria (Bungener et al., 2017; Kaltiala-Heino et al., 2019). Partnered experiences of kissing, genital touching, oral-genital, and genital-genital sex are also in smaller proportions than comparable youth without gender dysphoria. Youth with coexisting gender dysphoria and autism spectrum have markedly lower levels of engagement in partnered sexual activities (Kaltiala-Heino et al., 2019).

Change in sexual embodiment is always a feature of development of adolescents' sexual pleasure because all of the components of pleasure—its social, behavioral, affective, and experiential foci—arrange the sensorimotor experiences of bodies changing through puberty (Marshall, 2016; Masson, 2015). Among youth with chest dysphoria, 60% of those who have not had chest surgery report difficulties with physical intimacy/sexual activity, compared to 3% of youth after chest surgery (Olson-Kennedy et al., 2018). Masturbation, sexual arousal, and orgasm increase among adults receiving testosterone, with decreases among those receiving estrogen (Wierckx et al., 2011). Gender dysphoria in adolescents, then, is often associated with additional reconfigurations of pubertal and post-pubertal bodies. Pharmacologic interventions—gonadotropin releasing hormone agonists, estrogen/testosterone, and androgen antagonists—either postpone development of the ultimately sexualized components of post-pubertal bodies or reorganize their physical structure, function, meaning, and even naming. Even less typically sexualized aspects of sexual embodiment such as voice as an instrument of pleasure may be reconfigured as people learn and relearn the experience and expressions of sexuality (Donaldson & Meana, 2011). Learning to name, use, and respond to the diverse sexual body configurations is a key challenge to many gender diverse adolescents and adults (Schilt & Windsor, 2014). Consider, for example, the nature of embodied pleasure in the context of a queer-identified, masculinized person whose partner is queer-identified and feminized; both have had gender-affirming chest surgery and both engage unmodified post-pubertal sexual anatomy (often renamed to better match gender experience) for sex (Edelman & Zimman, 2014). Sexual pleasure, then, occurs in the context of new embodiments that match sensation and meaning, confirming or magnifying the link of sexuality and gender (Williams et al., 2013, 2016).

13.4 Summary and Conclusion

We set out in this chapter to consider the ontogeny of sexual pleasure during adolescence, beginning with an intuition that pleasure experiences of young people may qualitatively differ from those of older, "sexually experienced" people. We knew in the beginning that an evidence-based perspective on adolescents' sexual pleasure was limited and disconnected, with sexual pleasure often a point of adult anxiety, surveillance, and prohibition for many young people. What remains at this point is to sketch a framework for development of sexual pleasure during adolescence. What does this look like? We offer three "pillars" from which to base new inquiries.

13.4.1 Pillar 1: The Experiences of Sexual Pleasure in Adolescence

The development of sexual pleasure during adolescence turns out to be complex, nuanced, and intertwined in a constellation of aspects of sexual experience that recombine with each experience and help create both expectations and skills related to sexual pleasure. We think sexual pleasure in adolescent sexuality needs substantial theoretical and empirical repositioning, to accomplish two main objectives. The first objective requires that the experiences of sexual pleasure be understood through the developmental lens of pubertal and post-pubertal adolescence rather than simply via overlays of adult sexual experience. This incorporates adolescents' sexual pleasure into a learning-based framework of sexual selfhood, sexual negotiation, and sexual empowerment, linked through personal agency, interpersonal intimacy, and social advocacy (Arbeit, 2014).

Second, the development of other affective and sensual sexual experiences—sexual disgust, for example—would allow for a much fuller connection to understanding of sexual health and sexual well-being, especially in terms of the influences of sexual arousal or sexual trauma. This developmental approach requires new types of youth-specific data: An important recent paper, for example, explores the idea that prepubertal children find many sexual activities to be disgusting, with sex-relevant disgust peaking in early adolescence compared to prepubertal children and middle adolescents (Borg et al., 2019). Such data support the need for a more integrated program of research that address sexual pleasure within intersections of multiple experiences—including disgust, as well as pain, shame, and sexual trauma—and would allow better understanding of adolescent sexuality development as well as better connection of adolescents' sexuality to that of the sexual adults they inevitably become.

13.4.2 Pillar 2: Sexual Pleasure and Diverse Sexual Bodies in Adolescence

Our focus on sexual embodiment brings attention to the physicality of sexual experiences, and the ways by which sensory and motor elements of pleasure are intrinsic to the cognitive and affective elements of young people's sexual pleasure (Masson, 2015). Recognizing the sexual bodies of young people as performance sites for sexual pleasure helped us consider the experiences of pleasure in the context of the sexual embodiments of spina bifida, autism spectrum, and gender dysphoria. In this, we emphasize the importance of diversity of embodied experiences of sexual pleasure, allowing us to step beyond the erasure of pleasure for many people marginalized by their diverse bodies (Campbell, 2017). In turn, this acknowledgment of the diversity of embodied experience reflects back on the diversity of pleasure in all forms of adolescent sexuality development, without privileging any as legitimate representatives of "normal" (Shildrick, 2007).

13.4.3 Pillar 3: Pleasure as a Sexual Right During Adolescence

Sexual pleasure is thought to be integral to sexual rights, sexual health, and sexual well-being (Ford et al., 2019). Although sexual rights for youth still focus on protection against exploitation, coercion, and adverse outcomes such as pregnancy, sexual pleasure was included in a recent joint document of the International Planned Parenthood Federation and the World Association for Sexual Health (2016). This provides basis for more explicit inclusion of sexual pleasure in sexuality education, but the fierce debates around the place of pleasure in sexuality education for young people show no signs of resolution (Essack et al., 2016; Orza et al., 2017; Rohrbach et al., 2015). In the vacuum, many youth recognize the limits of parental- and school-based education, finding more comprehensive, realistic, and pleasure-inclusive resources online (Nelson et al., 2019).

The final issue pertaining to pleasure as a sexual right has to do with how young people's rights as sexual people can be best supported along with the legitimate interests of parents, families, and social institutions in terms of protecting less experienced sexual decision-makers from sexual exploitation (International Planned Parenthood Federation & World Association for Sexual Health, 2016). Youth may have evolving perspectives on sexual rights and pleasure (Berglas et al., 2014), and adults generically endorse elements of sexual rights such as youth-friendly sexual and reproductive health services, access to accurate and complete sexuality information, control of choice of persons as potential partners, freedom from gender- and sexual-identity violence, and participatory inclusion (Orza et al., 2017). However, the best balance of youth's autonomy and protection/control in terms of sexuality and sexual pleasure is in no way clear (Martinez & Phillips, 2008).

Spotlight Feature: Sexuality Development Among Youth with Intellectual Disability—Societal Aspects in Theory and Practice

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A Normative and Protective World

Youth with intellectual disabilities are a heterogenous group. Variations among them are related to the impairments in abstraction, verbal, and communicative abilities (Löfgren-Mårtenson, 2004). The variations also relate to demographic aspects such as gender, social class, ethnicity, and sexual orientation. Young people with intellectual disabilities are often seen as sexually vulnerable because their disabilities are thought to lead to difficulties in understanding sexual norms, codes, and signals (Löfgren-Mårtenson, 2012). Many grow up in a normative and protective world in which professionals (e.g., teachers, personal assistants) and parents feel responsible for the youngsters' sexuality due to worries of unwanted pregnancies and sexual abuse. Thus, research shows immense variation in sexual conduct and experiences, where intercourse seems to be quite unusual and parenthood is restricted to those with a mild intellectual disability. Furthermore, LGBT persons with intellectual disabilities seem to be "invisible" (Löfgren-Mårtenson, 2009). One way of describing this normative and protective world is through Gagnon and Simon's (2005) theory of sexual scripts, which posits that sexual conduct is socially shaped within different societal and cultural settings. In line with this theory, research shows the sexual script geared towards youth and young adults with intellectual disabilities is a restrictive one (Löfgren-Mårtenson, 2004, 2009, 2012).

The Need for Relevant and Comprehensive Sex Education in a Multicultural Society

The contradictory sexual and cultural norms concerning sexual openness and restrictiveness that characterize multicultural society may affect youth with intellectual disabilities, as well as other young people (Löfgren-Mårtenson & Ouis, 2018, 2019). For example, attitudes towards premarital sexual relationships, homosexuality and pornography vary markedly (Löfgren-Mårtenson & Månsson, 2010; Löfgren-Mårtenson & Ouis, 2018, 2019). Thus, when such attitudes are in opposition to

the cultural values of the families of young people with intellectual disabilities, this can restrict young persons' sexual expressions (e.g., ability to choose the gender of one's partner) (Schlytter & Linell, 2010). The concept of "honor-related" violence and oppression is one way of labelling these traditional and patriarchal gender structures and is characterized as a practice that is conducted collectively (Ouis, 2009; Socialstyrelsen, 2014).

In addition, the view of disability can appear different in various cultures. Having a child with a disability could be seen as a blessing in some cultures but is also perceived as shameful in many cultures (Östman, 2008). Löfgren-Mårtenson and Ouis (2018, 2019) uses the term "honor-related experiences" to capture the broadness of the subject, as these experiences may not necessarily be violent, but are nevertheless connected to the family's cultural views on sexuality as well as on disability. Honor-related experiences of youth with intellectual disabilities and honor-related scripts directed towards them can be described as being along a continuum between care and control (Löfgren-Mårtenson & Ouis, 2018, 2019). Families often strive for the so-called normality, which seems to be an important factor in understanding, for example, arranged marriages among youth with intellectual disabilities. This can be viewed as an opportunity for the young person with a disability to have an "ordinary life" with a spouse and children instead of living in isolation (Löfgren-Mårtenson & Ouis 2018, 2019). Not the least, it can also be a way of securing an economic and social future. At the same time, people with intellectual disability are perceived as especially vulnerable when it comes to sexuality (e.g., unwanted pregnancies, sexual abuse) (e.g., Löfgren-Mårtenson, 2012; Tilley et al. 2012). Consequently, marriage may force young people with intellectual disability into sexual situations that they have difficulties understanding and managing as a result of their psychosexual development and limited knowledge about sexuality and reproduction (e.g., Löfgren-Mårtenson, 2012). Therefore, Löfgren-Mårtenson and Ouis (2018) argued that young people with intellectual disability growing up in Sweden with a cultural background other than that which is typical of Swedish society may undergo a "complicated tug of war" between contradictory cultural norms connected to sexuality and disability. Because of life-long dependency, it is difficult for young people with intellectual disability to oppose the values and wishes of parents and school staff concerning how they should express their sexuality and/or choose a partner (Löfgren-Mårtenson, 2012; Löfgren-Mårtenson & Ouis 2018, 2019).

The provision of sex education, including information about honor-related experiences, is especially important because of young people's need for concrete and nuanced information (Löfgren-Mårtenson, 2012; Löfgren-Mårtenson & Ouis, 2018, 2019). The current focus on risk, sexually transmitted infections (STIs), and reproduction is seldom perceived as relevant by the youth themselves. Instead, a curriculum based on pleasure, intimacy, and positive aspects of sexuality is requested. Colleagues with different cultural backgrounds can act as "cultural bridges" for professionals who lack strategies, methods, and materials. Increasing professionals' prerequisite qualifications (e.g., further education, supervision) and adopting autonomy-promoted conduct can empower pupils with intellectual disabilities to exercise autonomy over their sexuality.

Use of the Internet and Social Media

Today's youth with intellectual disabilities use the Internet and social media just as many others do as a way of communicating with current and potential friends and partners (Löfgren-Mårtenson et al., 2015). While youth with intellectual disabilities are often socially isolated, making use of the Internet and social media can be a way of participating in wider society without having the disability as the primary identity label applied to them by others. However, the Internet is often seen as a complicated and risky social arena by those in their surroundings. A Net-script, consisting of rules on how, when, and in what ways to use the Internet is then geared towards young people with intellectual disabilities (Löfgren-Mårtenson et al., 2018). The youth themselves often view the risk of not finding a partner on the Internet as a greater concern than the risk of being abused as a result of making use of the Internet. Therefore, there is a need for a dialog regarding risks between the different perspectives.

Lack of Sexual Agency: Sexual and Reproductive Health and Rights

The term "crip" (shortening of cripple) was originally used in aggressive and condescending ways (McRuer, 2006); however, it has parallels to the term queer, with both constructs evoking the dialectic between the "normal" and "abnormal." Crip theory illuminates the constructions and meanings of "functionally impaired" versus "able-bodied." By claiming the power of the terms, and appropriating them in positive ways, the perspective is reversed, and the stigma embraced (Rydström, 2010). By combining crip theory with script theory, Löfgren-Mårtenson (2013) investigated what is considered to be a normal sex life for people with intellectual disabilities in Sweden. It concluded that crip theory can be of use for researchers and activists, and suitable for educating staff members, in that it questions sexual norms that are most often taken for granted. However, because research or activism inspired by crip theory seldom includes consideration of intellectual disabilities, its usefulness is limited and more work is needed to solve problems surrounding agency, stigma, and visibility.

Another study reviewed the concept of sexual and reproductive health and rights in relation to people with intellectual disabilities (Löfgren-Mårtenson, 2020). It explored the relevance and significance of this concept and its implications for choice, relationships, and sexuality for people with intellectual disabilities. The review suggested there are several barriers for people with intellectual disabilities that present challenges to their prospects of being fully engaged in choices to achieve sexual and reproductive health and rights. These barriers include their surroundings' heteronormative attitudes and focus on protection, the lack of comprehensive sex education, and the invisibility of sexual agency among people with intellectual

disabilities. Exploring the target groups' own voices and promoting self-sexual advocacy were identified as a means to create opportunities for choice, which is necessary to fulfill sexual and reproductive health and rights.

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Chapter 14
Pornography Use in Adolescence and Young Adulthood

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Abstract In this chapter, the authors critically review the body of research on adolescents' and emerging adults' pornography use and its consequences. We start with a number of theoretical concepts—including social learning and comparison theories, sexual scripting, self-objectification theory, the confluence model, the value congruence model, cultivation and media practice models developed in communication science, and the differential susceptibility to media model—that have been employed in the field, mainly with the goal of understanding possible effects of youth pornography use. Next, we explore the prevalence (both pre- and post-internet), the dynamics (i.e., change over time), and correlates of pornography exposure and use. Associations between pornography use on the one hand and sexual risk taking and sexual aggression on the other hand are explored in separate sections. The role of pornography use in young people's psychological and sexual well-being is also explored, focusing on possible negative, but also positive outcomes. Acknowledging rising societal concerns, we also reviewed the research on the role of parents in their children's experience with pornography, as well as the potential contribution of emerging pornography literacy programs. In the final section, we present some recommendations for future research. In particular, much needed measurement (for pornography use and its specific content) and research design improvements are suggested, and practical implications are briefly discussed.

Keywords Pornography use · Adolescents and emerging adults · Sexual risk taking · Sexual aggression · Psychological and sexual well-being

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In 1995, at the beginning of a period of near-exponential growth in Internet pornography, Philip Elmer-Dewitt shocked many parents with his *Time* cover story about "Cyberporn." The cover line salaciously promised to reveal how "wild" Internet pornography had become, and explicitly framed the pornography debate around the balance between protecting free speech and protecting children (Elmer-Dewitt, 1995). The story described soon to be discredited research that claimed that growth in online pornography was primarily driven by pedophilic and hebephilic interests (see Rimm, 1995). Upon release, both Rimm's study and Elmer-Dewitt's story were lambasted—with the *Time* article eventually becoming required reading in ethics of journalism classes as a case study in what not to do (Elmer-Dewitt, 2015). Despite criticism by many journalists and scholars, both pieces resonated with deep-seated fears among many Americans surrounding sexuality and children (Levine, 2006), which ultimately coalesced into the *Communications Decency Act*, the first attempt by the U.S. Congress to regulate Internet pornography.

Concern about pornography and children is not new, as George Putnam asserted back in 1965, "[a] flood-tide of filth. . ." always seems poised ". . .to pervert an entire generation of our American children" (Citizens for Decent Literature, 1965). However, as Elmer-Dewitt's story illustrates, in recent decades, pornography on the Internet seems to have given new urgency to the issue, perhaps because of the assumed, if largely undemonstrated (Byers et al., 2004), increase in anonymity, affordability, and accessibility that the Internet provides (Cooper et al., 2000, 2004). This Internet-fueled panic about pornography has likely motivated the recent surge in academic interest in adolescent pornography use over the last two decades.

The clear focus on adolescents in recent years is unsurprising given the pervasive concern among academics that adolescents are uniquely vulnerable to the effects of pornography exposure (Valkenburg & Peter, 2013), presumably because of underdeveloped inhibitory-control systems in the pre-frontal cortex (Owens et al., 2012). Although this is a reasonable supposition to propose, and it may very well be true, it has yet to be demonstrated empirically that adolescents are uniquely vulnerable to the effects of pornography. At the same time, this perspective is also more than a little reminiscent of the long-standing paternalistic Western tradition of regulating access to sexual materials so that those with poor "moral fortitude"—namely, women, children, and the less educated—would not be corrupted by its influence (Kendrick, 1987).

The generally assumed vulnerability of adolescents has manifested in specific concerns about pornography's impact on sexual risk taking, sexual aggression, and well-being among young people (Collins et al., 2017; Owens et al., 2012; Peter & Valkenburg, 2016; Pizzol et al., 2016). In recent years, concern about pornography has also driven the development of porn literacy programs as well as other interventions designed to reduce its presumed harms (Rothman et al., 2018). This review seeks to provide a critical examination and summary of this literature. It will begin by providing an overview of relevant theory in this area followed by a description of research concerning adolescent pornography use. Next, the research regarding pornography's impact on adolescent sexual risk taking, sexual aggression, and well-being will be discussed. After describing emerging insights from efforts to

improve porn literacy and briefly discussing the role of parents for mitigating harms associated with pornography use, the review will conclude with recommendations for future research in this area.

Before we begin, we wish to clarify what we mean by "pornography." The meaning of this term has a rather confusing history among academics, as various, and often conflicting, definitions have been proposed by a number of scholars. This state of affairs has led some researchers to claim that pornography is such an idiosyncratic concept that developing a universally agreed upon definition may be a futile effort (Manning, 2006). Others have tried to side-step the issue by coining alternative non-pejorative language (e.g., "sexually explicit materials," "visual sexual stimuli")(Vaillancourt-Morel et al., 2019). We believe that both of these perspectives are mistaken. Pornography is the most widely used term among both academics and laypersons to refer to sexual representations, and empirical research suggests that individual and cultural differences in its meaning are relatively trivial. Employing diverse terminology unnecessarily fragments the field (for a comprehensive review, see Kohut et al., 2020). In this chapter, we use the term pornography to mean "representations of nudity which may or may not include depictions of sexual behavior" (Kohut et al., 2020).

14.1 Theoretical Approaches to Understanding Young People's Pornography Use

Four types of theoretical approaches have been used in research involving young people's pornography use: (1) general social psychological conceptualizations, such as Bandura's social learning (Peter & Valkenburg, 2011a) and Festinger's social comparison theories (Wright & Štulhofer, 2019; Peter & Valkenburg, 2014); (2) communication science models of media effects, such as the cultivation (Gerbner, 1998; Morgan & Shanahan, 2010), the media practice (Brown, 2000; Steele, 1999; Steele & Brown, 1995) and the Differential Susceptibility to Media models (Valkenburg & Peter, 2013); (3) feminism-informed objectification and self-objectification theoretical models (Fredrickson & Roberts, 1997; Vandenbosch & Eggermont, 2014a, 2014b), which bridge body image and communication studies focusing mainly on the sexualization of young women; and (4) pornography-specific conceptualizations that seek to explain the specific effects of such materials (Grubbs & Perry, 2018; Valkenburg & Peter, 2013; Vega & Malamuth, 2007; Wright, 2014). Generally speaking, pornography-specific models focus on the role that pornography plays in young people's sexual socialization, a process that includes sexual identity and role formation, as well as the crystallization of beliefs about the sexual roles of partners, internalization of sexual body ideals and sexual power dynamics, the shaping of views about the relationship between sexuality and emotions, and scripting of specific sexual activities as well as their expected sequences (Štulhofer et al., 2010). From this perspective, it is assumed that ubiquitous online pornography

is a powerful agent of sexual socialization that serves as a constant reminder of the social imperative to be sexual, acts as a source of (mis)information about the acceptance of specific sexual acts, and, consequently, generates specific normative expectations (Brown et al., 2005). Such models will be the primary focus of this review.

Originally developed to improve the prediction of sexual aggression (Malamuth et al., 1996), Malamuth's Confluence Model was later extended to include pornography as a risk factor for sexual aggression (Kingston et al., 2009; Malamuth, 2018). In essence, the model posits that pornography use—especially, but not exclusively, violent sexually explicit content—increases the risk of sexual aggression, but only among men who are predisposed to such behavior (Malamuth et al., 2000). More precisely, individual characteristics, primarily hostile masculinity (a hostile, distrustful and narcissistic need to dominate women) and impersonal sexuality (the callous, unemotional, and promiscuous orientation toward sex), shape both the preference for specific pornographic content and frequent consumption of such materials, as well as the proclivity to sexual aggression (Malamuth & Hald, 2017). Thus, frequent pornography use is expected to increase the risk of sexual aggression among a relatively small subgroup of users high in hostile masculinity and impersonal sex. While this theory has received support in several samples of emerging adults (Malamuth, 2018), and has been referenced in the adolescents literature (Ybarra & Thompson, 2018), the critical interaction between vulnerability factors (e.g., hostile masculinity and impersonal sexuality) and pornography use has yet to be examined in adolescent samples.

Based on the sexual scripting (Simon & Gagnon, 2003) and the cultivation theories, Wright proposed the Acquisition, Activation and Application Model ($_3$AM) of pornography-affected sexual socialization (Wright, 2011, 2014). The model specifies three psychosocial causal mechanisms—acquisition, activation, and application—that underlie, usually in a sequential order, the impact of pornography use on real life sexuality. Briefly, the acquisition phase refers to the process of internalizing pornographic scripts, which is facilitated by sexually explicit, arousing, and attention-grabbing content. In the next phase, the newly acquired scripts can be activated in certain situations, depending, among other things, on script-situation correspondence. Finally, pornographic scripts will be evaluated and applied in a situation if the presumed benefits exceed the costs related to script enactment. According to Wright, a number of factors influence all three phases. For example, gender and age are likely to moderate script acquisition, frequency of pornography use and gender stereotypical attitudes are likely to influence the process of activation, while negative mood may increase the likelihood of the application of risky sexual scripts (Wright, 2011; Wright & Bae, 2016). Whether or not adolescents are especially likely to acquire sexual scripts from pornography remains an empirical question.

Recently, a new conceptual model was presented to account for self-assessed problematic pornography use. The Moral Incongruence model posits that holding negative religious or faith-based evaluations of pornography while simultaneously using pornography can cause significant distress induced by the discrepancy

between one's attitudes and one's behaviors. This discrepancy is experienced as a perceived lack of control over pornography use, which in turn contributes to self-diagnosed addiction to pornography (Grubbs & Perry, 2018; Grubbs et al., 2019). Such theorizing has distinguished between truly (i.e., objectively) dysregulated use of pornography and perceived (i.e., subjective) out-of-control pornography use due to moral incongruence, and explicitly allows for a possible link between the two (Grubbs et al., 2019). According to meta-analytic findings (the Moral Incongruence hypothesis has received considerable empirical support; see Grubbs & Perry, 2018), the association between moral incongruence and problematic pornography use is markedly stronger than relationships between religiosity and frequency of pornography use on the one hand, and problematic pornography use on the other hand (Grubbs et al., 2019). Although this model emerged from an effort to explain why highly religious young adults experience considerable distress and perceived pornography addiction despite generally low or moderate levels of pornography use, a recent study that used two independent panel samples of male Croatian adolescents did not substantiate these model-based expectations (Kohut & Štulhofer, 2018a).

Finally, although it was not specifically developed to explain possible effects of pornography use, the Differential Susceptibility to Media model (Valkenburg & Peter, 2013), not to be conflated with Belsky's differential susceptibility hypothesis (Belsky, 1997), will also be briefly mentioned here. We feel that it is important to describe this model because it is an integrative conceptual framework that synthesizes much of the media effects literature, and thus can greatly assist researchers in the field of pornography use. The model attempts to inform answers to the following questions: What makes some individuals more vulnerable to media effects; what are the mechanisms underlying media effects; and how can these effects be modified? Four propositions form the core of the Differential Susceptibility to Media model. First, media effects are conditional on consumers' (1) dispositional (gender, personality characteristics, and attitudes), developmental (adolescence as a particularly vulnerable period), and social susceptibility (family and peer environments, culture-specific norms and institutions). Secondly, media effects are indirect, mediated by cognitive, emotional, and excitative response states. Thirdly, differential susceptibility predicts the type and frequency of media use, but also moderates the associations between media consumption and response states. Finally, media effects are assumed to be transactional, meaning that there are feedback loops from media-influenced outcomes to differential susceptibility, response states, and future media use (Valkenburg & Peter, 2013). For example, frequent use of online pornography may normalize a specific sexual act (by creating an impression that most people have incorporated it into their sexual repertoire) that the person previously found morally unacceptable. This media-influenced normalization may increase the likelihood of trying the sexual act. Provided it was rewarding, the experience may lead to more exposure to pornographic content that depicts the act and to higher sexual arousal while watching it. Compared to the above-described conceptual models, the Differential Susceptibility Model is obviously an exhaustive and well-structured list of individual-level moderators and mediators to be considered when exploring media effects, rather than a limited set of theoretical expectations to be empirically tested.

While often theoretically informed, research concerning adolescent pornography use rarely evaluates theoretical explanations for the impact of pornography use in a rigorous manner. This is particularly true with respect to theories that specify potential vulnerabilities to the effects of pornography, the study of which has been previously characterized as a "patchwork of haphazardly selected moderators with inconsistent results rather than a systematic research program" (Peter & Valkenburg, 2016). A central component of the hypothetico-deductive scientific method is that theories are tested by subjecting derived predictions to empirical scrutiny (Haig, 2018). If observations accord with the predictions, then the theory is seen as more credible; but, if they do not, then some aspect of the theory may need to be revised. This latter aspect of the scientific method is not prominent when researchers consider the impact of pornography use among adolescents. Instead, theory tends to be used to justify the investigation of a specific phenomenon (e.g., the association between pornography use and sexual risk taking), sometimes by appealing to multiple explanatory mechanisms that can be used to justify the same prediction (see, for example, Brown & L'Engle, 2009). Upon finding the expected phenomenon, researchers rarely go on to test underlying assumptions, consider competing explanations for the same phenomenon, or even address how the findings of the current analyses strengthen or undermine specific aspects of the theory that premised the investigation in the first place. Such theoretical refinements are particularly necessary in the social sciences where many theories are so vague that they cannot be properly falsified (Smaldino, 2017). The failure to systematically refine theory through empirical testing in this area makes it difficult to ascertain the true value of these theories for explaining the effects of pornography use among adolescents.

14.2 The Prevalence of Pornography Use Among Adolescents and Emerging Adults

Although interest in adolescent pornography use has increased dramatically in the last two decades (Koletić, 2017; Peter & Valkenburg, 2016), research of this sort dates back to the President's Commission on Obscenity and Pornography (Commission on Obscenity and Pornography, 1971). Reviewing data collected before the year 2000 is informative, and helps to provide a context for understanding changes in adolescent pornography exposure that may have occurred with the introduction of the Internet.

14.2.1 Pre-Internet Exposure/Use

Even before the Internet, prevalence research indicated that most adolescents (46–91%; Bryant & Brown, 1989; Lo et al., 1999) had experience with

pornography. An early study of American high school students (16–19 years old) selected through stratified random sampling from a single school district in a Midwestern US industrial area reported that 79% of adolescent males and 38% of adolescent females had seen nude photographs of women that displayed genitals and 54% of adolescent males and 15% of adolescent females had viewed a photograph of nude men and women engaging in sexual behavior (Elias, 1971). Similar figures were reported more than a decade later in a sample of secondary students in California, where 83% of adolescent males and 48% of adolescent females had reported exposure to pornography (Cowan & Campbell, 1995). Around the same time, nine out of ten adolescent males and six out of ten adolescent females in a Canadian sample of grade nine students reported exposure to video pornography (Check & Maxwell, 1992). The highest prevalence estimate of adolescent exposure to pornography (91%) during this period was derived from a large ($N = 1858$) Taiwanese sample of adolescents (grades 10 through 12) toward the close of the millennium (Lo et al., 1999). While the primary sources of pornography in this sample appeared to be television programs (59%) and pornographic comic books (46%), by this time, 38% of male and 7% of female adolescents in this Taiwanese sample reported exposure to pornography on a computer.

Estimates of the average age of first recalled exposure to pornography prior to the year 2000 varied considerably. Early research with a sample of American college students across five North-Eastern campuses indicated that average age of first exposure to pornography may be as low as 11–12 years old (White & Barnett, 1971), while a sample of adolescents collected around the same time suggested that the figure may be closer to 14–15 years old (Elias, 1971). A national probability sample of American adults during this period estimated that first exposure to pornography occurred between the ages of 14 and 17 years for men and 17 and 20 years for women (Wilson & Abelson, 1973). Approximately 10 years later, a report presented to the Attorney General's Commission on Pornography indicated that the average age of first exposure to pornographic magazines was 14 years, while the average age of exposure to pornographic films was 15 years (Bryant & Brown, 1989). The only American data available from the 1990s suggests that the age of first exposure was 11 years old for boys and 12 years old for girls (Cowan & Campbell, 1995). Figures were comparable for Canadian samples during this period; one National probability sample suggested that the average age of first exposure to pornography occurred between 10 and 15 years of age (Peat and Partners 1984, as cited in Bryant & Brown, 1989), while a smaller convenience sample indicated that the average age of first exposure was under 12 years of age (Check & Maxwell, 1992).

14.2.2 Post-Internet (Online) Exposure/Use

The accessibility of Internet pornography changed dramatically through the late 1990s and early 2000s (Barss, 2011), re-igniting fears about young people's

pornography use. Consequently, much of the contemporary literature concerning adolescent pornography use concentrates on online pornography use and the number of such estimates has increased dramatically since the early 2000s. Although there is a notable concentration of research in the United States (Bleakley et al., 2011; Hardy et al., 2013; Mitchell et al., 2003, 2007; Wolak et al., 2007; Ybarra & Mitchell, 2005; Ybarra et al., 2011) and the Netherlands (Doornwaard et al., 2015; Peter & Valkenburg, 2006, 2008, 2011b, 2011c), estimates of adolescent pornography use have been examined in a wide range of other countries, including Australia (Flood, 2009; Hasking et al., 2011), Belgium (Beyens et al., 2015; Vandenbosch & Eggermont, 2013), China (Dong et al., 2013), the Czech Republic (Ševčíková & Daneback, 2014), Croatia (Tomić et al., 2018), Ethiopia (Bogale & Seme, 2014), Germany (Weber et al., 2012), Greece (Tsitsika et al., 2009), Israel (Mesch, 2009), Hong Kong (Ma & Shek, 2013; Shek & Ma, 2012a, 2012b; To et al., 2012), Italy (Bonino et al., 2006), Korea (Kim, 2001, 2011), Malaysia (Manaf et al., 2014), Morocco (Kadri et al., 2013), Sweden (Häggström-Nordin et al., 2011; Skoog et al., 2009), Switzerland (Luder et al., 2011), and Taiwan (Chen et al., 2013). Sexual norms across these countries diverge considerably, and it is likely that some of the variation in estimates of adolescent pornography use may be attributable to cultural differences.

The range between the lowest and highest estimates of the prevalence of adolescent pornography use appears extreme. For example, Flood (2009) noted that only 2% of female and 38% of male adolescents (16–17 years of age) in an Australian sample purposefully accessed pornographic websites, while Weber and his colleagues (2012) indicated that 81% of female and 98% of male adolescents (16–19 years of age) in Germany had ever seen a pornographic movie. Certainly, some of the difference between these estimates can be attributable to factors like age, degree of parental supervision, and culture, but another important factor concerns how exposure to pornography is measured. In their recent review, Peter and Valkenburg (2016) differentiated between three measurement approaches that may be relevant here: those that measure unintentional exposure (e.g., unsolicited e-mails, URL redirects, peer exposure), those that measure intentional exposure, and those that measure any exposure. According to their overview, between 19 and 84% of adolescents were unintentionally exposed to pornography, between 7 and 59% of adolescents have purposely viewed pornography, and between 7 and 71% of adolescents had any exposure to pornography (Peter & Valkenburg, 2016). While these estimates also represent very broad ranges, it is noteworthy that studies that conduct direct comparisons typically report that unintentional exposure is more common than intentional exposure among adolescents (Chen et al., 2013; Flood, 2009; Luder et al., 2011; Ybarra & Mitchell, 2005), though there are some exceptions (Weber et al., 2012).

Estimates of age at first exposure to pornography since the early 2000s are less variable than estimates before this period, but do not appear to be considerably lower. An early study of Danish men and women between the ages of 18 and 30 years reported mean first exposure to pornography of 13 years for men and 15 years for women (Hald, 2006). American samples of comparable ages reported

similar estimates for men (12–14 years) and women (15 years) (Morgan, 2011; Sabina et al., 2008; Sun et al., 2016). A sample of American college students surveyed during this period also indicated that the average age of first exposure to pornography was 14 years old for men and 15 years old women, and few men (3.5%) and women (1.5%) reported exposure before 12 years of age (Sabina et al., 2008). Median ages of first exposure to pornography of 13 years old for males and 14 years old for females have also been reported from a large sample of Swedish adolescents and young adults (ages 16–23) (Mattebo et al., 2014). A Croatian study carried out in a large-scale national probability-based sample of emerging adults found that mean age at first exposure was between 11 and 12 years for male and 13 and 14 years for female participants (Sinković et al., 2013). Interestingly, limited evidence indicates that age of first exposure to pornography may precede regular use of pornography by several years (Miller et al., 2018).

14.2.3 Changes in Pornography Use across Adolescence

Consistent with Miller et al.'s observation of delayed habitual use, several longitudinal samples of adolescents suggest that the frequency of pornography use increases with age (Cranney et al., 2018; Doornwaard et al., 2015; Rasmussen & Bierman, 2016). For example, data from a nationally representative panel of adolescents in the United States indicate that the frequency of pornography use increases in both males and females (Rasmussen & Bierman, 2016). Among the limited number of available studies, there is some indication that pornography use begins earlier (Willoughby et al., 2018), and that growth in the frequency of pornography use is higher among male adolescents than female adolescents (Doornwaard et al., 2015; Rasmussen & Bierman, 2016). There has also been some consideration of the role of religiosity, though the reported effects are contentious. Research in the United States suggests that externalized religiosity (e.g., church attendance) suppresses growth in pornography use among adolescents (Rasmussen & Bierman, 2016), while research in Croatia does not (Cranney et al., 2018). Further examination of the Croatian panel has provided some corroboration of the American findings when it comes to indicators of internalized religiosity (e.g., belief in God), but only among adolescents who do not exhibit symptoms of problematic pornography use in later adolescence (Kohut & Štulhofer, 2018b). Among those who do express symptoms of problematic pornography use, religiosity is associated with a delayed onset of pornography use but a higher rate of change over time. Finally, abstention from pornography use has also been found to be more common among religious individuals in a study that examined adult recollections of pornography use during adolescence (Willoughby et al., 2018), although the effect of social desirability cannot be ruled out.

14.2.4 *Exposure to and Use of Pornography: Correlates, Predictors, and Potential Confounds*

In the broader literature, pornography use is typically framed as a unique causal agent that negatively impacts how people think, feel, and behave. Despite the preponderance of causal theorizing, most of the available research is correlational in nature and much of it fails to rule out plausible alternative hypotheses for established associations between pornography use and its presumed harms (Campbell & Kohut, 2017). Fortunately, research within the specific domain of adolescent pornography use appears to be somewhat less prone to such errors (see, for example, Brown & L'Engle, 2009; Ybarra et al., 2011). Moreover, research with adolescent samples has identified a number of correlates that are unlikely to be direct consequences of pornography use, such as impulsiveness and sensation seeking (Brown & L'Engle, 2009), self-control and religiosity (Hardy et al., 2013), pubertal status (Beyens et al., 2015; Peter & Valkenburg, 2006), victimization (Dong et al., 2013), non-sexual delinquent behavior (Wolak et al., 2007), substance use (Ybarra & Mitchell, 2005), family dynamics (Mesch, 2009), peer influence (Weber et al., 2012), and the extent of overall Internet use (Mitchell et al., 2003). Further research in this area would do well to rule out these and other potential confounding factors when examining presumed causal relationships.

14.3 Pornography Use and Sexual Risk Taking

Recent reports on the relationship between pornography use and adolescents' well-being (Martellozzo et al., 2016; Quadara et al., 2017) have pointed to potential links between pornography use and risky sexual behavior as a major concern. Due to risky sexual behaviors, adolescents have the highest age-specific proportion of unintended pregnancies and the highest age-specific risk for acquiring sexually transmitted infections (Centers for Disease Control and Prevention, 2017). These public health concerns have yielded extensive research into psychosocial and cultural determinants of adolescent sexual risk taking (Kotchick et al., 2001; Zimmer-Gembeck & Helfand, 2008), but only a minority of studies have addressed the potential role of pornography use in adolescents' sexual risk taking.

Taking into account commonly used measures of sexual risk taking (condom use, number of sexual partners, and age of sexual debut), the existing evidence of the association between adolescents' pornography use and risky sexual behavior is mixed. A significant association between not using a condom at most recent sexual intercourse and the frequency of pornography use was reported in three cross-sectional studies carried out among female African-American adolescents (Wingood et al., 2001), male Swiss adolescents (Luder et al., 2011), and emerging adults from the USA (Wright et al., 2016b). In contrast, cross-sectional studies carried out among Australian and US adolescents and young adults (Braun-Courville &

Rojas, 2009; Lim et al., 2017), as well as emerging Croatian adults (Sinković et al., 2013) reported no relationship between pornography use and condom use. A two-wave study of Dutch and a five-wave study of Croatian adolescents also failed to corroborate the link (Koletić et al., 2019b; Peter & Valkenburg, 2011b).

The association between pornography use and multiple sexual partnerships was confirmed in three cross-sectional studies carried out in the USA (Braun-Courville & Rojas, 2009; Wingood et al., 2001; Wright et al., 2016b), but not in Australian (Lim et al., 2017), Croatian (Sinković et al., 2013), and Swiss research (Luder et al., 2011). Longitudinal evidence is also mixed. A recent Canadian longitudinal study observed that participants who were characterized by early exposure to pornography and regular pornography use reported substantially more sexual partners compared to their peers (Rasmussen & Bierman, 2018). However, another study that explored links between recollections of early onset of pornography on the one hand and number of romantic partners and frequency of intercourse among emerging adults on the other hand did not find significant associations (Willoughby et al., 2018). A more recent Croatian study reported non-significant association between frequency of pornography use and multiple sexual partnership in two independent panel samples of adolescents (Koletić et al., 2019b).

With respect to the association between pornography use and adolescents' sexual debut, a couple of two-wave studies found a positive link among US and Belgian adolescents, respectively (Brown & L'Engle, 2009; Vandenbosch & Eggermont, 2013). A four-wave Dutch study also found a significant association between the two constructs, but only among male adolescents between the first two study waves (Doornwaard et al., 2015). In contrast to the Dutch study, a consistent non-significant longitudinal association between male adolescents' pornography use and sexual debut was reported in two independent panels of Croatian adolescents (Matković et al., 2018). The findings in female adolescents were inconclusive.

By including risky sexual practices other than condom non-use and number of sexual partners (e.g., one-night stands, intoxication prior to sexual intercourse), a couple of cross-sectional studies have examined the target association using a composite measure of sexual risk taking. According to Braun-Courville and Rojas (2009), adolescent online pornography users had significantly higher scores on a risky sexual behavior scale than non-users. In contrast, Lim et al. (2017) reported a non-significant association between the use of sexually explicit material and another composite sexual risk scale. In a recent three-wave longitudinal study of adolescents, higher baseline frequency of pornography use predicted a steeper increase in male adolescents' composite sexual risk scores over a period of 15 months (Koletić et al., 2019c). A significant positive association between baseline pornography use and sexual risk taking was also found among female adolescents.

Research in adults suggests that both the age of first exposure to pornography and the frequency of pornography use among men who have sex with other men are correlated with unprotected anal intercourse (Perry et al., 2019). However, there is also evidence that specific content (i.e., depiction of condomless anal sex) in pornography may be more important than general pornography use (Rosser et al., 2013; Schrimshaw et al., 2016; Whitfield et al., 2018). Comparable research among

young gay and bisexual men is sorely lacking (see Nelson et al., 2016), despite the fact that sexual minority youth might be even more vulnerable due to bullying, as well as external and internalized homonegativity—constructs that have been linked to sexual risk taking in a large-scale cross-cultural research (Ross et al., 2013).

Inconsistent findings from the presented studies may stem from several methodological and contextual differences. First, age range and gender ratio differed across both cross-sectional and longitudinal studies. Second, the studies used markedly different operationalizations of pornography use and sexual risk taking. Third, objective indicators of sexual risk taking or its correlates were used only exceptionally, raising questions about culture-specific social desirability biases. The exceptions were vaginal specimen-based STI testing (Wingood et al., 2001) and salivary testosterone assessment of pubertal development (Koletić et al., 2019b). Fourth, control variables were used inconsistently across the available studies. Finally, given that the majority of the studies were conducted in fairly liberal and sexually permissive cultural settings, there is a notable lack of cultural heterogeneity in the body of research focusing on young people's pornography use and sexual risk taking.

14.4 Pornography and Sexual Aggression

Whether or not pornography use contributes to sexual aggression remains a contentious issue. Literature reviews and meta-analytic summaries concerning the link between pornography use and sexual aggression continue to arrive at conflicting conclusions, variously asserting that pornography contributes to sexual aggression (Wright et al., 2016a), that it does not contribute to sexual aggression (Ferguson & Hartley, 2009; Mellor & Duff, 2019), or that pornography use may be a risk factor for sexual aggression but only (or primarily) among individuals who are predisposed to sexual aggression (Fisher et al., 2013; Kingston et al., 2009; Malamuth, 2018; Seto et al., 2001). It is notable that several researchers have indicated difficulties with integrating research findings in this field because of inconsistent operational definitions of pornography use across studies (Mellor & Duff, 2019; Seto et al., 2001).

Several studies have linked pornography use among adolescents to beliefs about victim-precipitated rape, more endorsement of traditional gender roles, and more acceptance of other rape-supportive attitudes (Brown & L'Engle, 2009; Check & Maxwell, 1992; Cowan & Campbell, 1995; Stanley et al., 2018; Ybarra et al., 2011). Perhaps more importantly, a combination of cross-sectional and longitudinal studies suggests that pornography use is associated with self-reported sexual harassment, sexual assault, and rape (Bonino et al., 2006; Brown & L'Engle, 2009; Kjellgren et al., 2010, 2011; Ybarra & Thompson, 2018). Overall, such findings suggest that pornography is implicated in the commission of sexual violence.

There are several reasons, however, to question the view that pornography use *causes* sexual violence. To being with, a recent systematic review of juvenile offender research has concluded that such studies have not established a consistent

link between pornography use in childhood and adolescence and subsequent sexual offending (Mellor & Duff, 2019). Further, much of the correlational research demonstrating connections between pornography use and rape supportive attitudes has failed to adequately control for potential confounding variables (e.g., delinquency, substance use, impulsiveness) and the research that has controlled for such variables typically has not found such associations. The work of Kjellgren et al. (2010) illustrates this well. An examination of a large national sample of Swedish male adolescents in their third year of high school indicated that sexually coercive male adolescents were more likely to report frequent pornography use, viewing violent pornography, having friends who use pornography frequently, and having friends who like violent pornography than male adolescents who did not engage in sexual coercion and had no conduct disorder problems. However, the same differences were found when male adolescents with non-sexual conduct problems were compared to those who did not have such problems. Moreover, none of these variables distinguished between sexually violent adolescents and their peers with non-sexual conduct problems in multivariate analyses that controlled for potential confounding variables. Lastly, research that adequately controls for confounding variables has found that violent pornography use is associated with sexually violent behavior while use of non-violent pornography is not (Kjellgren et al., 2011; Ybarra et al., 2011; Ybarra & Thompson, 2018). Taken together, such findings suggest that links between sexual aggression and non-violent pornography use among adolescents may partially result from confounding with other putative causes of sexual violence (e.g., substance use, conduct disorder).

While it appears that use of pornography, particularly aggressive or violent content, may be implicated in the enactment of some sort of sexual violence, it remains difficult to determine whether non-violent pornography use plays an important causal role. As Mesch (2009) has previously pointed out, research tends to indicate that "despite the wide availability of pornographic material on the Internet, its consumption at high frequency is more a characteristic of troubled adolescents who lack a sense of being part of the society and positive attitudes to school, and report problematic relations with their families." Given the connections between such individual characteristics and sexual aggression, correlational research is likely to reveal associations between pornography use and sexual violence (particularly in large and heterogeneous samples) even if pornography is not a causal contributor.

14.5 Pornography Use and Young People's Psychological Health and Sexual Well-Being

Several issues have been raised in the research literature regarding young people's pornography use, psychological health, and sexual well-being. In most cases, empirical assessments focused on potential harms related to pornography use, such as

negative mood, compulsive pornography use, pornography-related sexual dysfunction, as well as reporting lower sexual satisfaction.

Research interest in compulsive use of pornography has been increasing, particularly in the past decade (see, for example, Grubbs et al., 2015; Kraus et al., 2016; Werner et al., 2018). Despite the fact that adolescents may be especially vulnerable to problematic use of pornography, due to developmental (neurobiological and socio-psychological) characteristics (Owens et al., 2012), only a handful of studies have recently addressed the phenomenon among adolescents—possibly due to ethical concerns and constraints. In the first of the two cross-sectional studies, which were carried out in three samples of Israeli adolescents, a weak association between compulsive sexual behavior (over a third of items from the composite measure that was used to assess the construct asked about pornography use) and psychopathology scores was observed (Efrati, 2018). In the second study (Efrati & Gola, 2018), the authors reported three latent profiles of adolescent pornography users, with 12% of participants belonging to a group that scored high on four dimensions associated with compulsive sexuality (sex as affect regulating behavior; perceived lack of control over sexual behavior; adverse effects of sexual behavior; and unwanted consequences of sexual behavior). In comparison to the other two latent profile groups, this compulsive sexual behavior group was characterized as having a higher external locus of control, greater loneliness, a more anxious attachment style, and, expectedly, higher frequency of pornography use. Finally, a longitudinal study that included male adolescents from two independent panel samples found a significant, albeit weak, association between baseline pornography use (at the age of 16) and scores on a brief Compulsive Pornography Consumption scale 2 years later (Kohut & Štulhofer, 2018b). Controlling for sensation seeking, impulsivity, and social desirability, a consistent link between growth in pornography use over time and symptoms of sexual compulsiveness at the final wave was observed only among more religious adolescents. Taken together, these studies' findings suggest that some adolescents may benefit from educational interventions and counseling focused on problematic pornography use and emphasize a need for more data about the phenomenon.

High prevalence of pornography use among male adolescents and emerging adults, which has been observed in different cultural settings, and an apparent coinciding increase in erectile dysfunction prompted claims about an epidemic of pornography-induced erectile dysfunction among young men (de Alarcón et al., 2019). Although the idea that high pornography use reduces sexual desire for real life partners, resulting in erectile difficulties, seems to have gotten some traction in the popular media and online discussion groups, particularly in the USA (Grubbs et al., 2019), the concept remains highly controversial (Ley et al., 2014). Taking into account a lack of rigorous studies on sexual dysfunctions in adolescence and emerging adulthood, which reflects consistent observations of a negative association between age and erectile function, empirical support for pornography-induced erectile dysfunction among men 20–40 years old is lacking (Berger et al., 2019; Landripet & Štulhofer, 2015).

A more general line of research is represented by studies that explored possible links between pornography use and adolescent psychological health and subjective well-being. Taken together, cross-sectional evidence remains contradictory: negative links, no associations, and even positive relationships have been reported (Kim, 2001, 2011; Morrison et al., 2006; Peter & Valkenburg, 2016; Ybarra et al., 2011). Similarly, a recent study found that adults who retrospectively reported early adolescent initiation into and continued use of pornography were characterized by lower life satisfaction, but not higher depression, than those who had rarely used pornography during adolescence (Willoughby et al., 2018). Additional longitudinal evidence is sparse, but points to no association between pornography use and various indicators of adolescents' psychological health and well-being. The first of the four available studies reported a relationship between lower life satisfaction at Time 1 and higher frequency of pornography use at Time 2 (Peter & Valkenburg, 2011b, 2011c). The other three studies found no substantial associations between pornography use and physical self-esteem (Doornwaard et al., 2015), subjective well-being, general self-esteem, and symptoms of depression and anxiety (Kohut & Štulhofer, 2018a; Štulhofer et al., 2019)—regardless of the patterns of change in the frequency of pornography use (Štulhofer et al., 2019). However, the authors of these two most recent longitudinal studies noted that their assessment did not rule out the possibility of pornography use being related to depression and anxiety symptoms, as well as self-esteem, in early adolescent girls.

A recent meta-analysis of studies carried out mostly in adult samples found a small but significant negative association between the frequency of pornography use and sexual satisfaction in men, but no association between pornography use and measures of intrapersonal satisfaction (e.g., self-esteem, body satisfaction) in either men or women (Wright et al., 2017). The authors suggested that social comparison theory provides a fruitful framework for understanding the negative relationship, but warned against oversimplifying underlying mechanisms (e.g., the meta-analysis observed no link between pornography use and body satisfaction). Only three longitudinal studies have explored the association between pornography use and sexual satisfaction in adolescents and emerging adults. The first two, both carried out in the Netherlands, found small but significant relationships in both genders (Doornwaard et al., 2015; Peter & Valkenburg, 2009). It should be noted that the two studies sampled participants in different developmental phases (participants' ages ranged from 10 to 18 years in the former and from 13 to 20 years in the latter study), which impedes more precise insights. More recently, a longitudinal study that followed a sample of 16-year-old participants for 2 years observed no significant associations in either female or male adolescents between baseline level and change in pornography use over time and sexual satisfaction levels reported at the end of the study, controlling for satisfaction levels at the previous data collection wave (Milas et al., 2019). Considering these conflicting findings, more research is warranted before any conclusions are made.

Finally, a number of qualitative studies have pointed to the fact that pornography is also used by adolescents and young adults as a source of information about sex and sexuality (see, for example, Litras et al., 2015; Löfgren-Mårtenson & Månsson,

2010; Rothman et al., 2015; Scarcelli, 2015). This may be particularly relevant for young lesbian, gay, and bisexual individuals, for whom relevant information is often not readily available offline (Kubicek et al., 2010; Mustanski et al., 2011). However, navigating the landscape of pornographic imagery may be difficult for young people, particularly if they lack critical thinking skills and other sources of information about human sexuality. In such cases, informational benefits might be offset by specific biases and distortions embedded in pornography.

14.6 Emerging Insights on Pornography Literacy and the Role of Parents

Rising concerns about young people's pornography use have prompted thinking about possible educational interventions to minimize adverse outcomes. Based on evidence that media literacy programs can reduce risky behaviors associated particularly with media use in adolescents (see Vahedi et al., 2018), ideas about promoting *pornography literacy*—which can be defined as the ability to think critically about pornographic imagery—

have been gaining popularity (Albury, 2014; Dawson et al., 2019). This critical understanding of pornography, and the related awareness of its norms (unemotional and sexually disinhibited performance), power differential (eroticized gender inequality), and unrealistic body appearance and performance expectations, has been suggested as the solution for problems associated with adolescents' and young adults' online exposure to sexually explicit material (Dawson et al., 2019; Rothman et al., 2018; Vandenbosch & van Oosten, 2017).

Due to the contemporary moral climate surrounding the issue of pornography use among young people, but also, more generally, sex-positive teaching (Fortenberry, 2016), pornography literacy would likely be difficult to incorporate in school-based health and sexuality education programs (Albury, 2014). A notable exception seems to be the Netherlands, where a recent longitudinal study found that addressing pornography in sexuality education curriculum weakened the link between online pornography use and sexist attitudes (Vandenbosch & van Oosten, 2017). Recently, a 5-session program in pornography literacy was piloted and evaluated in a group of adolescents and emerging adults from the USA (Rothman et al., 2018). The authors found the program's implementation feasible from the perspective of both parents and students. Although several expected differences in pre- and post-intervention knowledge about and attitudes toward pornography were noted, low statistical power and the lack of correction for multiple comparisons render the reported findings suggestive at best.

Currently, pornography literacy interventions appear to be a promising idea. Although there is some evidence that addressing pornography in school-based sexuality education can be beneficial (Vandenbosch & van Oosten, 2017), next to nothing is known about what actually *works* in teaching pornography literacy,

whether a behavioral change is feasible, and whether the outcomes are long lasting. It is likely that pornography literacy interventions will become more popular in the future—either as a part of comprehensive sexuality education or as stand-alone programs—which will require rigorous evaluation studies to ascertain whether helping young people to adopt a more critical understanding of sexually explicit material may reduce their vulnerability to pornography-related adverse outcomes.

Parents may also play a role in mitigating the potential harms of pornography use among adolescents. Theoretically, parents may regulate their children's access to pornography either directly, via restricting or monitoring Internet use, or indirectly, by restricting or monitoring contact with some peers. More lastingly, they may reduce children's vulnerability to pornography by actively shaping their sexual value systems, by modeling healthy relationships and behaviors, or by providing children with critical thinking tools that will help them challenge pornographic scripts. Parents who are highly engaged in their children's upbringing and socialization, who provide rules and guidance, emotional support, and encourage autonomy and communication, may minimize the risk of negative outcomes associated with pornography use. Despite the fact that parents are often either overconfident in their ability to monitor their children's online activities, or feel ill-equipped to deal with it (Clark, 2014), there is some preliminary evidence that parents can have a role in shaping adolescents' experiences with pornography. A cross-sectional Croatian study, for example, found that parental monitoring was related to less pornography use at the age of 16 years (Tomić et al., 2018), while a longitudinal exploration observed a negative association between male Dutch adolescents' pornography use and parental rule setting for Internet use (Doornwaard et al., 2015). Given the rising concerns among parents regarding sexualized online content, researchers are encouraged to explore and elucidate mechanisms that may underlie socialization-based reductions in adolescent vulnerability to adverse outcomes of pornography use.

14.7 Recommendations for Future Research

At present, the field of research concerning young people's pornography use and its consequences is moderately theoretically informed, empirically insightful but inconsistent in quality, and steadily growing. Overall, quantitative cross-sectional studies carried out in North America, Australia, and Western Europe predominate the field, with markedly conflicting findings (e.g., research findings on pornography use and sexual risk taking). In a great majority of cases, researchers have been preoccupied with negative effects of pornography use, to the point of occasionally exhibiting a moral bias by assuming that pornography use is problematic behavior per se. In addition, many empirical observations are only loosely conceptualized, resulting in the data not being used to test and further develop explanatory theories in the field.

Taken together, do findings on the effects of young people's pornography use represent a comprehensive body of evidence that can guide educational and other policies? At present, the authors of this chapter see the current contradictions in

research findings as a substantial obstacle to optimism. However, the current lack of consensus about adverse outcomes associated with pornography use—who is affected and how?—should not be perceived as discouraging, but rather as an imperative to improve the quality of our explorations. To this aim, in this section, we briefly note a number of points intended to improve scientific quality and rigor in the field, and strengthen its pragmatic role—to inform and assist policies focusing on young people's psychological, sexual, and reproductive health and well-being.

14.7.1 Using Data to Test Theories

There are various legitimate ways to engage in the scientific method, one of which involves testing theoretical explanations for a phenomenon with empirical observations. Research concerning adolescent pornography use could do more in this regard. At the outset of a study's design, researchers should carefully consider alternative theoretical explanations that justify the same empirical prediction and craft elements of the study to test competing hypotheses. At a study's conclusion, researchers should spend more time reflecting on how their specific findings inform the credibility of the theory or theories that provided the study's rationale. Moreover, regardless of the results (i.e., whether a specific prediction is confirmed or disconfirmed), subsequent efforts should be undertaken to test the implicit and explicit assumptions that underlie the original hypothesis.

Suppose, for example, that a researcher believed pornography contributes to risky sexual behavior through the process of script acquisition, activation, and application (Wright, 2014). Simply demonstrating that self-reported pornography use is associated with self-reported risky sexual behavior tells us virtually nothing about the explanatory value of the $_3$AM. It could be the case, for example, that such an association is not the result of script acquisition at all, but occurs because both pornography use and sexual risk taking are characteristic behavioral expressions of someone who is unrestricted in their sociosexuality (Simpson & Gangestad, 1991). The careful design of research, systematic reflections on what patterns of findings mean for the credibility of a theory, and systematic follow-up research would be needed to disambiguate these alternative explanations for the same phenomenon.

14.7.2 Terminology and the Importance of Defining the Construct

Considering technological changes that made online pornography the predominant source of sexually explicit material for adolescents and young adults, it would make sense for researchers to systematically adopt terms such as *online pornography* or

Internet pornography in their work.[1] Although some researchers use the terms pornography and sexually explicit material/media interchangeably—or even prefer the latter expression as a more neutral term—sexually explicit material is less precise and is a potentially broader construct. Apart from the terminology issue, researchers who ask adolescents about their use of "pornography" should always provide a definition of this construct for participants and clearly state such definitions in their papers (Willoughby & Busby, 2015), which is still not standard procedure (Peter & Valkenburg, 2016; Short et al., 2012).

There are a variety of definitions of pornography in the literature (see, for example, Baer et al., 2015; Hald, 2006; Peter & Valkenburg, 2010; Štulhofer et al., 2019), but none of them have been widely accepted. In an effort to improve conceptual consensus in the field, Kohut et al. (2020) recently reviewed academic definitions of pornography, empirical research concerning lay conceptualizations of pornography, and elaborated on potential meanings of the use of such materials, to offer the following conceptual definition of pornography use:

> Pornography use is a common but stigmatized behavior, in which one or more people intentionally expose themselves to representations of nudity which may or may not include depictions of sexual behavior, or who seek out, create, modify, exchange, or store such materials. Pornography use, which is primarily for sexual purposes, can involve one or more types of online and offline materials, and can occur in a variety of locational, social, and behavioral contexts. The extent and nature of such behaviors are regulated and shaped by a combination of personal and social hedonic motives, as well as other individual differences and environmental factors. Pornography use can evoke immediate sexual and affective responses, and may contribute to more lasting cognitive, affective, and behavioral changes (Kohut et al., 2020, p. 37).

However, in some cases—for example, when exploring the link between pornography use and sexual risk taking—researchers should define pornography more narrowly (see Koletić et al., 2019b), so that participants would only consider their use of material that contains explicit presentation of sexual behaviors, usually focusing on penetrative sexual activities.

14.7.3 Measurement Issues

Currently, there are very few commonly used measures of pornography use across studies (Kohut et al., 2020; Short et al., 2012). This state of affairs hinders direct comparisons of research findings across studies and may be partially responsible for some of the inconsistencies that are present in this field (Mellor & Duff, 2019; Peter & Valkenburg, 2016; Seto et al., 2001). Having recognized this issue, it is critical for the research community to systematically adopt common measures of pornography use that have been well validated. Some preliminary validation work has been offered for several multi-item scales (Hald, 2006; Peter & Valkenburg, 2006), but,

[1] This is not to say that the term offline pornography may not be relevant in some cases.

critically, criterion validity involving objective measures of pornography use behavior (e.g., movie rentals, pay-per-view records, browser history, Internet browsing logs) has yet to be considered. Related research concerning the validation of measures of self-reported smartphone use has found that existing measures do not always reflect participants' actual behavior (correlations range from 0.13 to 0.40; Ellis et al., 2019). Given such findings, researchers in the field of pornography should be cautious when interpreting their results until evidence of criterion validity is offered.

The first measurement-related issue that must be confronted concerns the nature of pornography use behavior that researchers are most interested in. As is already recognized, intentional use can be distinguished from unintentional exposure. If intentional use is of most interest, it is a broad construct that may include seeking out or exposing oneself to pornography, or creating, modifying, storing, or exchanging such materials, and researchers may wish to focus their attention on a limited number of these behavioral facets. If self-exposure is of most relevance, researchers still must decide whether they should be measuring duration of use (i.e., the difference between current age and age of first use), frequency of use (i.e., number of uses over a period of time), temporal use (i.e., the amount of time spent in an assessment window), or time since last use, or some combination of these factors. Pornography use can also occur in a variety of contexts that may have some bearing on relevant antecedents and consequences, so researchers may also need to consider the relevance of online/offline use, private/public use, solitary/partnered/social use, masturbatory/non-masturbatory use, etc.

Once the specific nature of pornography use is clarified, a decision must also be made between the use of single-item versus multi-item assessments. It is often assumed that multi-item approaches improve the reliability of measures in the field. While this makes sense, there is evidence that single-item measures can perform as well as multi-item indicators under specific limited circumstances (Bergkvist & Rossiter, 2007), or even outperform them, as appears to be the case when it comes to predicting the actual time that users spend on their smartphones (Ellis et al., 2019). However, a further consideration in favor of multi-item assessments stems from the fact that researchers need not ask participants about their "pornography" use directly, and instead, ask them about how often they use materials with specific characteristics (e.g., "An image of a heterosexual couple having sex which shows the man's penis penetrating the woman") (Leonhardt & Willoughby, 2019). The advantage of such an approach is that it may reduce error introduced by variations in participants' understanding of the concept of pornography (Willoughby & Busby, 2015). While advocates of single-item assessments can certainly adopt this approach, the use of multiple items—provided they are not redundant—would allow for a more thorough assessment of the breadth of construct of pornography. In a very similar way, multi-item assessments could also be easily extended to measure the use of specific types of sexual content without invoking concepts that are explicitly undesirable (e.g., "rape" pornography), or theoretically contested (e.g., "violent" pornography). The proper measurement of pornography

use, as well as specific and theoretically relevant content features of pornography, is an area that deserves a great deal of attention.

To reiterate a recommendation by Peter and Valkenburg (2016), participants' preferred type of pornographic content should be also inquired about whenever possible, as specific content, rather than sheer frequency of pornography use, may be an indicator of vulnerability to adverse outcomes (see, for example, Štulhofer et al., 2010). However, how to best assess the usage of or preference for specific content is currently unclear, as validated measures are rare (Hald et al., 2018; Landripet et al., 2019; Vandenbosch, 2015).

14.7.4 Research Design

Considering that experimental studies are problematic in this area,[2] more high-quality longitudinal studies are needed. Although several longitudinal studies with a focus on adolescents' use of pornography emerged in the past decade (Koletić, 2017), the field remains overpopulated by cross-sectional research studies of varying quality. Considering the developmental processes that characterize adolescence and, consequently, the importance of exploring links (both at between- and within-individual levels) between changes in pornography use and various adverse outcomes over time, researchers should be encouraged to plan for longitudinal, rather than cross-sectional, assessment. To start disentangling the question of directionality—for example, between pornography use and sexual satisfaction—at least two observation points would be needed. Similarly, to carry out a true (i.e., conceptually valid and methodologically sound) mediation analysis would require at least three observation points (Kline, 2015; Little et al., 2009). In short, we believe that further development of this research field will primarily depend on high-quality longitudinal explorations.

Three important points regarding longitudinal design should be briefly mentioned here. First, the majority of existing longitudinal studies concerning pornography use have sampled participants of different ages, often ranging from early adolescence to emerging adulthood (see Koletić, 2017). This is unfortunate, because such approaches preclude age- or developmental phase-specific findings. To avoid such "pooled" estimates, which cannot be confidently attributed to any particular age group, future panel samples should either recruit a specific age cohort or, provided the sample size is sufficiently large to carry out key analyses separately by age group, several cohorts. Secondly, the risk of systematic dropout should be seriously considered and assessed. Although most of the longitudinal studies in the field

[2]Given that experimental studies in young people's pornography use are usually not feasible because of ethical constraints (intentionally exposing minors to pornography is widely seen as unethical) and difficulties in finding male controls (i.e., adolescents who have never been exposed to pornography), well-conducted longitudinal studies remain the best strategy to narrow the gap between correlational analysis and understanding possible causality in this population.

incorporate an attrition bias analysis or control for attrition in regression models by including the corresponding dummy variable as a predictor, such approaches have typically not determined whether the most vulnerable participants were more likely than their peers to leave the study before it concluded. We would recommend that future studies define study-specific vulnerability (i.e., characteristics that make an individual more vulnerable to a particular pornography-related outcome), include its operationalization in the survey materials, and explore systematic drop-out in parallel with data collection to make sure that their final estimates represent both participants with lower and higher theoretical vulnerability to pornography. Finally, longitudinal studies in sexually explicit media effects among non-heterosexual youth are sorely lacking. Taking into account that LGBT youth are at increased multiple health-related risks (Bontempo & D'Augelli, 2002; Garofalo et al., 1998) due to external and internalized homonegativity, future research should pay particular attention to this population. To successfully recruit a large-enough panel sample of non-heterosexual youth to be followed over time, the standard classroom-based surveying will likely need to be replaced with targeted online surveying, possibly relying on a network-based initial recruitment.

14.7.5 Analytical Robustness

It seems that the assessment of possible confounders and moderators of the links between pornography use and the outcomes explored is increasingly more common in the field. The importance of such analysis is impossible to overstate. It has been repeatedly emphasized that possible effects of pornography use are not uniform and that some young people are more vulnerable to adverse outcomes than others (Owens et al., 2012; Peter & Valkenburg, 2016). Exploration of conceptually and empirically plausible moderators at individual, family, and peer levels remains a crucial analytical strategy for identifying more vulnerable individuals. Similarly, potential confounders (e.g., sensation seeking, reduced inhibitory control, sex drive, social desirability) provide reasonable alternative hypotheses for many of the assumed outcomes of pornography use, and consequently need to be routinely included in questionnaires and controlled for in sequential models. We should also note that while we advocate for more longitudinal designs in this area, evidence of temporal precedence from longitudinal research does not rule out the potential role of confounding variables, so they must also be considered in such designs.

14.7.6 Ideological Biases

Taking into account that research in young people's pornography use is a sensitive and, in many socio-cultural settings, highly controversial topic, future research

would benefit from increased awareness about ideological and moral pressures and biases. More specifically, we would suggest that researchers discuss their beliefs and inclinations with other team members before commencing their work on designing a study and, perhaps, consider a brief disclosure in a footnote.

14.7.7 Applied Research

Given the ubiquity of online pornography and difficulties in restricting minors' access to it, pornography literacy and other educational interventions will likely become increasingly popular with time. Obviously, rigorous evaluation research, which will be needed to assess effectiveness of such programs, will have an important role to play in future educational policies. In our view, such work also presents an opportunity to advance the understanding of psychosocial mechanisms underlying presumed links between pornography use and young people's attitudes and behaviors in applied settings.

14.8 Conclusions

In the era of easy access to pornography for everyone, including adolescents, increasing concerns about potential adverse effects of such material for young people's health and well-being are understandable. Although the current evidence is mixed and limited by a number of shortcomings, it seems unlikely that pornography use is uniformly problematic. It is entirely possible, though it remains to be demonstrated, that early exposure to and consistently high frequency of pornography use constitutes a risk for a certain subset of particularly vulnerable young people. However, this does not mean that most young people would not benefit from help in navigating the world of sexualized media and pornographic imagery. Qualitative research elucidates that the majority of adolescents are at least confused, sometimes distressed, when first exposed to pornography. For some, these feelings are longer-lasting. There is a clear role for parents, school-based educators, and dedicated sexuality educators to address the reality of pornography exposure. Although such discussions may not be easy in the contemporary climate in which reasonable caution is too readily replaced with moral condemnation—particularly in the context of sexuality education—open conversations about pornography with parents, educators, and experts working in youth health centers remain essential for young people to make sense of their sexuality, health, and well-being. Fortunately, such discussions are often welcomed by young people (Dawson et al., 2019; Rothman et al., 2015) as they frequently desire more information about such topics than they

are given. As researchers of pornography use among adolescents, it should be our collective goal to strive to provide high-quality evidence to inform these conversations and assist in educational policies.[3]

[3] In this context, it should be stressed that there is evidence that asking adolescents about their pornography use does not encourage them to use it (Koletić et al., 2019a; Peter & Valkenburg, 2012).

Spotlight Feature: Sexually Explicit Media Use Among Sexual and Gender Minority Adolescents

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The use of sexually explicit media (SEM), for example, pornography, sexual networking applications, sexually explicit blogs, and magazines, is common among adolescents. Heterosexual youth report diverse motivations for using SEM, including curiosity about sex, sexual pleasure, and education (e.g., Peter & Valkenburg, 2016). Although sexual and gender minority (SGM) adolescents likely share similar motivations for using SEM, they may also have differing experiences related to their SGM identity.

In the absence of school-based sex education designed for SGM adolescents, they often turn to alternate sources for information on sexual orientation, gender identity, and same-sex/gender sexual behavior, including websites and other online media (e.g., Dawson et al., 2020; Nelson et al., 2019a). This research largely has relied on SGM young adults' retrospective accounts, with few studies focused on SGM adolescents themselves.

Studies of SEM use among SGM adolescents find that exposure to SEM among sexual minority adolescent males in the United States is nearly universal, with 80–90% or more of youth reporting use of pornography (Arrington-Sanders et al., 2015; Macapagal et al., 2019b; Nelson et al., 2019b). Fewer SGM male adolescents report use of other media, such as magazines, photos, or erotica (Arrington-Sanders et al., 2015; Macapagal et al., 2019b), likely reflecting the widespread availability of online pornography. Little is known about the prevalence of SEM use among sexual minority adolescent females or gender minority youth.

Sexual minority adolescent males report using SEM to learn about body parts involved in sex and their functions (Arrington-Sanders et al., 2015; Macapagal et al., 2019b). Other benefits of SEM use include facilitating exploration of youth's sexual minority identity and attractions, learning the mechanics of male-male sex, and sexual roles (e.g., top/bottom; Arrington-Sanders et al., 2015; Macapagal et al., 2019b; Nelson et al., 2019b). Although sexual minority adolescent males may find SEM educational, the accuracy of the information remains unclear. Further, experiences with SEM are not uniformly positive. Sexual minority adolescent males have indicated that SEM provides unrealistic expectations about bodies and sex (Macapagal et al., 2019b; Nelson et al., 2019b). Two studies have also found that exposure to condomless male-male sex in SEM may be related to condomless sex among sexual minority male adolescents (Arrington-Sanders et al., 2015; Nelson et al., 2019b).

Although the literature on SEM use in SGM adolescents has focused largely on online pornography, participatory media (e.g., sexual networking smartphone applications, social media) are increasingly being used for sexual purposes. These newer

media can facilitate exchanging sexually explicit material between SGM adolescents and adult partners, or partnering between adolescents and adults, which may pose significant risks for both parties. For instance, Macapagal et al. (2018) found that over half of sexual minority adolescent males reported using smartphone applications (e.g., Grindr) to meet male partners for sex or to have sexually explicit online conversations with them. Relatedly, Ybarra and Mitchell (2016) found that sexual minority adolescents may be more likely than heterosexual adolescents to sext. Attention to how these internet-mediated sexual behaviors impact adolescent sexual relationships and the legal implications of sharing sexual content created by and picturing minors (Strasburger et al., 2019) are important avenues for research and policy.

As SEM use among SGM individuals has been studied primarily in the context of HIV prevention research, our limited knowledge centers on sexual minority adolescent males, with scant attention to SEM experiences among sexual minority adolescent females and gender minority adolescents. One Swedish study reported that lesbian and bisexual girls were more likely to view pornography compared to heterosexual girls (Mattebo et al., 2016). A qualitative study of gender minority adolescents in the United States found that some youth learned about sex and their gender identity through pornography, but at the same time felt that depictions of transgender people in SEM could be inaccurate or harmful (Bradford et al., 2019). For example, one participant reported that exposure to transphobic online pornography during adolescence gave them "the wrong idea of what [being trans] was," which negatively impacted their sense of self. This same participant indicated that this type of pornography was easier to access than medically accurate sexual health information. Unpublished qualitative data from the lead author on transgender and nonbinary adolescents suggests that sexual networking smartphone application use is not uncommon, but that use of such media may be unsatisfying due to lack of representation of people of diverse genders, and concerns about disclosing one's gender identity to others.

Potential obstacles to research on SEM use in SGM adolescents are scientists' and ethics review boards' concerns about the risks, appropriateness, and intrusiveness of conducting sexuality research with SGM adolescents (Mustanski, 2011). There may also be concerns about studying illicit behaviors as access to SEM is typically restricted by law and/or terms of service to those who have reached the age of majority in their location (frequently age 18 or 21). This reluctance may be amplified in locales where identifying as SGM remains illegal or highly stigmatized. However, research suggests that, at least in some regions of the world, many SGM adolescents are comfortable answering questions about sex relative to other types of health-related questions (e.g., Macapagal et al., 2019a). Guidelines on navigating sensitive research and ethics board reviews involving SGM adolescents are available (e.g., Mustanski, 2011; Schrager et al., 2019).

Sexual curiosity, interest in sex, and sexual exploration are a normal part of adolescent development (Fortenberry, 2013). Thus, it is unsurprising that SGM adolescents access SEM to explore their sexuality and gender identity, especially given the lack of information around same-sex/gender sexual relationships they

receive from traditional sources (e.g., school, parents/guardians; Nelson et al., 2019a; Raifman et al., 2018). Continued research on the role SEM plays in SGM adolescents' lives is needed to better understand their sexual health and development. Exploring the possible roles of porn literacy curricula and other methods of providing sex education to SGM youth is also critical (e.g., Dawson et al., 2020; Mustanski et al., 2015; Nelson & Carey, 2016).

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Chapter 15
A Review of Theoretical Models and Lifespan Approaches to the Study of Sexual Offending

Skye Stephens, Kailey Roche, and Sarah Moss

Abstract In this chapter we focus on the heterogenous phenomena of contact sexual offending perpetrated by males. We briefly review the frequency of sexual offending with a focus on general trends in the literature regarding common characteristics among those who perpetrate and those who are victimized. Our review focuses on a discussion of different theoretical models that can be applied to a broad range of sexual offending behavior with a focus on two integrated models of sexual offending and the motivation-facilitation model. Next, we consider longitudinal research on sexual offending trajectories that have been conducted from a Developmental and Life Course Criminology perspective. These studies provide greater insight into within-individual change in sexual offending across the lifespan and allow for stronger tests of different theoretical models that often include etiological factors associated with the onset of sexual offending. We conclude by considering future research directions specific to testing different theoretical models and the development of early intervention and prevention programs that include embedded program evaluation to evaluate the efficacy of these different approaches.

Keywords Sexual offending · Theory · Models · Development and life course · Criminology

Sexual offending encompasses a diverse range of illegal sexual behaviors, including contact offenses (physical contact with a victim, e.g., sexual assault), non-contact offenses (no physical contact with a victim, e.g., voyeurism), and offenses facilitated by technology (e.g., viewing child sexual exploitation material)—supporting the

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notion that individuals who commit sexual offenses are a heterogenous population. Despite the heterogeneity in the phenomena, this chapter focuses on the perpetration of sexual offenses by male adolescents and adults with an emphasis on contact offending. The basis for this decision stems from the consistent finding that males represent the largest group of individuals who commit sexual offenses (e.g., Conroy & Cotter, 2017) and, as a result, much of the research literature has focused on males who perpetrate sexual offenses. Nonetheless, it is important to highlight that women commit sexual offenses, and this has been a focus of a distinct line of research (see Cortoni, 2018 for a summary of research on women who sexually offend).

In this chapter, we briefly summarize the frequency and prevalence of sexual offending. We then turn our attention to review major theoretical models that are broad in scope and are applicable to a wide range of people who commit sexual offenses. Following this, we review longitudinal research on sexual offending trajectories with a focus on prospective longitudinal research that has mainly followed youth who have committed sexual offenses. We conclude the review with a discussion of future research directions.

15.1 Prevalence and Trends of Sexual Offending Perpetration and Victimization

Establishing the prevalence of sexual victimization and offending behavior is inherently complex. Global meta-analytic data suggests that rates of childhood sexual abuse are higher in women (180 per 1000) compared with men (76 per 1000). Prevalence rates of childhood sexual abuse have been found to vary by geographic region (Stoltenborgh et al., 2011). For example, rates of self-reported childhood sexual abuse are higher in the United States and Canada compared with European countries. Rates of victimization among adults also vary. For example, within a stratified random sample within the United States, 22% of women and 3.8% of men report experiencing sexual assault during adulthood (Elliott et al., 2004). In Germany, prevalence estimates of sexual assault within the preceding 12 months were estimated at 1% of the population and 1.2% reported having engaged in sexually violent behavior (Allroggen et al., 2016).

Although data from governmental agencies and academic literature can help us to better understand the prevalence of sexual offending, sexual assault is vastly underreported (e.g., Brennan & Taylor-Butts, 2008; McGregor et al., 2000; Morgan & Kena, 2018; Sinha, 2013). For example, self-report victimization data suggests that only 5% of sexual assaults are reported to police (Allen, 2018). Notably, the development of the #MeToo movement has contributed to a significant increase in the number of sexual assaults reported to police and a decrease in the amount of time between the occurrence of the assault and police involvement (Rotenberg & Cotter, 2018). Although research suggests an increase in reporting rates, it is important to highlight that this may not reflect actual changes in prevalence rates. We argue that it

is likely that prevalence rates would be unaffected, perhaps even decreasing, because of the shift in societal discussion that emphasizes that sexual violence is unacceptable. There is a need for additional research on the impact of social movements, like #MeToo, on both reporting rates and victimization.

There are several well-established trends on the incidence of sexual offending. First, most perpetrators of sexual offenses are male (e.g., 94% reported in Conroy & Cotter, 2017). Nonetheless, meta-analytic data suggests that police reported sexual victimization perpetrated by women are much lower (2.2% of sexual offenses perpetrated by females based on police data) than data from victimization surveys (11.6% of sexual offenses perpetrated by females; Cortoni et al., 2017). Although young women have higher rates of victimization (e.g., Elliott et al., 2004), individuals who are transgender are more likely to experience sexual assault compared to cis-gendered individuals from the LGBQ community (Langenderfer-Magruder et al., 2016). Second, people are at the greatest risk of being victimized by those who are known to them (e.g., family members, acquaintances) compared with a stranger (e.g., Buzi et al., 2002; Conroy & Cotter, 2017; Ogrodnik, 2010; Snyder, 2000). Lastly, children and youth are overrepresented as victims. For example, 61% of individuals were under 18 years old when they were victimized and the rates were highest for females between 11 and 19 years old and males 3 and 14 years old when examining police data (Kong et al., 2003).

Age is a robust determinant of sexual offending perpetration. In a prospective study of all individuals born in the Netherlands in 1984, the rate of sexual offending among adolescents was 0.4% and 0.6% for adults (Lussier & Blokland, 2014). Overall, sexual offending perpetration peaks during adolescence and early adulthood (Brennan & Taylor-Butts, 2008; Conroy & Cotter, 2017; Lussier & Blokland, 2014; Piquero et al., 2012). The strong presence of sexual assault on campus further parallels these findings (e.g., Demers et al., 2018; Martin-Storey et al., 2018). The peak in sexual offending during adolescence is consistent with the onset of puberty, transitioning to high school, and an uptake in impulsive behavior (Lussier, 2017). Additionally, the combination of formidable experiences with sexual drive (i.e., pubertal onset) and continued exposure to same-aged or younger peers (e.g., school, extra-curricular activities, siblings) offers many occasions for possibly engaging in inappropriate sexual behavior (Glasgow et al., 1994). Although there may be only slight age differences between those who perpetrate sexual offending and those victimized (Conroy & Cotter, 2017), these discrepancies could be significant with respect to the significant developmental changes during adolescence, both of which are likely influential in sexual offending behavior (Glasgow et al., 1994).

15.2 Theoretical Models of Sexual Offending

Research on prevalence and trends is important to better conceptualize general trends in sexual offending, but theoretical models are important in informing our understanding of the development of sexual offending so we can adequately respond

to and prevent its occurrence. Previous research on sexual offending focused on single-factor theories (Ward et al., 2006); however, it is currently understood that sexual offending requires a multifactorial explanation (Ward & Hudson, 1998; Ward, 2014). In this chapter, we review theoretical models that emphasize developmental factors, are multifactorial, or those that can be applied to a wide range of sexual offending behavior (e.g., offending against children and adults). Our review of theory is non-exhaustive, and for a more fulsome review, readers are directed to the comprehensive text on theoretical models of sexual offending (Ward et al., 2006).

15.2.1 Marshall and Barbaree's Integrated Theory

Marshall and Barbaree (1990) developed an integrated theory of sexual offending that has been used to explain a wide range of sexual offending behavior and incorporates learning experiences, biological factors, and situational factors into a comprehensive multifactorial model. Briefly, the theory argues that biological vulnerabilities combine with adverse childhood experiences and situational factors to influence the development of sexual offending. These vulnerabilities and environmental factors result in difficulties forming relationships during adolescence and problems differentiating between aggressive and sexual urges, which results in a fusion between sex and aggression (Ward et al., 2006).

15.2.1.1 Learning Experiences

Marshall and Barbaree (1990) focus on the role of vulnerability in sexual offending. They argue that vulnerability exists on a dimension from extreme vulnerability to resilience to any inclination to sexually offend (Ward, 2002). According to Marshall and Barbaree (1990), the development of vulnerability is most critical during childhood, as it is during these years that children develop interpersonal skills that allow them to achieve key developmental milestones during adolescence, including the formation of relationships. Most notably, there is a significant emphasis on attachment style in this theory with a focus on insecure attachments that results in a host of problems (e.g., difficulty with problem solving; Ward, 2002).

Vulnerabilities are further exacerbated by adverse childhood experiences. For example, people who commit sexual offenses and have experienced childhood sexual abuse may normalize the abuse and subsequently develop offense-supportive attitudes (e.g., children benefit from sexual activity with adults) that condone sexual offending (Marshall & Barbaree, 1990). Similarly, exposure to antisocial behavior in the home may result in the child emulating this behavior. Together, inappropriate early experiences may later result in the integration of sexual impulses and aggression (Marshall & Barbaree, 1990).

15.2.1.2 Biological Factors

Early vulnerabilities are expressed during adolescence due to the onset of puberty, which results in an increase in sex hormones and the formation of sexual attitudes and behavior (Marshall & Barbaree, 1990). According to this integrated theory, if adolescents did not learn social and self-regulation skills during childhood, they struggle to develop healthy sexual relationships and resort to inappropriate sexual behavior (Marshall & Barbaree, 1990). Biological factors also play a role in the ability to discriminate between sexual impulses and aggression. Marshall and Barbaree argue that both sexual and aggressive impulses emerge from the same neural structures in the midbrain and the release of sex steroids produce the union of sexual impulses and aggression in men (Marshall & Barbaree, 1990). This fusion is hypothesized to result in the inability to regulate sexual behavior based on societal norms and to inhibit aggression during sexual encounters. Nonetheless, the integrated theory has been criticized for the lack of detail surrounding the process behind the fusion of sexual and aggressive impulses (Ward et al., 2006).

15.2.1.3 Situational Factors

This integrated model states that certain situational factors (e.g., substance use, access to victims) interact with individual vulnerabilities to increase risk of sexual offending (Marshall & Barbaree, 1990). For example, consuming alcohol does not typically lead to sexual offending, but in a vulnerable individual, alcohol, coupled with victim access, can assist with overcoming inhibitions regarding committing a sexual offense. According to Marshall and Barbaree, the higher the vulnerability, the less intense the situational factors need to be for a sexual offense to occur.

15.2.2 Ward and Beech's Integrated Theory

Ward and Beech (2006) developed their own integrated theory that incorporates factors from several theories and distinct levels of analysis. Ward and Beech include several key features in their integrated theory, including brain development, ecological factors, and neuropsychological functioning, which create clinical symptoms related to sexual offending.

Drawing from Marshall and Barbaree's (1990) model, Ward and Beech (2006) discuss the role of brain development and its role in producing vulnerability. Ward and Beech argue that evolutionary explanations are important in understanding sexual offending. Sexual selection may create specific vulnerabilities in men that increase the likelihood of sexual offending if men have difficulty attracting a partner. Additionally, genetic factors can create certain predispositions while learning experiences guide individuals in how they obtain their goal; inappropriate social

modeling at an early age can result in an individual sexually offending in the face of sexual urges (Ward & Beech, 2006). These behaviors can be further intensified by high levels of stress and sex hormones, which increase impulsivity and sexual preoccupation, respectively (Ward & Beech, 2006).

A second factor in Ward and Beech's (2006) integrated model is the individual's "ecological niche," or their sociocultural roles, and environmental factors. According to the integrated model, these factors can result in sexual offending, regardless of the presence of vulnerabilities. Nonetheless, psychological vulnerabilities increase the likelihood of a sexual offense depending on the environment, which is a distal risk factor (Ward & Beech, 2006). Proximal, or current, dimension of risk includes the individual's present environment, which can provide access to victims and trigger vulnerabilities that could result in sexual offending (Ward & Beech, 2006). In addition, unique circumstances, such as the individual having suffered from their own childhood sexual abuse may lead to psychological and sexual dysfunction and attempts to relive these experiences as a victim (Burton, 2003; Ward & Beech, 2006).

According to Ward and Beech (2006), biological and environmental factors impact the following systems of neuropsychological functioning: motivation/emotional functioning, action selection and control, and perceptions and memory. In relation to motivational/emotional functioning, individuals with deficits in this system may respond inappropriately to stressful events and respond with aggression. The action selection and control system is responsible for planning, implementation, evaluation, and controlling behavior and emotions (i.e., executive functioning; Ward & Beech, 2006). Disruption of this system can lead to problems with impulsivity, inhibition of negative emotions, and difficulty in problem solving (Ward & Beech, 2006). Lastly, disruptions within the perception and memory system can result in dysfunctional beliefs, maladaptive attitudes, and the inability to correctly interpret social situations, which may lead to sexual offending. Impairments in these symptoms manifest in clinical symptomatology, which is related to sexual offending and is the fourth factor of this integrated model.

According to Ward and Beech (2006), clinical symptomatology includes emotional problems, social issues, cognitive distortions, and atypical sexual interests. The first clinical symptom is emotional and behavior regulation problems, resulting in impulsivity and emotional or behavioral outbursts. These symptoms stem from disruptions within the motivation/emotional system and the action selection and control system. In situations where an individual is experiencing stress, their inability to control their emotions and/or behaviors may lead them to use sex as a coping mechanism, especially if they associate sex with emotional well-being (Ward & Beech, 2006). Secondly, Ward and Beech discuss social difficulties, which includes loneliness, low self-esteem, and feelings of inadequacy. Social difficulties are thought to be the result of disruptions within the motivation/emotional system and are related to insecure attachment styles, which is also a factor emphasized by Marshall and Barbaree (1990) in their integrated model. Thirdly, offense-supportive attitudes, which are often present in individuals who commit sex offenses, are ideas and/or attitudes that help the individual justify non-consensual sexual contact (Ward

& Beech, 2006). These attitudes are thought to be implicit and develop during childhood and are, therefore, linked to the perception and memory system (Ward & Beech 2006). The fourth clinical symptom associated with the integrated theory is atypical sexual interests and sexual preoccupation. Atypical sexual interests (i.e., paraphilias) are experiences of sexual arousal towards atypical objects, activities, and/or targets (American Psychiatric Association, 2013) and sexual preoccupation occurs when an individual's psychological functioning is dominated by sex (Mann et al., 2010). Ward and Beech (2006) hypothesized that dysfunction within all three systems can lead to atypical sexual interests and sexual preoccupation.

The final component of the model is the maintenance and escalation of clinical symptomatology. According to Ward and Beech (2006), the commission of a sexual offense worsens the previously discussed factors. For example, an individual may become further isolated after their offending which leads to an exacerbation of clinical symptomatology.

15.2.3 Seto's Motivation Facilitation Model

A more recent model of sexual offending is Seto's (2017) motivation facilitation model. Seto's model first highlights motivating factors that drive sexual offending behavior. The first motivating factor is represented by atypical sexual interests (i.e., paraphilias). According to Seto (2017), paraphilias of particular importance when considering sexual offending are pedophilia (sexual interest in prepubescent children), hebephilia (sexual interest in pubescent children), biastophilia (sexual interest in sexual coercion), non-consensual sexual sadism (sexual interest in the pain, suffering, or humiliation of others), exhibitionism (sexual interest in exposure of one's genitals to an unsuspecting person), and voyeurism (sexual interest in watching unsuspecting persons engaged in sexual activity or disrobing) (American Psychiatric Association, 2013). While not all individuals with paraphilias commit sexual offenses, there is evidence to suggest that these interests help explain sexual offending. For example, research has shown that males who commit sexual offenses present with higher rates of paraphilias than men who commit other types of criminal offenses (e.g., Seto, 2018; Seto & Lalumière, 2010).

Seto (2017) suggests that a high sex drive may also serve as a motivational factor. High sex drive may be marked by sexual preoccupation, excessive viewing of pornography, excessive masturbation, and frequent casual sexual encounters without regard for one's physical, financial, or social well-being (Seto, 2017). Although a high sex drive may not necessarily lead to criminal behavior, in some individuals, a high sex drive could enable one to overcome inhibitions they would normally have for sexual coercion or having sexual contact with a child (Seto, 2017).

The final motivating factor discussed by Seto (2017) is intense mating effort, which is the energy that an individual invests in acquiring new mates and novel sexual experiences (e.g., new sexual partners). It is hypothesized that sexual offending is common in men with intense mating efforts as they have more exposure

to multiple partners, which increases the opportunity to offend (Seto, 2017). The role of intense mating effort is similar to the emphasis in other theories of sexual offending as a preference for impersonal sex, which has been supported in longitudinal studies as an important factor in sexual offending (e.g., the confluence model; Malamuth et al., 1995).

Motivational factors must be accompanied by facilitation factors that allow individuals to overcome any inhibitions they have towards acting on motivational factors (Seto, 2017). Seto distinguishes between trait and state facilitators. An example of a trait facilitator is impaired self-regulation, which can encompass impulsivity and recklessness (Seto, 2017). The role of self-regulation problems has also been emphasized in the two previously discussed integrated theories of sexual offending. An example of a state facilitator is substance use, which results in disinhibited behavior.

Seto's (2017) motivation facilitation model also includes situational factors, which present opportunities that allow individuals to commit sexual offenses. According to Seto (2017), some of these situational factors can include, but are not limited to, victim vulnerability and the presence of capable guardians. These situational factors are also emphasized in different criminological theories, such as rational choice theory, that have been shown to be important in understanding sexual offending (e.g., Beauregard & Leclerc, 2007). Despite most sexual abuse prevention programs targeting situational factors, more research needs to be conducted to determine which situational factors are most relevant to sexual offending (Seto, 2017).

15.3 Developmental Precursors of Sexual Offending

Although there has been a considerable amount of theory developed to explain sexual offending, there is more limited research on developmental precursors to sexual offending. The absence of strong longitudinal research is a significant gap in the literature, given many theories emphasize developmental factors. More recently, this has been changing with research studies informed by developmental and life-course criminology (DLC).

15.3.1 Developmental and Life-Course Criminology

DLC utilizes prospective research to identify risk and protective factors associated with the onset, maintenance, and desistance from criminal behavior across the lifespan (Farrington, 2003, 2007; McGee & Farrington, 2018; Thornberry, 2005). The DLC perspective takes a person-centered perspective to examine within-person changes in offending behavior. The person-centered perspective contrasts with most studies that examine inter-individual differences on key variables at a single point in

time (e.g., comparing those who commit sexual offenses with those who commit other types of criminal offenses on variables, such as sexual abuse history; Lussier, 2017). Given the focus on the development of offending behavior, DLC is uniquely positioned to inform discussion of early intervention and prevention programs that may divert people from engaging in criminal behavior (Farrington, 2007).

There are several distinct theories that have been developed within the DLC framework (for a review of the similarities and differences between different DLC theories, see McGee & Farrington, 2018). Perhaps one of the most significant DLC theories is Moffitt's dual taxonomy of life-course-persistent and adolescence-limited antisocial behavior (Moffitt, 1993, 2018; McGee & Farrington, 2018). Recently, Moffitt (2018) provided an excellent 30-year overview of the theory in conjunction with relevant research findings.

According to Moffitt (1993, 2018), there are two trajectories of criminal behavior. The first trajectory is the adolescence-limited offending trajectory where offending typically begins with pubertal onset and desistance occurs by young adulthood. This trajectory is believed to account for most offending committed by adolescents (Moffitt, 1993; Piquero & Brezina, 2001). Those who follow this trajectory engage in criminal behavior due to the maturity gap, which is the result of a disconnection between biological factors associated with puberty and the responsibilities that occur with adulthood. The maturity gap creates dissatisfaction that makes antisocial behavior appealing, which often occurs in the context of a delinquent peer group (Ferguson & Meehan, 2011; Moffitt, 2018). Rather than more serious or violent crimes, those on an adolescence-limited offending trajectory typically engage in rebellious behavior (e.g., underage drinking) or less serious criminal behavior (e.g., property crime; Hill et al., 2016; Moffitt, 1993; Piquero & Brezina, 2001). As they reach early adulthood and spend more time in adult roles, such as independent living, their offending decreases (Hill et al., 2016; Moffitt, 1993). Interestingly, Moffitt (2018) argues that some degree of antisocial behavior during adolescence is normative and that those who do not engage in antisocial behavior experience a range of negative outcomes (e.g., problems in social relationships).

The second trajectory is the life-course-persistent offending trajectory. These individuals display evidence of antisocial behavior at an early age (Boutwell et al., 2013; Moffitt, 1993). Moffitt (1993, 2018) suggests that those following the life-course persistent trajectory have neuropsychological variations (e.g., minor birth-related injuries) that are common in individuals with antisocial behavior (Moffitt & Henry, 1991) and are exacerbated by negative environmental factors (e.g., child maltreatment; Moffitt, 2018). These individuals miss key opportunities to learn about prosocial behaviors during childhood and the interaction between neuropsychological deficits and environmental factors further entrenches them into a chronic antisocial lifestyle (Moffitt, 2018). Those who follow a life-course-persistent trajectory account for a much smaller percentage of those who engage in antisocial behavior; however, they are responsible for an inordinate amount of serious crime (Moffitt, 2018). For example, life-course-persistent offenders represent 5% of those who commit offenses, but they commit an estimated 50% of all crime (DeLisi, 2001). In addition to criminal behavior, those who follow a life-course-persistent

trajectory are subject to a host of adverse outcomes, including increased risk for a wide range of diseases and early mortality (Moffitt, 2018).

Although Moffit's taxonomy has been influential, a significant issue is that different research groups have identified more than two trajectories (e.g., Livingstone et al., 2008; van der Geest et al., 2009; Ward et al., 2010). For example, McCuish et al. (2016) found four trajectories in their longitudinal examination of offending. Interestingly, youth who commit sexual offenses were not overrepresented among one of these trajectories and, as a result, were not marked by one specific offending trajectory.

15.3.2 DLC and Adolescents Who Sexually Offend

Although the examination of criminal trajectories has been quite informative, there have been few studies that have explicitly taken a DLC approach to sexual offending (Piquero et al., 2012). Research that takes a DLC approach to sexual offending is crucial because it has broad implications for management and policy decisions affecting those who commit sexual offenses (e.g., Lussier, 2017). For example, the DLC approach highlights that most youth do not persist in sexual offending, suggesting that policies that treat youth as if they will continue to offend in adulthood are misinformed (e.g., Lussier, 2017; Moffitt, 2018).

To date, studies utilizing a DLC approach have focused on sexual offending that emerges during adolescence (e.g., Lussier, 2017; Lussier et al., 2012; McCuish et al., 2016). In one of the few studies explicitly examining sexual offending trajectories, Lussier et al. (2012) identified distinct trajectories for sexual and non-sexual offending (e.g., assault, property offenses) in 498 adolescents (aged 12–32) who committed sexual offenses in the Netherlands. They found two distinct trajectory patterns for sexual offending. The adolescence-limited group represented 90% of the sample and these individuals peaked in their sexual offending behavior at the age of 14 years old and desisted rapidly towards the end of adolescence. Recidivism rates were 35% in adolescence and 2% in adulthood. If this group persisted with criminal offending into adulthood, it was generally confined to non-sexual offending. This group is similar in nature to the adolescence-limited group discussed by Moffitt (1993, 2018). In comparison, the high-rate slow desisters (10% of the sample) peaked in sexual offending behavior at age 12 and desistance occurred at a much slower rate and into adulthood. Recidivism rates in this group were 52% in adolescence and 63% in adulthood. Although this group eventually desisted, it occurred at a much slower rate due to the presence of multiple early risk factors for sexual offending and a proposed childhood-onset of sexual behavior problems (Lussier, 2017). Although childhood sexual behavior problems are discussed in the literature, it is important to emphasize that there is a lack of agreement about the best way to operationalize this construct, as well as a more limited understanding of what would be considered developmentally atypical and/or problematic (Lussier et al., 2018).

In contrast to their results for sexual offending, Lussier et al. (2012) found five trajectories of non-sexual offending in youth who committed sexual offenses. Notably, they found that 5% of their sample specialized in sexual offending, meaning that their offending was largely confined to sexual offenses. The presence of multiple trajectories for non-sexual offending is widely consistent with others that found multiple criminal trajectories in youth who commit criminal offenses (e.g., McCuish et al., 2016). Further, there was evidence of discordance between sexual and non-sexual offending trajectories. For example, the "high-rate persisters" group evidenced a chronic pattern of non-sexual offending; however, all of these youth followed the adolescence-limited sexual offending trajectory. Further, 92% of the "late starter" group (peaked in their non-sexual offending in their mid-20s) were members of the adolescence-limited sexual offending trajectory, despite committing relatively few non-sexual offenses as adolescents (Lussier et al., 2012).

The Lussier et al. (2012) study highlights that there is discontinuity between sexual offending in adolescence and adulthood (e.g., Lussier & Blokland, 2014; Piquero et al., 2012; Zimring et al., 2007, 2009). Another example of this discontinuity is a study by Piquero et al. (2012) who followed 411 boys from a blue-collar neighborhood in South London over a 50-year period. In their sample, 2% committed a sexual offense (four sexual offenses were committed by youth and six were committed by adults); however, none of the youth who sexually offended as adolescents sexually recidivated as adults. This is in comparison to the 43% of youth who evidenced continuity between adolescence and adulthood in non-sexual offending. A similar finding from a study of over 6000 American adolescents found that only four males across three birth cohorts had contact with police for sexual offending during both adolescence and young adulthood (Zimring et al., 2007).

Relatedly, Lussier & Blokland (2014) examined the continuity of sexual offending in a longitudinal sample of people born in the Netherlands. They found that 3% of their sample of youth demonstrated continuity in sexual offending into adulthood. Most notably, the rate of continuity quadrupled for individuals who sexually recidivated during adolescence (12% of these youth demonstrated continuity). Further, 91% of sexual offenses in adulthood were committed by individuals who had no history of sexual offending as adolescents. Although an adolescent sexual offense was predictive of continuity, chronic offending in youth (defined as incurring six criminal offenses during adolescence) was a stronger predictor of adult sexual offending. Together, these findings provide strong evidence for discontinuity in most youth who commit sexual offenses and that chronic offending in adolescence may be more predictive of continuity in sexual offending across the lifespan.

Although previous studies highlight that youth typically follow a pattern of discontinuity, this does not negate that some adolescents persist in sexual offending across distinct developmental periods. DLC research suggests that the rate of persistence range from 5 to 10% (Lussier & Blokland, 2014; Lussier et al., 2012). Although an exception to the norm, it is a crucial phenomenon that is important to better understand. Lussier and Blokland (2014) emphasize that this group recidivated in both a sexual and non-sexual manner as adults and displayed a high

rate of criminal versatility (i.e., committing a wide range of different types of offenses). As a group, these individuals may require specialized intervention that explicitly focuses on managing sexually aggressive behavior (Lussier & Blokland, 2014).

Lussier and Blokland (2014) also make the argument that persisters may have greater difficulty with sexual preoccupation, which may drive their offending behavior. This is significant as sexual preoccupation is one of the strongest predictors of sexual reoffending (Hanson & Morton-Bourgon, 2005; Mann et al., 2010). Further, sexual preoccupation has been proposed to exert a significant impact on victim selection, as some studies suggest these individuals offend against a much wider range of victims (e.g., children and adults; Olver & Kingston, 2019). In partial support of these findings, those men with low response discrimination during phallometric testing (measurement of sexual arousal patterns to sexual stimuli) were more likely to offend against a wide range of victims (i.e., both children and adults; Michaud & Proulx, 2009). We argue that it is possible that a subset of men who are persistent in their sexual offending have a wide range of sexual interests and a high degree of sexual preoccupation that manifests in persistent and versatile sexual offending behavior (e.g., offending against different victims). To date, this hypothesis has not been empirically tested, but should be the focus of future research.

15.3.3 Trajectories of Child Sexual Behavior Problems

A notable limitation of the DLC research is that virtually all studies have followed youth from the age in which they can incur criminal charges (e.g., age 12 years in Canada; Youth Criminal Justice Act, 2002). There are relatively few studies that have followed children from an earlier developmental period using longitudinal methods. This is a critical issue as Lussier (2017) estimated that approximately 5–26% of adolescents who commit sexual offenses have early childhood onset sexual behavior problems. Prior to discussing trajectories of children with sexual behavior problems, it is important to note that sexual behavior problems in children should not be criminalized or viewed as the same phenomena as sexual offending. Further, the difference between normative and non-normative sexual behavior in children is poorly understood (Lussier, 2017).

Recently, there has been prospective longitudinal research examining the psychosocial development of preschoolers with a subset of studies examining sexual behavior. A notable strength of these studies is that they are comprised of a diverse group of children from clinical samples who exhibit externalizing problems, an at-risk sample comprised of children from neighborhoods that experience significant deprivation, and a community comparison group (e.g., Lussier & Healey, 2010). Early results from these studies suggest a high co-occurrence of sexual behavior and externalizing problems in preschoolers, with boys from low-income families more likely to show co-occurrence (Lussier & Healey, 2010). Further, preschoolers with

exposure to intimate partner sexual violence exhibited a higher rate of sexually intrusive behaviors (i.e., sexual behavior that could cause harm, such as sexual touching of other children) compared with children not exposed to intimate partner sexual violence (Cale & Lussier, 2017). The finding on the co-occurrence of sexually intrusive behaviors and externalizing problems is consistent with a recent longitudinal study of children referred to protective services because of sexual behavior problems. Sexual behavior problems that emerged in childhood were associated with the greatest number of child welfare referrals and the highest number of adverse experience (Lussier et al., 2019).

Using the same definition of sexually intrusive behavior as detailed above, Lussier et al. (2018) conducted the first longitudinal study of sexually intrusive behaviors in children between ages three and eight. Prior to describing the different developmental trajectories, it is important to note that sexually intrusive behavior was not uncommon in preschoolers. In the sample, 94% of children engaged in one of the sexually intrusive behaviors with some of these behaviors being less common than others. For example, in preschoolers (3–5 years), attempting to watch others undress or others who were naked was quite common (52%), whereas attempting to have oral sex or sexual intercourse with others was quite uncommon (0.9%). Overall, sexually intrusive behavior was more common in preschoolers than elementary school children (6–8 years). These findings highlight the importance of being careful to not pathologize sexually intrusive behavior in children and to gain a better understanding of typical and atypical sexual behavior in children.

In their study, Lussier et al. (2018) found four trajectories of sexually intrusive behaviors in young children. The first trajectory represented 11% of the sample who exhibited a very low base rate of sexually intrusive behaviors across the study period. Similarly, the second trajectory (28%) showed a low and declining trajectory, where sexually intrusive behaviors peak at age five and by age eight appeared similar to the very low base rate trajectory. Two other trajectories were found that exhibited a greater degree of sexually intrusive behaviors. In the moderate stable trajectory (48%), children engaged in a higher degree of sexually intrusive behavior as preschoolers and continued to engage in a moderate degree of sexually intrusive behavior during elementary school. Lastly, the high rate increasing trajectory (13%) had the highest rate of sexually intrusive behavior across the study period and there was an increasing rate of sexually intrusive behaviors from preschool to age 8. Interestingly, few individual, family, or environmental factors differentiated the four groups.

Although Lussier et al. (2018) were unable to examine the continuity of sexually intrusive behaviors from childhood to adolescence, they will likely be able to examine this in the future. For example, it is possible that children in the high-rate increasing trajectory are more likely to commit sexual offenses during adolescence. The examination of continuity across the entire lifespan is theoretically important as Lussier (2017) argue that the high-rate slow-desisters are more likely to exhibit sexual behavior problems as children. The identification of these children at earlier stages of development is crucial, as it is possible that comprehensive intervention programming may divert them off this problematic trajectory.

15.4 Future Research Directions

There has been significant progress in the development of multifactorial theoretical models and improvements in our understanding of sexual offending from a lifespan perspective. Despite these developments, there are many potentially fruitful avenues that should be explored in future studies that are directly related to these advancements.

15.4.1 Testing of Theoretical Models

There has been more limited attention to testing different theoretical models of sexual offending (Ward, 2014). Although there are some models that have been the focus of extensive research (e.g., the confluence model of sexual aggression; Malamuth et al., 1995), this appears to represent an exception. The development and testing of theoretical models have lagged behind applied issues, such as risk assessment. There is a clear need for a greater focus on testing different theoretical models of sexual offending (Ward, 2014). Conducting strong empirical studies of theoretical models is difficult, especially given that many theories emphasize developmental factors that would require prospective longitudinal studies to provide strong tests of the theories. Given the increasing number of studies that utilize prospective longitudinal designs, we may be able to examine the longitudinal sequence of different etiological factors in sexual offending in the future. Nonetheless, short-term longitudinal studies can still provide some clarity, as we can examine the impact of proposed causal factors on the onset of sexual offending behavior. An example of this is a recent short-wave longitudinal study in a community sample that found a small association between offense-supportive attitudes at time one and sexual aggression at time two (Hermann & Nunes, 2018).

15.4.2 Early Intervention and Prevention

Perhaps one of the most exciting developments in the field is the greater emphasis on early intervention and prevention prior to the occurrence of a sexual offense. An example of a preventative treatment program is the Prevention Project Dunkelfeld (PPD; see Beier et al., 2009). The PPD is an innovative program developed in Germany that provides comprehensive assessment and treatment to individuals with pedohebephilia (enduring sexual interest in prepubescent and/or pubescent children) who are not currently involved in the legal system (Beier et al., 2009, 2015). In the program, approximately 75% have a history of offending (mostly undetected) and 25% have never offended (Beier et al., 2009). The program provides a 12-month group-based treatment program largely predicated on Cognitive-Behavioral Therapy

principles (Beier et al., 2015). The program also provides additional treatment, such as couples therapy and sex drive reducing medication (Beier et al., 2009).

Recent research on the PPD has provided evidence for within-individual change on several risk factors associated with contact sexual offending (Beier et al., 2015; Engel et al., 2018). Although Beier et al. (2015) included a non-matched control group who did not receive the intervention, they did not examine the crucial treatment group and time interaction (Mokros & Banse, 2019). Mokros and Banse (2019) found that an examination of that interaction produced a median effect size (Morris D) of 0.30; however, all confidence intervals included zero suggesting that there was not a significant effect of treatment on clinical change. Mokros and Banse argued that future studies should utilize stronger research designs that are adequately powered to examine treatment effects and until then caution is needed in interpreting the positive findings from the initial study.

There is clearly a need for rigorous evaluations of prevention programming. Further, projects like the PPD focus on a subgroup of individuals with sexual interest in children. Although sexual interest in children is a robust predictor of sexual recidivism in samples of men who have committed sexual offenses (Hanson & Morton-Bourgon, 2005), approximately 40–50% of individuals who offend against children do not have a sexual interest in children (e.g., Seto, 2018). Further, through our own research we are aware that some individuals with sexual interest in children argue that the overt focus on prevention in these programs, as opposed to a focus on general mental health, increases stigma towards people with sexual interest in children. Additionally, programs that provide services to those who are at-risk of offending against adults are also needed. Together, future prevention programs may want to target those who have other risk factors of sexual offending. For example, antisociality is another key dimension that may help explain why individuals who do not report having sexual interest in children sometimes nevertheless commit sexual offenses against children (Hanson & Morton-Bourgon, 2005; Seto, 2018). As a result, a focus on sexual boundaries may be worth including in programming for individuals who have committed non-sexual offenses.

Lastly, the DLC approach provides a strong impetus for future research that takes a lifespan approach to examine risk and protective factors for sexual offending. It is possible that children or youth can be identified early on, optimally before they engage in developmentally inappropriate sexually intrusive behavior and provided with comprehensive assessment and treatment services. Nonetheless, additional work is required to further understand what types of sexually intrusive behaviors may be problematic and atypical. Based on the research from Lussier et al. (2018), children who are referred to child protective services for multiple instances of victimization may be an important population to receive preventative treatment.

15.5 Conclusion

In conclusion, sexual offending is a heterogenous phenomenon and there is no single profile that best describes a prototypical case of someone who has committed a sexual offense. Despite the heterogeneity, researchers have proposed several multifactorial theoretical models that help us better understand the onset and persistence of sexual offending. In this chapter, we focused on reviewing theoretical models that are broad and best capture the heterogeneity of sexual offending in that they are applicable to a wide range of offending behavior. Nonetheless, our review of these theoretical models is not exhaustive, and it is acknowledged that there is a need for well-designed empirical studies to test different models, which should be the focus of future research.

In addition to theoretical models, there has been an increased focus in recent years on trajectories of sexual offending informed by the DLC perspective, with most research focusing on youth and young adults. These studies provide greater insight into the onset, maintenance, and desistance from sexual offending and allow for stronger tests of different theoretical models that often emphasize etiological factors associated with the onset of sexual offending. This research has the potential to inform strong early intervention and prevention programs that should be subject to rigorous empirical research testing their efficacy in future research.

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Chapter 16
Learned but Not Chosen: A Reward Competition Feedback Model for the Origins of Sexual Preferences and Orientations

Adam Safron and Victoria Klimaj

Abstract Is sexual orientation an evolutionary adaptation or social construct? With respect to sexual preferences, to what extent are we "born that way" and to what extent does learning matter? This chapter discusses how nature and nurture may interact to shape sexual motivation by reviewing existing literature on sexual preferences and orientations, as well as by considering sex/gender differences in erotic plasticity, sexual fluidity, and the specificity of sexual arousal. We describe how these phenomena might be accounted for by processes in which mind-body feedback loops amplify some sexual responses over others on multiple levels, which we refer to as the Reward Competition Feedback (RCF) model. With respect to sex/gender differences, we describe how these positive feedback processes might be amplified in men compared with women, potentially substantially driven by differences in the constraints and affordances of female and male anatomy. More specifically, we argue that the well-known female-male difference in the concordance of genital and subjective arousal may contribute to well-known differences in sexual specificity and plasticity/fluidity. We further provide convergent support for RCF by reviewing preexisting theories of sexual learning. Finally, we consider some of the ethical implications of models in which sexual orientation might be shaped by experiences over the course of development.

Keywords Sexual preference · Sexual orientation · Sex · Gender · Development · Learning

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16.1 Sexual Motivation: Nature and Nurture

Evolutionarily speaking, one would predict that most women would prefer to have sex with men, and most men would prefer to have sex with women. Though the underlying mechanisms remain unclear, this is precisely what is observed: most individuals report primarily heterosexual orientations, but a substantial minority of individuals also report homosexual and bisexual attractions and orientations (Chandra et al., 2011; Santtila et al., 2008). Although the term sexual orientation is sometimes used to indicate individuals' self-defined sexual identities, *sexual orientation* is herein defined as an *enduring pattern of sexual desire, which is often (but not necessarily) motivated by sexual arousal* (Bailey, 2009; Diamond, 2003a; Laumann et al., 1994; Reiter, 1989). S*exual preference*, in contrast, is defined as *motivation for particular types of sexual experiences,* regardless of whether this motivation is driven by sexual desire, and irrespective of duration or stability. In this view, sexual orientation can be viewed as a special case of sexual preference, and the potential origins of both these phenomena will be explored within this chapter.

Many attempts have been made to explain the origins of these phenomena, as well as the variability found within and between individuals and cultures (Lippa, 2005, 2009). The primary difference between these models is the degree to which they emphasize learned or innately predetermined factors. From the *nativist* perspective (Pinker, 2002) that has been historically characteristic of the fields of ethology and biology, most animals are genetically programmed to be attracted to features of the opposite sex, and humans are no exception. From the *empiricist* perspective that has been historically characteristic of the fields of sociology and cultural anthropology—i.e., the "standard social science model" (Wright, 1995)—all humans are born with an unbound capacity for experiencing sexual pleasure, but are shaped to have different patterns of attraction and aversion on the basis of their different social roles and personal histories. Debate continues regarding the extent to which innate and learned factors shape human sexuality (Vasey & Lalumière, 2012).

To the extent that sexuality is influenced by evolution, adaptations are thought to depend on the relative "feminizing" and "masculinizing" effects of hormones on the developing brain (LeVay, 2010; Savic et al., 2010; Swaab, 2008). More specifically, hormones are believed to be necessary mediators for shaping nervous systems to respond in particular ways towards physical and behavioral characteristics typical of male and female organisms (Conway et al., 2010; Viveros et al., 2012). According to this model, non-heterosexual attraction results from these processes of developmental masculinization and feminization proceeding in ways that are sex-"atypical" (Muscarella, 2002; Muscarella et al., 2004; Paus, 2010).

Although genetic effects on sexuality have been observed, among identical twins where at least one sibling reports homosexual preferences, the probability of the other sibling reporting homosexuality has consistently been estimated as less than 50% (Bailey et al., 2000a; Bailey & Pillard, 1991; Burri et al., 2011; Hu et al., 1995; Mustanski et al., 2005; Rice et al., 1999). This limited heritability demonstrates that orientation cannot be completely determined by genetic factors. Rather,

developmental programs may be genetically specified, but the underlying processes could be altered by a variety of environmental factors (e.g., hormonal and immunological), especially prenatally (Blanchard et al., 2006; Blanchard, 2008; Lalumière et al., 2000). In this way, there can be innate influences on sexuality that are biologically determined without being genetically specified.

Alternatively, the intensely pleasurable nature of sexual activity implies that reward learning can have profound impacts on sexuality (Hoffmann & Safron, 2012). Indeed, some have argued that classical and operant conditioning may be the central means by which adult sexual preferences are established in humans as well as other species (Coria-Avila, 2012; Hoffmann, 2012, 2017; Pfaus et al., 2012; Woodson, 2012; Wunsch, 2010). These proposals have been generally dismissed on the grounds that reproduction is central to evolutionary fitness, and so natural selection must have evolved specific and robust mechanisms for ensuring adaptive (i.e., reproductive) behavior.

However, experience-focused models are increasingly plausible as general learning processes are discovered to be more powerful than previously recognized (Flusberg et al., 2010; Gentner, 2010; Lakoff & Johnson, 1999; Pezzulo et al., 2011; Tenenbaum et al., 2011; Tomasello, 2001). In these empiricist accounts, organisms learn complex world models through experience, rather than merely tracking "simple" correlations between stimuli, actions, and outcomes. By utilizing these learned models, organisms are capable of maximizing evolutionary fitness more effectively than would be the case if they relied upon genetically determined responses. Indeed, learning processes may be capable of explaining evidence commonly interpreted as supporting innate neural mechanisms. For example, an aspect of psychology can be nearly universally observed in humans because of convergent learning on the levels of individuals and cultures (Bell, 2010; Bell et al., 2009; Laland, 2008). Or, a phenomenon could be observed in very young children and still result from learning that occurs shortly after birth (Gómez & Gerken, 2000), or even prenatally (DeCasper et al., 1994; Mehler et al., 1988). Even for behaviors as fundamental to survival as drinking or eating, experience is required for newborn rats to learn the association between approaching water and obtaining hydration when thirsty, or between approaching food and obtaining nutrition when hungry (Changizi et al., 2002; Hall et al., 2000).

Although learning may play a surprisingly powerful role in shaping sexuality, potential innate shaping is suggested by intriguing correlations between sexual preferences and sexually differentiated brain structures (Berglund et al., 2006; Byne et al., 2000, 2001; Kinnunen et al., 2004; Safron et al., 2007; Savic et al., 2005, 2010; Savic & Lindström, 2008; Swaab, 2008). For example, inspired by work in which male rodents exhibited female-typical sexual behavior (e.g., lordotic back arching to expose the anogenital region) with disruption of prenatal hormonal surges, LeVay (1991) conducted postmortem analyses of the brains of homosexual men compared with heterosexual men and women. The third interstitial nucleus of the anterior hypothalamus (INAH-3) was approximately twice as large in heterosexual men than it was in heterosexual women and homosexual men. A later study replicated the gender differences in INAH-3, but only found a nonsignificant trend

for smaller volumes in homosexual men, with no differences in the number of neurons (Byne et al., 2000, 2001). Additionally, Garcia-Falgueras and Swaab (2008) found that the INAH-3 volume of male-to-female transexuals was similar to control females. Perhaps most compellingly, female-typical characteristics of preoptic/anterior hypothalamic nuclei have been found to correspond with male rams exclusively mounting other males (Roselli & Stormshak, 2009a, 2009b). However, it is difficult to know how to reconcile this homosexual mounting behavior with the "feminized" behavior observed in the rodent literature. These neurological differences remain poorly understood, particularly the means by which they impact behavior. Theoretically, genetically and hormonally differentiated neural systems may indirectly influence what developing organisms learn as they interact with their environments. That is, evolved developmental programs may produce more or less female-typical or male-typical response patterns via modulating factors that are causally upstream, such as pain sensitivity or thresholds for psychomotor activity (Chakrabarti et al., 2010; Dewing et al., 2006). However, these differences could also result from brain plasticity—the brain's ability to change itself through experience—rather than being caused by organizational effects of sex hormones (Doidge, 2007; Remedios et al., 2017).

This theoretical review attempts to account for factors contributing to the development of orientations, with the overall goal of parsimoniously integrating findings from sexology with models emphasizing reward learning. To this end, this chapter is divided into three main sections. First, we review existing literature on sexual preferences and orientations, describing gender differences in the specificity and flexibility of sexual responses, as well as their potential functional significances. Then, we attempt to account for these sex/gender differences in orienting by providing an integrative model in which a variety of feedback processes contribute to the amplification of particular patterns of desire on multiple levels. Finally, after laying out a proposal for the reward-driven shaping of sexuality, we describe how convergent support for these models may be found in independently developed theories for the origins of sexual preferences and orientations.

16.2 Sexual Preferences and Orientations

16.2.1 Gender Differences in Erotic Plasticity

Baumeister (2000) controversially proposed that women are more malleable than men in terms of the effects of sociocultural and situational factors on sexuality. Three lines of evidence were presented in support of this model of greater female erotic plasticity:

1. Women show larger effects of social and cultural factors on sexual attitudes, desire, and behavior.

2. Sexual attitude-behavior consistency is lower in women than in men.
3. Women exhibit more intra-individual variability in sexual behavior.

A variety of non-mutually exclusive explanations were suggested for the origins of these gender differences. First, Baumeister suggested that men have had greater power than women throughout history, with some of this dominance continuing into the present day; on account of this power differential, men were able to influence women by encouraging a more flexible sexual response. Second, he speculated that change is an inherent part of the female role in sex in that when sex happens, it is usually because "the woman has changed her vote from no to yes" (Baumeister, 2000, p. 367). While one could argue that it is just as necessary for men to be able to transition from no to yes, men (on average) seem more likely to have a default response of "yes" (Bailey et al., 1994, 2000b; Buss & Schmitt, 1993; Gangestad & Simpson, 2000; Symons, 1981). Finally, he argued that women have a weaker sex drive than men, and as such, it should be easier to transform desire if the initial configuration is less strongly directed. This last proposition was supported by evidence from gender differences in self-reported spontaneous thoughts about sex, frequency and variety of fantasies, desired frequency of intercourse, desired number of partners, masturbation, liking for various sexual practices, willingness to forego sex, initiating versus refusing sex, making sacrifices for sex, and other measures (Baumeister et al., 2001). However, he further noted that this gender difference should not be generalized to other constructs such as sexual capacity, enjoyment, or extrinsic motivation.

Baumeister's proposal was controversial when it was first introduced (Andersen et al., 2000), and would likely be even more controversial if it were openly discussed today. A substantial proportion of such controversies may arise from failures to distinguish between descriptive and normative statements. That is, just because a sex/gender difference is observed (on average), that in no way speaks to the desirability of associated behaviors. Ethical considerations notwithstanding, while researchers have provided alternative explanations for these phenomena as well as opposing results (Benuto & Meana, 2008; Hyde, 2005; Hyde & Durik, 2000; Petersen & Hyde, 2010), the overall volume of findings suggests a substantial gender difference in sexual flexibility, with men exhibiting relatively less plasticity compared with women (Beckstead, 2012; Kinnish et al., 2005; Savin-Williams et al., 2012; Vrangalova & Savin-Williams, 2012).

16.2.2 Sexual Fluidity: The Dynamic Systems Perspective

In considering these gender differences in erotic plasticity, Diamond's (2008b) seminal research provided a particularly rich source of data by collecting detailed interviews over extended periods of time. In a prospective study involving 89 women with same-sex attractions, a surprising amount of "sexual fluidity" was observed with respect to partner choices, feelings, and identities (Diamond, 1998,

2003b, 2008a). Two thirds of women changed identity labels at least once during a 10-year period, with one third changing labels two or more times, and with the most commonly adopted identity being "unlabeled." Notably, although unlabeled and bisexual women exhibited greater variability than did homosexual women, these identities did not represent a "transitional stage" on the way to homosexuality or heterosexuality. More women adopted bisexual and unlabeled identities than relinquished them, and very few women ultimately identified monosexually. Furthermore, all of these non-heterosexual women reported an increased ratio of other-sex to same-sex behavior over time, suggesting a potential continuity between female homosexuality and bisexuality. Although one could question the representativeness of this sample for heterosexually identified women (Mock & Eibach, 2012), these findings provide additional support for the hypothesis that sexual motivation may be more complexly determined (on average) in women than in men (Carvalheira et al., 2010; Carvalho & Nobre, 2010, 2011; Rupp & Wallen, 2008).

Based on this evidence, Diamond (2007, 2012) argues that a dynamical systems approach is necessary for conceptualizing the development, expressions, and transformations of female same-sex sexuality over life courses. In her longitudinal research, women exhibited discontinuities in attractions, behaviors, and identities, characterized by abrupt emergence of novel erotic feelings and experiences in specific contexts, as well as periodic episodes of reorganization in sexual self-concept. Diamond contends that these observations are best explained using dynamical systems models, which emphasize nonlinearly changing, bidirectional person-environment interactions. From this perspective, the sexual identity transformations experienced by these women would correspond to "phase shifts" in which old patterns of interactions break down and a system fundamentally reorganizes.

According to Diamond (2012), in contrast to the regularity suggested by "essentialist, organismic" (p. 78) models of sexual orientation, the dynamical approach anticipates that developmental pathways will be complexly determined through interactive processes, and thus are necessarily idiosyncratic. More specifically, situations and patterns of interaction influencing sexual identities change over time, as experiences shape patterns of behavior that shape further experiences. Further, dynamical systems exhibit "equifinality" in that similar outcomes (in this case, sexual identities) can be achieved through different routes, as well as "multifinality" in that radically different developmental trajectories can emerge from similar initial conditions, depending on unique aspects of life histories. Despite this inherent variability, Diamond (2012) clarifies that stability in identities may "reliably [emerge] as new patterns of thought and behavior are repeated and reinforced via internal feedback mechanisms" (p. 78). While this emergent stability of sexual identities is necessarily dynamic with respect to changing contexts, she notes that some patterns are more or less prone to reorganization in response to internal or external events. The relative stability or instability of an aspect of sexuality is determined by the precise configurations of parameters that influence the person as a system, such as biological predispositions, early sexual experiences, sex drive, cultural norms, or other factors. However, when a parameter or

combination of parameters varies outside of typical ranges, it may trigger the sort of nonlinear "phase shifts" observed in the sexualities of non-heterosexual women.

Diamond suggests that the relative variability of sexual identities can be modeled in terms of the influences on the development of "chaotic attractors." She defines these attractors as "coordinated patterns of thought and behavior that tend to "pull" subsequent thoughts and behaviors towards them, producing consistency and regularity in experience over time" (Diamond, 2007, p. 155). In a particularly informative visualization, she describes a metaphor in which rivulets of water gradually carve out a ditch through a flower garden with each rainfall; water running into a shallow ditch might easily run out again, but water is less likely to escape from deep ditches. While a broad ditch might capture raindrops from far away in the garden, narrow ditches will only capture raindrops that fall immediately around it. With respect to these attractors, breadth determines the range of influence, and depth determines the degree of "attractive force." She goes on to describe how heterosexuality could be represented by having a strong other-sex attractor, but a same-sex attractor "so weak as to be potentially nonexistent" (Diamond, 2007, p. 156). However, she also notes that attractors can have different "basins" that vary as a function of biological and cultural factors, as well as idiosyncratic sexual histories of opportunities and experiences. Diamond also defines "degree of fluidity" as the capacity to respond to different opportunities once available. All these factors might influence an individual with a predominantly heterosexual attractor to develop a "competing same-sex attractor." For example, periodic same-sex intimate contact could result in a single emotional bond, but this desire for homosexual intimate contact may not generalize to individuals outside of that particular connection. In this case, those experiences "triggered the initial formation of a same sex-attractor, albeit a shallow and narrow one" (Diamond, 2007, p. 156). If this bond persists over time or results in the woman being more open to homosexual relationships, then "the same-sex attractor can be expected to grow deeper and broader, making it progressively more likely that she will pursue such relationships in the future" (Diamond, 2007, p. 156). Alternatively, Diamond describes "broad but shallow" attractors, corresponding to desire being stimulated by a wide range of experiences, but only weakly and "readily displaced by competing other-sex attractions and relationships" (Diamond, 2007, p. 156).

Diamond (2007, 2012) further proposes a research program for defining and characterizing the multiple parameters influencing variations in women's same-sex and other-sex sexualities. Although nondeterministic, these models could yield "probabilistic predictions about conditions promoting stability and change" in sexual attraction, behavior, and identity (Diamond, 2007, p. 156). By analyzing sexual variability in these terms, it may be possible to systematically account for coexisting biological, cultural, and situational influences, as well as for additional complexities such as the fact that shifts can take place suddenly and unpredictably, and can be precipitated by a variety of factors over extended periods of time. (Hypothetically, support for these kinds of dynamical system views may potentially be evidenced if changes in patterns of attraction are predicted by the widespread phenomenon of "critical slowing" (Carhart-Harris & Friston, 2019; Friston et al., 2012), in which

systems with attracting states at boundaries between modes of organization show longer periods of time in returning to equilibrium after perturbations.)

Although Diamond focuses on female sexuality, this sort of ecological thinking can be applied to many psychobiological phenomena. Thus, to the extent that there are average differences in sexuality between women and men, they may arise from different manifestations of fundamentally similar processes. More specifically, both women and men's preferences can be modeled as attractor networks, but different configurations of parameters may influence dynamics in different groups of individuals. The greater the number and variety of attractors that influence sexual dynamics—rather than systems being dominated by fewer, deeper attractor basins—the more likely it is that nonlinear patterns will result, as Diamond (1998, 2003b, 2008a) observed in non-heterosexual women. In this way, although all biological systems are dynamical, qualitatively different emergent properties might characterize female and male sexuality. While this manuscript particularly focuses on Diamond's work as illustrating the ways that sexuality can dynamically change over time, for interested readers, we also recommend Fausto-Sterling's (2019) embodied dynamic systems perspective as being particularly emblematic of the kind of thinking that motivates this chapter.

16.2.3 Sexual Arousal, Preferences, and Orientations

Bailey (2009) has offered an additional explanation for gender differences in erotic plasticity and sexual fluidity; namely, he argues that orientation is best conceived of as a sexual arousal pattern capable of driving behavior, and that this mechanism may be present in most men, but not most women. Thus, female sexuality could be particularly changeable because of the absence of specifically directional sexual desire, which should be distinguished from the proposal of an attenuated sex drive described above (Baumeister, 2000; Baumeister et al., 2001). In claiming that sexual orientation is a sexual arousal pattern, Bailey (2009) distinguishes orientation from other phenomena such as behavior patterns, private identities, public identities, and preferences. These other aspects of sexuality do not necessarily match each other, and preferences are distinct from orientation in that a person may prefer to have sex with people who they do not find sexually desirable. Unlike sexual orientation, these other factors are considered to be malleable, potentially complexly determined, and not necessarily driven by feelings of desire that are specifically sexual in nature. Orientation is commonly described in terms of desire, fantasy, and attraction, but physiological arousal is the only aspect that can be directly measured independent of self-report.

Although it may seem as if this conceptualization of orientation in terms of arousal is methodologically motivated, Bailey (2009) argues for this operationalization on theoretical grounds. That is, he views sexual orientation as an evolutionary adaptation for ensuring reproductive fitness, where directed arousal patterns constitute the underlying proximate mechanism. Specifically, sexual arousal

is rewarding, and if a given kind of stimulation reliably generates arousal, then organisms will engage in behaviors to maximize that stimulation pattern. If evolutionary ancestors innately varied in the stimuli that they found to be sexually arousing, then the greatest reproductive success would have been achieved by individuals who found characteristics of the opposite sex to be arousing, and hence rewarding. Thus, if genes existed that were capable of shaping brains to respond to cues indicating fitness, then these genes would eventually predominate in the species.

In men, patterns of genital arousal are consistent with this evolutionary account in that heterosexual men exhibit patterns of sexual arousal that are *category specific* in being specifically directed towards women, but in women, the situation is more complex (Blanchard et al., 2012; Chivers et al., 2004, 2007, 2010; Chivers & Bailey, 2005; Suschinsky et al., 2009). Using genital assessment, previous research has demonstrated that women's patterns of sexual arousal do not closely correspond with their self-reported orientations. Compared with men, homosexual and heterosexual women tend to have a more bisexual pattern of sexual arousal in the laboratory, with more similar levels of genital arousal to male and female erotic stimuli. Notably, relative to men, women also show a larger degree of subjective arousal to their less preferred sex. Men, however, tend to show a high degree of correspondence (or *concordance*) between self-reported orientation and their category-specific genital arousal patterns. That is, homosexual and heterosexual men show substantially higher arousal to the gender category that they prefer—i.e., men for homosexual subjects and women for heterosexual subjects—compared with their nonpreferred gender category. Most women, on the other hand, do not show this pattern. Interestingly, homosexual women show a greater degree of category specificity than do heterosexual women, in that they have relatively elevated genital and subjective arousal to stimuli depicting their preferred sex (Chivers et al., 2004, 2007). Notably, relatively greater erotic specificity in homosexual women has also been observed in neuroimaging investigations focusing on the ventral striatum (Safron et al., 2018), a dopamine-sensitive area of the brain of central importance for reward learning and action selection (Mannella et al., 2013). However, homosexual women also exhibit substantial arousal to their nonpreferred sex (on average), suggesting a relatively bisexual pattern compared with the results for homosexual and heterosexual men. Bailey (2009) speculates that the brains of homosexual women may have been masculinized to some degree and that this could potentially account for a more male-typical (i.e., category-specific) arousal pattern.

When non-concordance occurs in men, it is frequently because they fail to show erectile activity to stimuli that are subjectively arousing, which happens with approximately 1/3rd of men in plethysmography experiments (Bailey, 2009). An additional form of non-concordance was observed in a study of bisexual men, where although relatively bisexual subjective arousal patterns were reported, genital arousal patterns were indistinguishable from those of homosexual and heterosexual men (Rieger et al., 2005). However, by using more stringent inclusion criteria, a later investigation by Rosenthal et al. (2011, 2012) succeeded in finding distinctly bisexual arousal patterns in bisexually identified men. In subsequent work, these

bisexual arousal patterns were also found to be reflected in brain activations in the ventral striatum (Safron et al., 2017). Most recently, by aggregating data across prior studies (474–588 individuals, depending on analyses), it was unambiguously demonstrated that bisexual men show greater levels of nonspecific arousal as assessed by genital measures (Jabbour et al., 2020).

While neuroimaging investigations involving men have shown clear correspondences with the genital arousal literature (Safron et al., 2007, 2017), patterns in women remain inconclusive. An early study by Ponseti (2006) and colleagues showed category-specific patterns of arousal in both homosexual and heterosexual women, including in the ventral striatum. However, interpretations of this study are unclear due to the stimuli being comprised of close-up pictures of female and male genitalia. That is, while it could be the case that functional neuroimaging has greater sensitivity than genital measures—and so is able to observe more subtle affective reactions—it could also be the case that women tend to respond with appreciable arousal for any stimulus indicating a possible sexual encounter (Rupp & Wallen, 2008; Spape et al., 2014). With respect to this particular study, women may tend to show erotic responses to either (a) context-rich stimuli (with a potential for nonspecific arousal patterns) or (b) context-poor stimuli with which they have had actual sexual experiences (resulting in category-specific patterns). Some notable evidence for nonspecific arousal in women was observed by Sylva et al. (2013), although not within brain areas for which clear valence could be inferred, such as the ventral striatum (Stark et al., 2005; Walter et al., 2008). That is, while elevated activity in sensory or motor regions could indicate increased sensitivity and preparation to engage with desired sexual stimuli, it could also reflect a more general kind of salience (e.g., novelty, or even negative reaction) that does not reflect sexual preferences. Interpretations of this study and subsequent investigations (Safron et al., 2018) are also challenged by generally low subjective stimulus ratings, thus making it unclear whether nonspecific arousal in women reflects actual bisexual attraction or merely a lack of interest in stimuli with uncertain ecological validity. Careful stimulus selection will be of paramount importance for future research (Safron & Hoffmann, 2017).

Despite observations of bisexual arousal patterns in the laboratory, most women do not behave or identify bisexually (Chandra et al., 2011; Kinnish et al., 2005; LeVay, 2010; McCabe et al., 2011; Mock & Eibach, 2012; Savin-Williams et al., 2012). In light of this disconnect between arousal and behavior/identity, Bailey (2009) considers three different options for conceiving of sexual orientation in heterosexual women. The first option is that most women have bisexual—or perhaps more broadly nonspecific or "pansexual"—orientations, but that this has little to do with their sexual identities and preferences. Alternatively, female arousal patterns could be thought of as category specific in the case that female genital arousal patterns are misleading and do not actually reflect the way in which sexual arousal is experienced subjectively. Finally, women could be oriented towards certain targets and not others, but factors other than arousal shape behavior; by this account, men and women both have orientations, but while men seem to be driven by sexual arousal patterns, women would be driven by factors other than sexual arousal. After

considering these three alternatives, Bailey concludes that the term "sexual orientation" is most productively conceptualized as a specific phenomenon of arousal directing sexual desires, fantasies, and attraction. However, based on the discrepancy between psychophysiology and behavior/identity, he proposes that a "compass"-like mechanism for directing sexuality may be an adaptation that exists in most men, but not most women. Women clearly have sexual preferences and desires, but on average, they may not have orientations of the same sort that drive male sexual behavior.

Although intuitively compelling, the proposal that sexual orientation is a compass-like mechanism is difficult to reconcile with the prevailing theory that male homosexuality is best explained in terms of either "incomplete masculinization" or partial "feminization" of a brain shaped by activational and organizational effects from sex hormones and genes (LeVay, 2010; Lippa, 2005, 2009). More specifically, if sexual preferences in women are determined by factors other than arousal, this suggests that a female-typical arousal pattern in homosexual men would correspond to a bisexual arousal pattern, rather than category specificity with respect to other men. During a meeting of researchers studying the origins of sexual orientation (Vasey & Lalumière, 2012), Bailey noted that the intensity of sexual motivation could interact with innate arousal patterns in shaping desire and behavior. Under the two-factor arousal-pattern orienting hypothesis, rather than lacking biases towards sex-specific cues, an attenuated sex drive in women could result in smaller differences in the magnitudes of the underlying vectors (i.e., the length of the compass needle pointing in a given direction) biasing arousal towards one sex or the other. This dual-factor model incorporating both the magnitude and direction of orienting may more effectively reconcile partial sexual differentiation theory with observations of nonspecific patterns in women and category-specific patterns in homosexual men. That is, homosexual men could potentially have a female-typical directing mechanism towards male features, and a male-typical sex drive. Relative degree of heterosexuality, homosexuality, or bisexuality would depend on the extent to which different aspects of these putative mechanisms were masculinized or feminized over the course of development.

In these ways, it may be the case that women have adaptive biases that are only physiologically measurable when they are also experiencing relatively greater motivation towards sexual reward. The finding of category-specific brain activation patterns in women provides indirect evidence for this hypothesis, since theoretically, functional neuroimaging could be more sensitive than genital assessment (Ponseti et al., 2006; Savic et al., 2001; Savic & Berglund, 2010). Also consistent with conditionally active sexual orientations, periods of increased fertility and desire are associated with more male-centered fantasies in heterosexual women (Dawson et al., 2012). Additionally, greater interest in highly masculinized men has been observed near ovulation (Rupp et al., 2009a), as well as in women with relatively high scores on measures of sociosexuality (Provost et al., 2006). However, evidence is lacking for the claim that women experience increased category-specific physiological arousal during the periovulatory window, despite increased responsiveness to sexual rewards (Slob et al., 1996; Wallen & Rupp, 2010).

Considering that an initially similar body plan can be differentiated into male-typical or female-typical anatomies depending on which genes are expressed (LeVay, 2010), the partially atypical sexual differentiation scenarios described above are not biologically implausible. However, it is more challenging to explain an innate basis for paraphilias, where individuals are motivated by sexual arousal patterns involving unusual objects, activities, or situations that would be unlikely to contribute to reproductive success in the environment of evolutionary adaptation (Rowland & Incrocci, 2008). However, some paraphilias are more common than others (Scorolli et al., 2007), and it has been suggested that many of these alternative sexualities could arise from the malfunctioning of mechanisms that were adaptive in other contexts (Quinsey, 2012). Yet, it is difficult to think of a neurologically realistic causal pathway that would not rely on a substantial degree of learning, especially considering instances of sexual arousal centering on imagining oneself as an amputee (Money & Simcoe, 1984), feeding one's partner to the point of obesity (Terry et al., 2012), desiring to transform into a cartoon dog (Freund & Blanchard, 1993), or numerous other scenarios. Anecdotally, individuals often report formative childhood experiences that were instrumental in shaping these atypical arousal patterns (Johnson, 1973; Pfaus et al., 2012), which can be considered to be "orientations" to the extent that they strongly and stably drive sexuality over time. The fact that individuals often act on these atypical desires in spite of social disapproval, or even imprisonment, provides evidence that at least some paraphilias can be considered to be orientations in the sense previously discussed (Bailey, 2009; Seto, 2012). When paraphilias are considered according to the two-factor model of orienting, degree of sexual motivation would need to be "male typical" in order to be capable of producing arousal strong enough to drive behavior. The fact that paraphilias are far more common in men than women is consistent with this hypothesis (Cantor, 2012). However, even if only a rare exception, paraphilias for which innate origins are a priori implausible—e.g., arousal responses to party balloons or bicycles (Scorolli et al., 2007)—represent a proof of concept that childhood experiences can result in robust patterns of arousal that continue into adulthood. Moreover, experiences of arousal must interact with learning processes in order to explain how specific aspects of preferences change with time.

If sexual orientations can arise without innate biases in at least some instances, then parsimony demands that we consider whether this could be the case more generally, as will be explored below. Regardless of the extent of mediation by learning processes, if stable arousal patterns are reliably associated with orienting sexuality, then they could instantiate a proximate mechanism by which natural selection directed sexual behavior in human males, but possibly not females. In the view presented here, sexual orientations could still be considered to be evolutionary adaptations, even if they lack significant inborn neurological biases towards specific stimuli.

16.2.4 On the Significance of Nonspecific Arousal Patterns in Women and Men

Genital arousal is part of a coordinated set of emotional and physiological changes that both result from and contribute to the psychological experience of sexual arousal (Janssen et al., 2000). In both men and women, vasocongestion and engorgement of reproductive tissue sometimes occurs spontaneously without any clear psychological cause, but in the context of an experiment where participants are viewing erotic stimuli, reliable genital responses to one stimulus type versus another suggests some degree of psychological causation (Basson, 2002; Chivers et al., 2010; Lawrence et al., 2005; Rupp & Wallen, 2008; Suschinsky et al., 2009). Similar results have also been obtained with non-genital measures such as looking time (Lippa, 2012). Yet the nature of these psychological processes is unclear, especially when one considers the phenomenon of women showing significant genital—but not subjective—arousal to videos of Bonobo apes copulating, while men do not exhibit signs of arousal to these stimuli (Chivers et al., 2007; Chivers & Bailey, 2005). While these were smaller magnitude effects compared to more typical erotic stimuli, they are nonetheless notable in that the videos only depicted brief encounters lasting a few seconds; theoretically, more extended sexual acts could have induced even stronger responses (if the Bonobos could be motivated to comply for the sake of advancing scientific research). Based on such findings, Chivers and colleagues have suggested that there may be innate psychological mechanisms in women for genitally responding to any sort of sexual stimulus, and that this adaptation may serve a protective function in preventing physiological damage from non-lubricated intercourse (Chivers et al., 2007; Lalumière et al., 2020; Suschinsky & Lalumière, 2010). This model is consistent with the finding that presence or absence of sexual activity in an image is more strongly associated with female genital responses than the sex of the person being depicted (Chivers et al., 2007); indeed, women in this particular study exhibited greater responses to pictures of sexual encounters featuring their "nonpreferred sex" compared with pictures of their "preferred sex" exercising in the nude.

Alternatively, conditioned learning processes could explain the nonspecific genital arousal patterns of women (Hatch, 1981; Hoffmann, 2012, 2017; Hoffmann et al., 2004; Slob et al., 1996). More specifically, experiences of aroused and lubricated intercourse are more likely to be pleasurable and rewarding, and experiences of intercourse without arousal are more likely to be painful and punishing. In this way, variability in reward associated with a woman's sexual experience may depend more on the extent to which vaginal lubrication takes place, regardless of how much attraction is felt towards that particular partner. If the contingencies of reinforcement and punishment for genital vasocongestion are primarily dependent upon the imminence of a sexual encounter, then genital arousal patterns may primarily be driven by the presence of sexual activity, even if it does not necessarily indicate subjective preferences.

These two hypotheses assume that female genital arousal does not necessarily reflect desire for the conditions that evoke it. Indeed, physical arousal patterns may

not necessarily reflect desire for the activities being depicted, as genital arousal can occur even in cases where people are experiencing substantial negative affect (Suschinsky & Lalumière, 2010). In the previously discussed studies, it is possible that the erotic stimuli depict people and situations that female participants would on some level want to engage with sexually. Or, women may automatically "mirror" with the depicted individuals and thus experience vicarious arousal (Mouras et al., 2008; Rupp & Wallen, 2008). Or, considering that female sexual autonomy may be treated with ambivalence by cultures and individuals (Eagly et al., 2004), implicit—and sometimes explicit—sociocultural messages about sexuality could lead women to experience their sexualities in a more reactive fashion.

These alternative interpretations do not exclude the possibility that nonspecific genital arousal also reflects the sexual fluidity observed in non-heterosexually identified women (Diamond, 1998, 2003b, 2008a), as well as the non-exclusivity of desire that has been documented in many heterosexual women (Chandra et al., 2011; Chivers & Timmers, 2012; Dawson et al., 2012; McCabe et al., 2011; Savin-Williams et al., 2012; Vrangalova & Savin-Williams, 2012). Further, although there is relatively low concordance between genital and subjective measures in women, self-reported sexual arousal for "nonpreferred" stimuli is also greater in women than in men. Thus, considering that feelings are not necessarily an all-or-nothing affair, it seems reasonable to conclude that nonspecific genital arousal patterns indicate at least some degree of greater flexibility in the conditions capable of inducing desire.

Below, we will propose an additional, non-mutually exclusive hypothesis for understanding the significance of genital arousal patterns: *gender differences in the degree of sexual arousal specificity may contribute to gender differences in the degree of concordance between genital and subjective arousal*. That is, strong correspondences between genital and subjective arousal in men (on average) may contribute to the acquisition of strongly directed arousal patterns during critical periods (i.e., the development of sexual orientations). Further, a more fluid relationship between genital and subjective arousal in women (on average) may contribute to the development of more fluid and plastic sexual preferences, rather than enduring orientations.

16.3 The Development of Sexual Preferences and Orientations through Reward, Competition, and Feedback

16.3.1 Physiological Arousal, Learning, and the Development of Sexual Orientations: The Reward Competition Feedback (RCF) Model

Sexual arousal is a composite psychological state constituted by arousing (and often rewarding) mind-body feedback loops of a sexual nature, which are typically (but not always) facilitated by either perceiving or imagining patterns of stimulation that

contribute to this state (Basson, 2001; Damasio, 2000, 2003; James, 1894; Lang, 1994). More specifically, mind-body feedback loops are created by attending to arousing sensations (i.e., genital engorgement), which can be perceived as viscerally pleasurable, and so result in the further enhancement of the physiological processes that produce these sensations. This feedback can occur both within and between physiological and psychological levels, where interactions can be mutually excitatory (e.g., awareness of arousal contributing to further arousal) or inhibitory (e.g., the types of dynamics associated with sexual dysfunction) (Janssen & Bancroft, 2007). If high arousal states are experienced as pleasurable (Hoffmann, 2012, 2017; Pfaus et al., 2012; Toates, 2009), then associated stimuli will become reinforcing, thereby strengthening underlying neuronal connections for actions—potentially including the mental "acts" of attending and thinking—that tend to result in those kinds of perceptions. Because these associations occur in the context of particular psychophysiological conditions, the appetitive behaviors potentiated by these stimuli will be of a specifically sexual nature (Hall et al., 2000).

These experiences of feedback-amplified arousal may cause sensitization to the conditions that result in their initiation and enhancement, so directing both attention and behavior in ways that further these dynamics through additional reward learning (Hoffmann, 2012, 2017; Pfaus et al., 2012). In this way, in addition to mind-body loops underlying particular sexual experiences, feedback processes may unfold on longer timescales as conditioning shapes behavior, shaping further conditioning experiences, and so on (Safron, 2015; Toates, 2014). An initial sexual experience may be only mildly arousing at first, or even neutral or possibly unpleasant, but with further experience it could become an "acquired taste." Importantly, unpleasant and punishing experiences may disrupt positive feedback cycles that amplify sexual arousal (Janssen & Bancroft, 2007; Safron, 2018), and may even produce negative affective associations, potentially leading to both mental and behavioral avoidance. Also importantly, it may not be necessary for these reinforcing or punishing experiences to be grounded in overt sexual behavior. Rather, affective associations can result from experiences with observed behaviors, or imagined scenarios, or even highly idiosyncratic fantasies with no clear basis in probable modes of sexual expression (e.g., transforming into a cartoon dog) (Freund & Blanchard, 1993).

Over time, accumulated conditioning could produce relatively stable preferences (Safron, 2018, 2019), depending on the strength of the feedback processes involved with respect to particular reinforcers, as well as individual experiential histories. In this process of differential amplification of affective responses via iterated action selection and reinforcement learning, different types of action tendencies (and evoking stimuli) can be viewed as competing (and cooperating) in shaping the overall development of the organism. We refer to this integrative perspective as the *Reward Competition Feedback (RCF) model*, which we believe offers a unifying perspective for the development of preferences and orientations. RCF can be considered to be a combination of the dynamic systems perspective described above (Diamond, 2007), the "Incentive Motivation Model" wherein sexual reward value is learned through experiences (Toates, 2009), as well as the "Dual Control Model" that emphasizes the importance of both positive and negative feedback processes in

regulating sexuality (Janssen & Bancroft, 2007). Notably, this account does not preclude the existence of innate orienting mechanisms, but describes how the maturation of such biasing processes into robustly enduring patterns of arousal and motivation is necessarily mediated by experience. Thus, RCF provides a general model for describing the development of goal-oriented behavior, applying not just to sexuality, but with potential application to all preferences and motivations.

16.3.2 Sex Differences in Arousal and Dynamics of Reward Competition Feedback

Although the distinctions between female and male genital arousal may seem obvious, it is important to consider the physiological characteristics of each (Basson, 2001; Pfaus & Scepkowski, 2005), as these provide somatic markers that direct attention and thus determine the nature of the mind-body loops underlying the "feelings" that ground emotions. More specifically, penile erection results in visually noticeable expansion in thickness and length, tactilely noticeable stretching and pressure sensations, and indirect proprioceptive information due to either gravity- or contact-induced torqueing forces. In women, on the other hand, the markers of genital arousal are subtler. Engorgement of the vaginal walls results in lubrication, of the clitoris results in increased turgidity, and of the labia results in swelling and temperature increases (Kukkonen et al., 2007, 2010). Although these physiological changes can be noticed, the relative parametric correspondences between percent changes in engorgement and gross changes in volume are such that genital arousal may be more obvious in men than it is in women (Laan & Janssen, 2007). While a woman may experience substantial genital arousal without realizing it, it is difficult to ignore an erect penis—even if only partially aroused, depending on the extent of arousal and situational context—as most men learn during adolescence. Furthermore, due to the physical characteristics of expanding cylinders described above, differences in erection allow for a dose-dependent (although not necessarily linear) relationship between degree of engorgement and degree of noticeable physiological sensations. In women, this sort of dose-dependent relationship is likely more difficult to ascertain due to the more complex and subtle geometric properties of female genitalia, relative to those that are manifestly observable for the hydraulically expandable/collapsible quasi-cylindrical objects that constitute male genitalia.

As a result of this difference in the availability of information pertaining to the degree of sexual arousal, one should expect a difference in the degree to which the previously discussed positive feedback processes take place. Enhancement of positive feedback processes in men would be even greater considering that conditioning most readily occurs when a precise temporal conjunction exists between clearly discernable behaviors and outcomes (Pickens & Holland, 2004). In this case, not only are physiological—and thereby hedonic (Laan & Janssen, 2007)—outcomes more readily discernable for men, but erectile activity changes can be monitored on a

moment-to-moment basis. Thus, any behavioral changes, including shifts in attention and imagination, can be correlated with the amount of arousal and pleasure experienced. The process of finding correspondences between behaviors and outcomes has been characterized as a "credit assignment problem" in reinforcement learning (Fu & Anderson, 2008), and with respect to genital arousal, this problem has been greatly simplified for men. Speculatively, the period of young men's lives where they are confronted with the challenge of reconciling erectile activity with social appropriateness may play a significant role in consolidating a specific relationship between genital and subjective arousal; theoretically, this sort of social learning could potentially result in the development of default inhibitory processes that further contribute to category specificity.

Indeed, greater parametric detectability of genital changes may allow arousal patterns to more readily drive orienting in men by making them consciously accessible to a greater degree, thus contributing to awareness-based amplification of physiological arousal (Safron, 2016, 2020). With respect to the feedback processes described above, the strength of excitation (or inhibition) may increase as individuals facilitate rewarding (or punishing) patterns of stimulation and attending to particularly pleasurable (or unpleasant) aspects of experience. Further, the temporal specificity of moment-to-moment changes in the arousal state may allow particular stimuli to become associated with sexual arousal, and thereby facilitate integration into erotic schemas and scripts (Pfaus et al., 2012). On the basis of this history of reinforcement, stimuli associated with arousal may be able to more readily capture attention when encountered and—depending on the extent of learning at that point in time—outcompete other stimuli for access to limited attentional resources. When a sufficient degree of conditioning has taken place, these stimuli may drive habitual thought patterns, fantasies, and eventually behaviors, all of which may produce additional experiences of reinforcement. And due to differences in genital arousal dynamics described above, men may be more likely to experience this "critical mass" of conditioning within critical windows of developmental plasticity (Safron, 2018).

In these ways, experiential intensity may both contribute to and result from arousal amplification, so shaping competitive reinforcement (or punishment), with accumulated conditioning shaping behavior and thought in ways that may further contribute to additional reinforcing and punishing experiences. Thus, although these processes operate on different timescales, they interact synergistically in that they are both affected by and capable of influencing the degree of arousal experienced in response to different stimuli under different circumstances. Feedback amplification occurs in women as well, but these processes may be sufficiently stronger in men such that a difference of degree creates a difference of kind, thus resulting in the emergent phenomena of specific arousal patterns capable of directing behavior (i.e., orientations), and potentially restricted sexual fluidity.

16.3.3 Additional Factors Influencing RCF Dynamics

Numerous and varied phenomena could synergistically contribute to differential rates of sexual learning in women and men. First, for the reasons described above, male anatomy may support mind-body feedback loops of higher intensity and specificity. Considering that the relationship between arousal-facilitating stimuli and genital pleasure may be more tightly coupled in men, they may begin masturbating at an earlier age than women. Indeed, not only is this the case, but men are also likely to masturbate more frequently once they begin to do so (Baumeister et al., 2001; Leitenberg et al., 1993). Although masturbation practices are clearly influenced by social pressures, considering the intensity of reward associated with direct genital stimulation and orgasm (Safron, 2016), age of initiation for sexual self-stimulation and specific masturbation practices could deeply influence the developing mind. Initial schemas and scripts set the stage for later developments (Pfaus et al., 2012), and thus the conditions surrounding early sexual experiences are more likely to have this "first-mover" advantage in shaping erotic development. Furthermore, the sooner a learning process begins in development (Safron, 2019), the more time it has to operate and thus accumulate a more extensive history of conditioning. Moreover, early experiences can take advantage of the greater plasticity of young brains, which are still in a period of dynamic alteration due to factors such as changing hormones, progressive myelination, and ongoing neuronal and synaptic pruning (Gogtay et al., 2004; Kuhn et al., 2010; Sisk & Foster, 2004; Teicher et al., 1995; Vigil et al., 2011).

Diverse factors are capable of influencing reward-driven learning through highly variable pathways. With respect to biology, in males, elevations in testosterone around puberty could interact with reinforcement processes more generally (Arnedo et al., 2000, 2002; Cunningham et al., 2009; Hermans et al., 2010; Pfaus, 2010; Redouté et al., 2005; Rupp & Wallen, 2007; Schober et al., 2005), and thereby enhance the feedback dynamics described above. Sex-specific epigenetic modifications could also influence reward-learning processes, and non-hormonally mediated genetic effects are also possible, such as have been observed for the male-determining Sry gene in impacting dopamine-producing neurons of the substantia nigra (Dewing et al., 2006). With respect to social influences, boys seem to be exposed to a greater degree of homophobia than are girls (Thurlow, 2001), and thus they may be less open to homosexual experience. Or, Baumeister's (2000) previously mentioned explanations of patriarchy or female behavioral restraint—specific causal pathways notwithstanding—could inhibit arousal processes in young women, thus making it less likely that a "critical mass" of rewarding experiences will trigger sufficient positive feedback amplification to learn strongly directed arousal patterns within developmental windows associated with elevated plasticity.

Group differences in sexual reward-driven feedback could be further attenuated by the fact that compared with men, women are generally more sensitive to social context and less sensitive to physiological states in interpreting emotions and drives (Roberts & Pennebaker, 1995). However, although men are generally more sensitive

to interoceptive signals such as heart rate and respiration, degree of sexual concordance in women is not correlated with awareness of these signals (Suschinsky & Lalumière, 2012). These results suggest that genital arousal may be particularly important in shaping human sexuality. However, while explicit conscious awareness of somatic states and their functional significances should be expected to enhance dynamics of feedback amplification, differences in genital morphology could impact sexuality in non-human animals as well. For example, while both male and female Bonobos initiate sexual interactions, males do so more frequently, and are also more likely to begin courtship behaviors at greater distances of separation (Furuichi & Hashimoto, 2004); females, on the other hand, require close proximity to males before engaging in sexual approach. Theoretically, these sex differences in non-human primates could be partially accounted for by the kinds of differential perceptual characteristics for female and male genitalia previously described (for humans). That is, most mammals have more prominent genital arousal in males than in females, which could potentially form a phenotypic basis for the development of heterosexual reproductive behavior. We might expect relatively greater category-specific sexuality in females with more pronounced genital arousal, although such experiments might be confounded if greater neural androgenization (Fenstemaker et al., 1999) contributes to bisexual behavior through overall increases in sexual motivation.

While RCF emphasizes learning processes, all of this evidence is consistent with a model in which sexual orientation is most validly understood as an evolutionary adaptation whereby specific arousal patterns shape motivation and drive behavior, and that this adaptation may be present in most men, but not in most women (Bailey, 2009). The reward-driven learning model described above does not address the existence of innate preferences for specific stimulus characteristics. Rather, it stipulates a proximate mechanism by which genital arousal acts as a powerful and reliable conditioning stimulus that amplifies preferences such that they may become enduring orientations.

While innate contributions to sexual orientations clearly exist, these may potentially operate in an indirect fashion that is substantially mediated by experience. For example, evidence of behavioral and (neuro)physiological sex-atypicality associated with homosexual orientations may be taken as evidence for overall differences in feminization and masculinization, including with respect to evolutionarily selected neural systems governing reproductive behavior. However, such findings are also compatible with models in which initial differences in femininity and masculinity contribute to different modes of interaction with the environment, and so differences in reward learning (Fig. 16.1) (Safron, 2018). Perhaps the best known (and widely contested) proposal along these lines is the "Exotic Becomes Erotic" theory described below (Bem, 1996). Yet, a range of models could provide a causal (rather than merely correlational) role for behavioral sex/gender-typicality in the development of sexual orientations. For example, a highly feminine boy may find himself identifying to a greater degree with more female-typical social scripts in culture and media, or may find himself more likely to internalize the affective reactions (including expressed attraction) of female peers. However, such an account would fail to

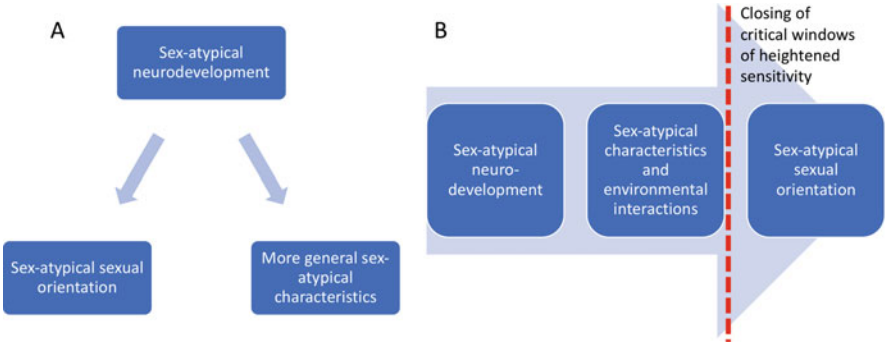

Fig. 16.1 Two models of the development of sex-atypical characteristics and sexual orientation (reprinted with permission from Safron, 2018): (**a**) Standard models assume that sex-atypicality in orientations (i.e., homosexuality) and more general sex-atypical characteristics (e.g., gender non-conformity) both result from a common process of sex-atypical neurodevelopment. (**b**) However, the same evidence is also consistent with a model in which the relationship between sex-atypical neurodevelopment and sexual orientations is mediated by sex-atypical characteristics and environmental interactions. Note: An experience-dependent causal pathway should not be taken to imply that sexual orientations are arbitrarily malleable, perhaps especially as plasticity decreases as development proceeds in time

address the development of homosexual attractions in largely gender-"typical" individuals, for which we might expect more idiosyncratic experiences to play a formative role in shaping patterns of desire.

Although the standard explanation of an innate neural module for orienting seems simplest, the experience-mediated causal pathways described above appeal to empirically demonstrated phenomena, and avoid appealing to poorly evidenced neurological mechanisms. When viewed as an adaptation, the genital-reward feedback model described above could be considered an "innate" mechanism in the sense that the human body-plan is genetically specified, as is the sensory innervation that makes genital stimulation pleasurable. Yet, in the process of creating category-specific arousal patterns, this mechanism is nearly completely mediated by experience, thus problematizing an innate/learned distinction. The evolutionary psychological explanation of sexual orientation is probably correct with respect to its ultimate cause as a means of ensuring successful reproductive behavior in men, as well as for the psychological-level proximate details of arousal patterns being essential for strongly directing sexual behavior. Nonetheless, it may be the case that sexual orientation is not strongly determined by inborn neural mechanisms of a domain-specific nature.

Independently of their mechanistic origins, greater female erotic plasticity may have been adaptive in light of the reproductive challenges that men and women likely encountered in our evolutionary history (Bailey et al., 1994, 2000b; Buss & Schmitt, 1993; Gangestad & Simpson, 2000; Symons, 1981). More specifically, from an "adaptationist" perspective (Dawkins, 1976; Dennett, 1996), a strongly directed arousal pattern could represent a liability in women, considering differences

in minimum obligate investment for successful reproduction (i.e., months of incubation and years of nursing, in contrast to mere minutes of energy expenditure on the part of men who avoid parental investment). That is, because the stakes of a sexual encounter are necessarily much higher for women, evolutionary fitness would be maximized by taking into account other higher-level factors, such as a tendency towards parental investment and status in potential mates. Theoretically, lack of a specific orienting mechanism in women could help to ensure that reproductive behavior is driven by complex considerations, which would require experience and time in order to be discovered by general-purpose learning mechanisms. Conversely, in men, sexual arousal may be such a powerful driver of behavior that more complex factors are less capable of shaping preferences. In this way, while category-specific genital arousal patterns may act as the primary source of reward that orient most men towards preferred sexual stimuli, sexual preferences may be determined by a greater number of more complicated factors in women.

A study of sexual decision-making in women exemplifies ways in which erotic motivation may be influenced by considerations of expected value that integrate multiple forms of utility (Rupp et al., 2009b). Rupp et al. (2009b) compared fMRI activations in response to male faces described as either frequently engaging in high-risk sexual practices (e.g., unprotected sex), or as being sexually cautious. Low-risk men were reported as more sexually desirable, and elicited stronger activations in areas associated with reward processes. However, executive control areas positively correlated with subjective evaluations of sex likelihood and response times during evaluation of high- but not low-risk men, which possibly reflected processing of conflicting motivations. Based on these findings, the authors concluded that for sexual decision-making, women utilize similar neural systems to those involved in non-sexual decision-making. These findings and interpretations are highly consistent with the evolutionary model described here.

Thus, sexuality may have highly different values for reproductive success based on women (relative to men) having a potentially greater burden in terms of obligate parental investment. Even with something as fundamental to evolution as ensuring adaptive mating behaviors in humans, genes may have achieved this "goal" through highly indirect means. More specifically, natural selection could have achieved nearly optimal adaptive behavior by specifying details of male and female body plans such that stimulation of reproductive organs differentially contribute to feedback amplification of experienced arousal and reward. By increasing the intensity of positive feedback processes in men, natural selection may have been able to produce qualitatively greater degrees of incentive motivation (Toates, 2009) towards stimulus characteristics associated with sexual arousal. Alternatively, by attenuating these processes in women, natural selection may have made it less likely that low-level stimulus features would dominate action selection (Safron, 2019), thereby allowing more abstract, complex, and context-sensitive reinforcers to be more heavily weighted in influencing behavior.

16.3.4 Multi-level Evolution and the Development of Adaptive Reproductive Behavior

In addition to the kinds of reward learning described above, animals may use social learning in addition to direct experience in inferring which behaviors are likely to be rewarding. This learning may be evolutionarily adaptive if cultures and other individuals (who may be potentially older and/or more experienced) are likely to encode successful patterns of behavior, which may be further enhanced in species wherein natural selection robustly occurs on the level of groups (Caldwell & Millen, 2009; Castro & Toro, 2004; Hyde & Durik, 2000; Molenberghs et al., 2009; Tomasello, 2001; Whiten et al., 2009). More specifically, pervasive and enduring selective pressures may allow aspects of life management to extend into culture, so providing a form of "sociocultural homeostasis" (Damasio, 2012), such as the practice of training children how to hunt. Indeed, it is increasingly appreciated that the rapidity and flexibility of cultural evolution may be responsible for more aspects of behavior than has been previously recognized (Henrich, 2017). Perhaps along these lines, with respect to sexual reproduction, norms supporting heterosexual interaction—or at least discouraging exclusively same-sex sexual activity (Safron, 2018; Savolainen & Hodgson, 2016)—could increase fitness both for individuals and groups.

Thus, in light of the ability of natural selection to occur across multiple levels, evolutionarily adaptive behavior need not depend on complex innate factors. Further, associated mechanisms are more likely to become vestigial if selective pressures are reliably satisfied by other means, whether via individually experienced rewards or through social learning. For example, the pheromonal system became vestigial in primates approximately 50 million years ago (Pfau et al., 2019; Safron, 2018; Zhang & Webb, 2003), potentially due to the ability of general purpose learning systems to reliably infer which patterns of behavior are likely to enhance the positive affective states associated with reproductive success. If natural selection could depend on learning to meet this evolutionary imperative, then stabilizing selection for other adaptations (e.g., the vomeronasal system by which pheromones are detected) will have less influence on determining variability in differential rates of reproduction. In this way, every selective pressure may be understood as competing and cooperating with every other selective pressure in shaping populations of organisms across time.

Notably, we should expect similar dynamics to be observable not just across organisms in populations, but also internally to organisms and their nervous systems (Figs. 16.2, 16.3, and 16.4) (Safron, 2018). This expectation is justified in that the multi-scale learning processes underlying affective orienting in action selection and the developments of sexual orientations can both be modeled as kinds of generalized evolution (Badcock et al., 2019; Campbell, 2016; Ramstead et al., 2017; Safron, 2019). More specifically, just as with selective pressures in phylogeny, RCF proposes that every preference competes and cooperates with every other preference in shaping both moment-to-moment action selection (i.e., orientation as proximate mechanism), as well as the overall developmental trajectory of an individual over

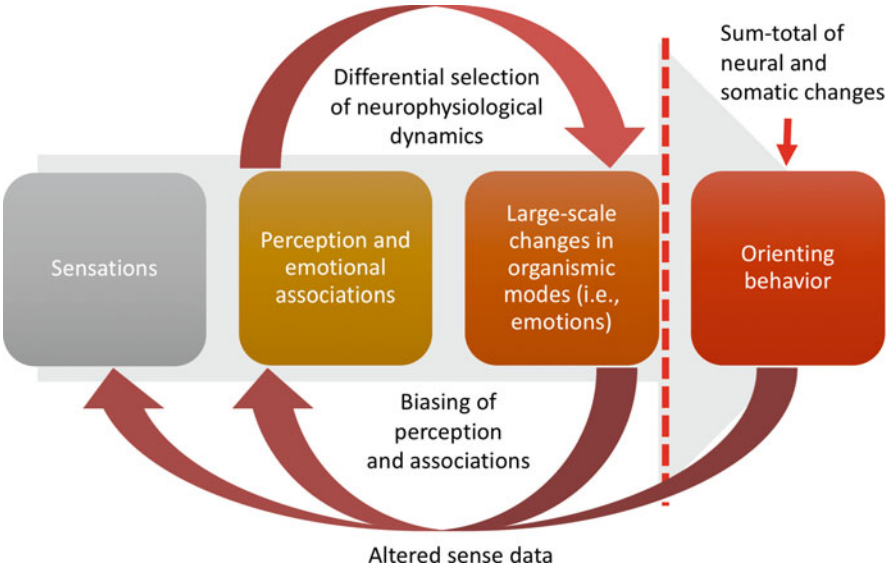

Fig. 16.2 Mechanistic causes of orienting (reprinted with permission from Safron, 2018): Mechanistically, orienting emerges from a process of sensation being assessed for affective value, so resulting in differential selection of neurophysiological dynamics (e.g., patterns of neural activity, autonomic and neuroendocrine changes). These affective assessments contribute to the selection of global organismic modes, which in turn bias perception in a circular process of affective construction (i.e., emotions/feelings). The sum total of this dynamic processing shapes overall neuronal activity selection, which may contribute to orienting sexual behavior, so influencing likely future experiences. However, incentive motivation of sufficient strength to influence actions will only be likely to occur if sufficiently robust orienting is present

the course of ontogeny (i.e., orientation as evolutionary adaptation and life history strategy).

In these ways, RCF demonstrates how seemingly incompatible "nativist" and "empiricist" perspectives on sexuality can be reconciled. Notably, this experience-dependent framework is not only mechanistically parsimonious, but is also capable of explaining previously mysterious gender differences. In the following sections, we discuss independently developed theories for explaining sexual behavior, and consider the extent to which they provide convergent validity and refinement of the models described above.

16.4 Additional Theories of Sexual Learning

The theories presented below are not meant to constitute an exhaustive review. For further discussion of many of the ideas contained in this portion of the chapter, we recommend that the reader turns to Toates's (2014) excellent book, "How Sexual Desire Works: The Enigmatic Urge." A review is also provided in Safron (2015).

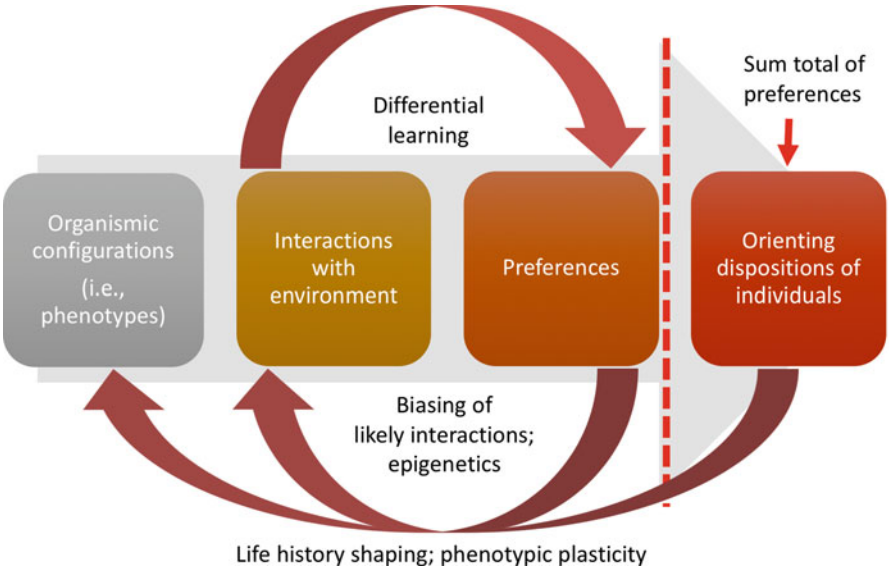

Fig. 16.3 Developmental causes of orienting (reprinted with permission from Safron, 2018): Developmentally, orientations emerge from a process of ontogenic programs shaping plastic phenotypes and likely affective experiences, so resulting in differential learning (i.e., selection of neural connections). These affective experiences contribute to the shaping of different preferences, which in turn bias future likely experiences in a circular process of niche construction for individuals (i.e., the ways in which organisms both adapt themselves to their environments and adapt their environments to themselves). The sum total of this experience-dependent affective learning shapes overall preferences, which may result in enduring orientations, so influencing the overall unfolding of a life history. However, preferences of sufficient strength and robustness to be considered to be orientations may only develop if sufficiently robust reward learning occurs during sensitive periods of development

16.4.1 Exotic Becomes Erotic; Familiar Becomes Boring

Other proposals for the establishment of gender differences in category specificity involve both innate predispositions and learning processes. In Bem's (1996) "Exotic Becomes Erotic" theory of orientation development, association with gender-segregated peer groups leads to non-sexual arousal when people outside of the more familiar group are encountered (Bem, 1998, 2000; Krisel, 2001; Nicolosi & Byrd, 2002; Peplau et al., 1998). This general arousal is then "misattributed" in sexual contexts emerging spontaneously around puberty, and thus biases the development of orientation in one direction or the other, depending on whether individuals have more exposure to same-sex or other-sex peer groups. Based on this theory, Baumeister (2000) suggested that more mixed-gender social groups in childhood could result in less discrimination between males and females with respect to sexual arousal, thereby contributing to more general erotic plasticity.

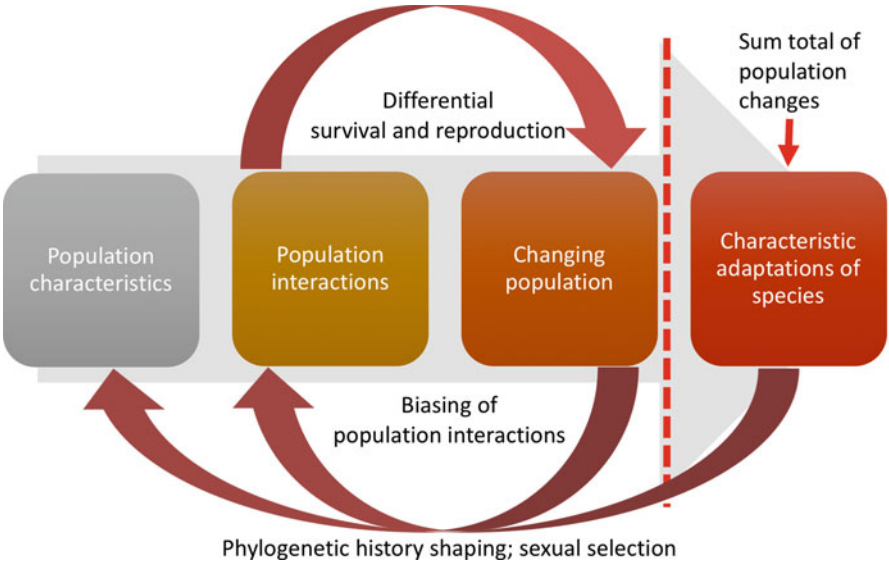

Fig. 16.4 Phylogenetic causes of orienting (reprinted with permission from Safron, 2018): Phylogenetically, changes in population characteristics emerge from a process of members of a population interacting with each other and the broader environment, so resulting in differential survival and reproduction (i.e., natural and sexual selection). The consequences of these interactions define operative selective pressures, which in turn bias the conditions of selection in a circular process of population-level niche construction. The sum total of these pressures shapes the overall direction of selection, which may result in appreciable fitness consequences for different phenotypes, so influencing future population characteristics over phylogenetic history. However, selection of sufficient strength and robustness to produce appreciable fitness consequences (sometimes yielding novel adaptations) may only develop if sufficiently robust selective pressures are present for multiple generations

While compelling in some respects, the Exotic Becomes Erotic theory underspecifies the means by which general arousal could influence the development of sexual preferences (Bem, 1996). Based on the kinds of differential feedback amplification between boys and girls described above, one would expect differential eroticization of the exotic to be more likely to result in category-specific arousal patterns in boys than in girls, even with identical peer group gender ratios. Additionally, Bem overlooked the relatively obvious mechanism of habituation (Rankin et al., 2009), wherein familiar stimuli become less psychologically impactful. Habituation may provide a mechanism capable of not only explaining reduced preferences for the familiar peer group, but also much of incest avoidance (Erickson, 1993; Leavitt, 1990; Lieberman et al., 2003). More specifically, as familiarity with a peer group increases, increasingly predictable stimulus characteristics will produce smaller magnitude reward responses (Schultz, 1998); perhaps intuitively, rewards are processed relative to expectations, such that an otherwise rewarding stimulus may be nonetheless negatively experienced if it is less impactful than anticipated,

and where only rewards greater than predicted are capable of producing strong affective reactions. This differential habituation would cause the more familiar peer group to become relatively boring compared with the unfamiliar peer group. Although not mutually exclusive with the exotic becoming erotic, this hypothesis of the familiar becoming boring may be sufficient for explaining the same phenomena. RCF may be further amplified if the inherently messy nature of sexual activities produces a default disgust reaction without successful eroticization (Fleischman et al., 2015). Regardless of whether the allure of the exotic or the lull of the familiar is more powerful, when differential arousal for familiar compared with unfamiliar peer groups is combined with reward-driven learning amplification, these models are potentially sufficient for explaining the developmental origins of sexual preferences and orientations.

16.4.2 The Emergence of Heterosexual Reproductive Behavior Via Partial Instincts and Cultural Evolution

Wunsch (2010) proposed a parsimonious model of sexual orienting, whereby stimulation of erogenous zones may be the only primary reinforcer needed for reward-learning processes to sufficiently explain mating behavior in primates. Drawing upon a dynamical systems perspective, Wunsch suggests that there may be no inborn central programming of motor sequences for reproduction, but rather a learning process wherein simpler bodily responses are combined to produce adaptive sexual behavior. He refers to these adaptations as "partial instincts" in that an incomplete set of innate elements are combined via associations with reliably predictable environmental circumstances. More specifically, heterosexual reproductive behavior is proposed to reliably emerge from the combination of (1) the innately pleasurable stimulation of "hairy skin," and (2) complimentary gonadal structures and body postures in females and males. With these basic elements, general-purpose learning mechanisms may be capable of discovering that pleasure is reliably achieved via vaginal-penile coitus, which animals come to prefer relative to forms of stimulation that tend to be less rewarding, on average.

In addition to the numerous sources of evidence identified by Wunsch, research on the development of sexual behavior in rhesus monkeys provides further support for this model (Wallen, 2001). Wallen (2001) found that male monkeys mount other males and females in equal proportions as juveniles, but switch to exclusively heterosexual mounting after puberty. Intromissions with other males do occur, but they are more likely to ejaculate with females. Notably, the timing of this transition was most strongly predicted by having ejaculated with a female and was less strongly correlated with increases in pubertal testosterone. Furthermore, the time-course of this transition was most strongly predicted by the number of ejaculations with females. The later removal of testosterone in adulthood reduced male sexual motivation, but it did not eliminate capacity for sex, nor did it change which sex was

preferred. Although not definitive, these data suggest that copulatory experience was a necessary mediator for directed heterosexual mating behavior to develop. At least in rhesus monkeys, evolutionary pressures for successful reproduction could be subserved by general-purpose reward-learning mechanisms and their interactions with the affordances and constraints of their embodiments and environments.

16.4.3 Olfaction, Innate Orientations, and Sexual Learning

Kohl et al. (2001) has proposed another parsimonious learning model where olfactory cues are the sole primary reinforcer involved in the development of a wide variety of phylogenetically significant behaviors, including those for reproduction (Kohl, 2007; Kohl et al., 2001). According to this theory, stimulus characteristics become "sexual" only because of conditioned associations with olfactory stimuli. Although strong links between smell and emotion have been clearly established (Barwich, 2020; Herz, 2008), Kohl's claims remain controversial in light of his insistence that innate affective responses for complex visual stimuli do not exist, as well as his claim that human pheromones do exist.

Kohl is indeed correct that unambiguous evidence is lacking for inborn responses to complex visual stimuli in mammals. However, ambiguous evidence is plentiful, as well as commonly cited as constituting strong evidence. As we discuss below, such mechanisms may be biologically implausible and possibly un-evolvable. Attractive features such as anatomical symmetry or sexually dimorphic physiology can be universal, but that does not necessarily imply an innate basis. If these attractive stimuli are correlated with other features of interest (e.g., strength, robustness, immunity, fertility), then organisms can reliably learn these associations either through individual experience or cultural evolution. Speculatively, to the extent that uncertainty is inherently punishing, or if a common cortical process reinforces successful prediction (Friston & Kiebel, 2009; George & Hawkins, 2009), then the enhanced predictability of symmetrical structures could potentially act as a primary reinforcer.

However, the claim that humans are responsive to pheromones seems unlikely in light of the deterioration of the vomeronasal organ and accessory olfactory bulb in humans and other Old World primates (Brennan & Zufall, 2006; Yang & Schank, 2006; Zhang & Webb, 2003). This system is usually responsible for sensing phylogenetically relevant classes of olfactory compounds from other organisms, and then triggering species-specific fixed action patterns through connections to structures such as the medial amygdala, and then the hypothalamus and brainstem. Although primates have shown phylogenetically relevant affective reactions to such odorants (Ferris et al., 2001, 2004), the lack of functionality of the accessory olfactory system and prior relevant experiences suggest that these responses may be learned (Ferris et al., 2004), and as such it may be misleading to describe these compounds as acting as "pheromones," per se. Finally, it is notable that, experience-dependence has been observed even for mammalian responses to pheromones

(Hosokawa & Chiba, 2005), and even with respect to the mating behavior of fruit flies (Zhao et al., 2020).

Nonetheless, smell is a unique sense in several respects (Croy et al., 2012; Shepherd, 2004; Yeshurun et al., 2009). First, compared with other stimulus modalities, smell is a priori more likely to be capable of influencing phylogenetically significant behaviors due to closer proximity of olfactory inputs to core structures for emotion selection, neurophysiological regulation, and memory encoding. Although these areas receive extensive projections from other sensory modalities, these connections are achieved through pathways with a far greater number of intervening synapses through a dynamically self-organizing cortex. Second, a large number of genes specifically code for odor receptors, which are sensitive to specific compounds. Although only 350–450 of our 1000 odor-receptor specific genes remain functional—compared with 1100 out of 1300 for mice, suggesting weaker selective pressures for olfaction in humans—the number of permutations of gene-expression profiles is still enormous. Thus, it is not unreasonable to suggest that evolution was able to use the olfactory system to adaptively shape behavior.

The amygdala complex is probably the most likely mechanism for mediating innate affective biases to particular odorants. This system receives extensive olfactory inputs, has been implicated in emotional learning and responses for appetitive and aversive stimuli, and has been shown to regulate sexual behaviors in a variety of animals (Maras & Petrulis, 2010; Pradhan et al., 1998; Winston et al., 2005). In both humans and non-human animals, the amygdala has high concentrations of sex hormone receptors (Cooke & Woolley, 2005; Fowler et al., 2008; van Wingen et al., 2010), as well as sexually differentiated anatomical features (Giedd et al., 1997; Goldstein et al., 2001). In neuroimaging studies, sex differences in amygdala responses have been observed for emotional processing (Cahill et al., 2004; Kilpatrick et al., 2006), as well as sexual processing (Hamann et al., 2004), with some evidence suggesting differences on the basis of sexual orientation (Safron et al., 2007).

However, although the amygdala receives multi-modal inputs, complex visual stimuli are unlikely to produce specific innate responses via cortex, given the dependencies of cortical development on idiosyncratic experiences of individual organisms (Cadieu et al., 2014; Held & Hein, 1963; Roe et al., 1992). Theoretically, the superior colliculus could provide this input using connections that are simpler and more predictable than a cortical pathway. However, although it receives a substantial portion of projections from the retina, receptive field properties of colliculus neurons are not sensitive to shape or color (Redgrave et al., 2008), and thus it is extremely unlikely that specific connections could form the basis of some sort of innate visual stimulus detector. However, if the relationship between the degree of smell-induced arousal and reward is characterized by an "inverted U" function—that is, too weak being unnoticeable, and too strong being aversive (Yerkes & Dodson, 1908)—increasing or decreasing the sensitivities of the innate olfactory system could provide an elegant means of ensuring that different smells will be likely to have different affective associations (Haddad et al., 2010).

Although, at the present moment, evidence is lacking for innate valence specificity being achieved via this sort of mechanism.

Kohl's model of primary olfactory conditioning is supported by evidence that attraction can be influenced by cross-modal associations with emotionally salient odors, as in a study where medial orbitofrontal cortex (implicated in appetitive responses) activated for neutral faces paired with positive odors, and lateral orbitofrontal cortex (implicated in aversive responses) activated for faces paired with negative odors (Gottfried et al., 2002). However, attractive and sexually arousing visual stimuli can also act as unconditioned rewards that engender affective associations with conditioned stimuli (Bray & O'Doherty, 2007; Klucken et al., 2009), as in Hoffmann et al. (2012) demonstrating that neutral smells facilitate arousal after pairing with sexual activity. This potential bidirectional conditioning between olfactory and non-olfactory stimuli suggests that caution is appropriate in interpreting studies of reward or arousal in response to sexually dimorphic smells. For instance, studies using androgen and estrogen related olfactory compounds have demonstrated both differential activations in heterosexual women and men, as well as sex-atypical activations in homosexual women and men (Savic et al., 2001, 2005; Savic & Arver, 2011; Savic & Berglund, 2010). Notably, these differential responses were not reflected in subjective reports, suggesting that these affective processes could operate unconsciously. Misleadingly, these studies were invariably reported as suggesting innate bases for preferences, but this sort of inference cannot be made from non-longitudinal observations of adults already shaped by a lifetime of experiences with male and/or female sexual partners.

Additional evidence is required to establish whether sexually dimorphic olfactory compounds contribute to sexual preferences. Longitudinal studies in children would be particularly promising, and given the non-explicitly sexual nature of many sex-specific odorants, such experiments could be conducted with minimal ethical concerns. Male children reporting gender dysphoria may be particularly informative, as nearly 75% of them go on to identify as homosexual men in adulthood (LeVay, 2010). Theoretically, these gender-atypical male children would be more likely to exhibit preferential brain responses to male-specific odorants, or they may have different expression profiles for relevant receptors. Some intriguing evidence exists along these lines, with pre-pubertal children who experience gender dysphoria showing gender-atypical responses to the male steroid-related chemo-signal, androstadienone (Burke et al., 2014).

16.4.4 Reward Learning and Flexible Critical (or Sensitive) Periods

On the basis of numerous lines of evidence, Pfaus et al. (2001, 2003, 2012) has argued that salient features from early sexual experiences come to be preferred in subsequent partners through reward-driven learning. By this view, a sexual

orientation represents a "constraint on learning, biasing the subsequent development of sexual preferences towards the preferred gender" (Pfaus et al., 2012, p. 53). This process unfolds over a series of critical periods where preceding stages influence which emergent properties are likely to arise in subsequent stages of development.

Pfaus et al. (2012) outline five "developmental epochs," which they map onto neo-Piagetian stages in which sexual behavior is molded by experience. The first epoch is an initial period of "sexual differentiation" where perinatal hormones shape the brain and body, commencing prenatally and extending into the sensorimotor stage (i.e., birth–2 years; simple reflexes to internalization of schemas). The second epoch is characterized by a period of "gender differentiation" wherein individuals identify themselves as female or male, beginning during the sensorimotor stage, and then extending into preoperational stages (i.e., 2–7 years; symbolic function, intuitive thought). The third epoch is characterized by a period of "social/emotional attraction and bonding," beginning during the preoperational phase, and then extending into the concrete operational phase (i.e., 7–11 years; logical reasoning, context dependency). During this period, genital arousal is increasingly recognized as caused by external circumstances, and becomes subject to classical and operant conditioning based on the reward-contingencies encountered by the learner. However, genital arousal is not explicitly linked to external causes until the fourth epoch, which begins during the concrete operational phase, and then extends into the formal operational phase (i.e., 11 years–adulthood; integrated cognitive theory, values, abstract reasoning, hypothetical-deductive reasoning). Pfaus et al. believe that sexual orientation derives from the first two epochs, but is not explicitly recognized by an individual as a sexual identity until the fourth epoch, or possibly as late as his fifth and final epoch. It is during this final period where sexual behavior and sexual reward begin to take a stable form as the adolescent/learner begins to experience the powerful reinforcements of masturbation and sexual interaction.

In this reward-based developmental trajectory, sexual and gender differentiation creates an initial foundation for early social interactions and bonding, which then interacts with developing awareness of genital arousal, and is finally consolidated by the powerful reinforcement of sexual stimulation. Sexually preferred features also move along a temporally unfolding continuum that ranges from more pre-potent (e.g., gender) to flexible (e.g., hair type). These preferences arise in the context of the development of sexual "gestalts" and "scripts" shaped by early experiences that "feed forward to create desire for distal, proximal, and interactive features that predict the reward state" (Pfaus et al., 2012, p. 54). The particular unfoldings of these dynamic processes will be unique in each individual, but commonalities occur due to species-specific behavior or stimulation patterns, or as features of culture-specific attractiveness. Yet, according to Pfaus et al., "there are as many sexual preferences as there are people," and "every desired feature is to some extent a "fetish" that is sought after in the people we find attractive" (Pfaus et al., 2012, p. 55).

Pfaus et al.'s model is grounded in animal literatures, and in particular their extensive studies of rat sexuality in terms of behavior, neural mechanisms, and learning (Pfaus et al., 2003, 2012). Pfaus and colleagues have demonstrated that

numerous aspects of mating behavior can be shaped by experience, and that initially non-sexual stimuli can become sexually rewarding through conditioning. Examples of sexual conditioning range from rats with "fetishes" for the velcro-jackets they wore during early sexual experiences, to rats that desire the smell of the initially unconditionally aversive odor of cadaverine. These mechanisms of sexual imprinting have been observed in numerous other species as well. As potential examples of the enduring results of imprinting (Bolhuis, 1999), adult male mice and geese both mate preferentially with females that have attributes similar to those of the females that nursed them early in life (Cooke & McNally, 1975; Yamazaki et al., 1988). Even more intriguingly, through cross-fostering, male and female goats and sheep were able to develop cross-species partner preferences (Kendrick et al., 1998). Notable evidence has also been observed for sexual imprinting in humans (Bereczkei et al., 2004), albeit with more subtle effects relative to those reported in animal studies.

As a neural basis for sexual learning, Pfaus et al. (2012) propose that odorants are processed within the olfactory tubercle and piriform cortex, and that sexual reward depends on the posterior dorsal nucleus of the medial amygdala and hypothalamic nuclei. These two pathways converge upon a third mesolimbic dopamine system that integrates both conditioned olfactory cues as well as rewarding sexual outcomes. Although the studies supporting this model used methods that are too invasive for human experimentation, other evidence suggests these neural mechanisms may support sexual learning in mammals more generally. Using olfactory cues that had been conditioned with sexual activity in rats (Kippin et al., 2003), neural activity markers were detected in rat brain areas similar to those activated in fMRI studies of human reactions to visual sexual stimuli. On the basis of previously observed activations in these regions in response to both unconditioned olfactory and genitosensory stimulation associated with copulation, Pfaus et al. speculate that conditioned odors may activate representations of the unconditioned rewards with which they are associated through experience. Moreover, considering that these conditioned rewards produce common activations with neural responses to stimuli predicting cocaine and heroin cues (Childress et al., 2008), as well as maternal bonding (Young & Wang, 2004), they go on to suggest that these regions "function together as a general system for appetitive arousal and desire related to reward" (Pfaus et al., 2012, p. 48).

Two notable neuroimaging studies of male marmoset monkeys provide supporting evidence that Pfaus et al.'s rodent olfactory studies may have identified evolutionarily conserved neural mechanisms for sexual reward (Kippin et al., 2003). When activation patterns were compared in response to the scents of a novel receptive female (periovulatory) compared with ovariectomized females, Ferris and colleagues found enhanced signal intensity in the preoptic area and anterior hypothalamus (Ferris et al., 2001). In an additional study by the same group (Ferris et al., 2004), periovulatory odors produced similar activation patterns to those observed in humans for visual stimuli (Georgiadis & Kringelbach, 2012; Kühn & Gallinat, 2011; Stoléru et al., 2012), suggesting that important aspects of sexual functioning may be similar across mammalian species. In addition to these responses to female sexual odors, male marmoset monkeys also exhibit increases in serum

testosterone (Snowdon et al., 2011), potentially suggesting pheromone-like properties. However, after Snowdon et al. (2011) paired sexual cues with an arbitrarily chosen lemon odor, these novel olfactory associations were capable of stimulating erections, as well as increased exploration of locations where they previously experienced a receptive female. In addition to suggesting that cortical expansion may have produced novel dynamics with respect to reinforcement learning, this study demonstrates that learned olfactory associations could produce pheromone-like effects without relying on specific receptor mechanisms.

16.5 Conclusion

The models discussed above are based on divergent empirical and theoretical considerations, but each account converges on general-purpose learning mechanisms as the primary means of producing adaptive behavior from diverse experiences. Although learning-based models such as RCF (Reward Competition Feedback) combine explanatory power with theoretical parsimony, further evidence could be obtained from cross-cultural, cross-species, and cross-sectional (or better yet, longitudinal) research. Such investigations have the potential to overthrow the currently dominant paradigm for understanding human sexuality in terms of inborn preferences. The scientific consensus about sexual orientation has been one in which individuals are "born that way."

The strong nativist model of sexual orientation has been politically expedient in terms of appealing to people's notions of fairness, in an argument that goes roughly as follows:

1. Sexual orientation is based on innately determined orientations.
2. Thus, people are unable to substantially control these preferences.
3. Therefore, as long as no one is harmed, people should be free to fulfill their desires, particularly if those desires overlap with matters as central to human happiness as romantic love.

Proposition 3 is so incontrovertible as to require no further elaboration. However, proposition 1 may end up being empirically unsupported, and conditional relations between these claims are based on unsound reasoning. More specifically, sexual orientations could be entirely learned, but individuals may still be unable to control their preferences in childhood, adolescence, and adulthood. The converse is also problematic, in that sexual orientations could be inborn, yet only weakly constraining, so allowing for substantial degrees of choice with respect to the expression and shaping of initial preferences via reward-related learning. However, given that brains lose plasticity with age, preferences may become similarly rigid and difficult to modify with time. Alternatively, on even longer timescales, changing life experiences and hormonal states may cause preferences to become plastic yet again. It is also possible that erotic plasticity may be present in the majority of women for most of their lives—and so proposition 2 might not hold—which is a

consideration that is often omitted from these discussions. Finally, propositions 2 and 3 are logically independent in that the connection between choice and permissibility seems to derive from an inappropriate extension of legalistic standards to social norms. Indeed, it is common practice to reduce punishments for violations where intentional choice is obstructed. But it is nonsensical to consider a harmless interaction between consenting adults as some sort of violation. If no one is violated, then the situation cannot rationally be construed as a legitimate penal matter, and all such quasi-legal reasoning is inapt. Conversely, there are some cases where choice is limited, yet social regulation is still applied due to negative consequences. But again, these types of considerations do not apply to harmless interactions between consenting adults.

While learning-based models of sexual preferences have implications that are potentially enormous for science, these implications are also probably miniscule for ethics. Yet, all of these considerations are irrelevant with respect to the accuracy of hypotheses, which in ideal scientific practice, rise and fall on the basis of evidence, and nothing else. Finally, no matter which models end up being supported by existing and future data, there is at least one conclusion about which we can be confident: Sexuality is central to the human condition in countless ways, and with relation to our varying sexualities, our flourishing requires us to relate to others (and ourselves) with respect and compassion.

Spotlight Feature: Bisexuality Across Cultures

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Large studies carried out in Western cultures suggest that self-identified bisexual males are relatively rare (Gates, 2011). In the Western psychological literature, a man is considered bisexual if he experiences notable sexual attraction and arousal to both men and women (e.g., Bailey, 2009). Accordingly, bisexual men should show substantial sexual interest in, and arousal to, images of both men and women relative to monosexual men (i.e., those who are exclusively sexually attracted to either women or men). Consistent with this prediction, it has been shown that bisexually identified men, in the West, exhibit a bisexual pattern of genital arousal (i.e., penile tumescence: Rosenthal et al., 2012; but see Rieger et al., 2005), pupil dilation (Rieger & Savin-Williams, 2012), and viewing time (Ebsworth & Lalumière, 2012; Lippa, 2012, 2017).

Outside of Western cultural contexts, bisexuality may be structured differently. This is, in part, because many non-Western cultures employ non-binary gender systems in which some individuals are recognized as neither men, nor women. These gender non-binary roles are commonly filled by feminine, same-sex attracted individuals who are born male—based on genital anatomy—and who often retain their male genitalia (e.g., Nanda, 1999). Contemporary examples include, but are by no means limited to, the *kothi* of India (Stief, 2017) and the *fa'afafine* of Samoa (Vasey & VanderLaan, 2014).

Although gender non-binary males such as *kothi* and *fa'afafine* are same-sex attracted, they do not engage in sexual interactions with each other; rather, they do so with masculine males who self-identify as men. In cultures such as these, it is not uncommon for men to engage in sexual activity with feminine, gender non-binary males. In the West, such interactions appeared to be much less prevalent. This underscores how men's sexual interest in feminine, gender non-binary males can vary considerably across different cultural contexts (Whitam, 1992).

Recent psychological research, in India and Samoa, has examined whether the men who are sexually interested in feminine, gender non-binary males show a unique, bisexual pattern of self-reported sexual attraction and viewing time. This research demonstrates that Indian men who have sex with *kothi* (Stief, 2017) and Samoan men who have sex with *fa'afafine* (Petterson et al., 2015) exhibit relatively bisexual response patterns, when compared to monosexual males.

Petterson et al. (2016) further examined whether patterns of sexual behavior are associated with unique patterns of self-reported sexual attraction and viewing time among men who had sex with *fa'afafine*. They showed that men who received and performed fellatio with *fa'afafine* partners respond in a fairly similar (i.e., bisexual) manner to images of women and men, but showed a slight preference for the former over the later. However, men who received fellatio from *fa'afafine*, but had not

fellated these partners, exhibited a pattern of viewing time that was closer to men who were exclusively sexually interested in women.

In sum, evidence exists that male sexual orientation, particularly bisexuality, manifests differently across disparate cultural contexts. In Western cultures, bisexual patterns of self-reported sexual attraction and viewing times have been found among self-identified bisexual men who report sexual attraction to both men and women, and who have a history of sexual activity with both (e.g., Ebsworth & Lalumière, 2012; Lippa, 2017; Rieger & Savin Williams, 2012). In non-Western contexts such as India and Samoa, bisexual patterns of viewing time do not appear to be contingent on bisexual identity. Furthermore, the majority of men who engage in sexual interactions with *kothi* or *fa'afafine* also engage in sexual activity with women, but not with men. This suggests that the manner in which bisexual patterns of sexual attraction manifest behaviorally vary from one culture to the next. Because men's willingness to engage in sexual interactions with feminine males varies markedly across cultures, the prevalence of bisexual behavior and bisexual patterns of attraction may also vary. This variation may be linked, in part, to the frequency with which feminine, gender non-binary males, such as *kothi* and *fa'afafine*, are found in the local social environment. The Indian and Samoan studies demonstrate the importance of continuing research on sexual orientation in non-Western cultures. Much like other aspects of human psychology, cognition, and behavior (Henrich et al., 2010), in the absence of non-Western investigations, our views of male sexual orientation run the risk of being biased, incomplete, or even erroneous.

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Chapter 17
Carving the Biodevelopment of Same-Sex Sexual Orientation at Its Joints

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Abstract Sexual orientation is a core aspect of human experience and understanding its development is fundamental to psychology as a scientific discipline. Biological perspectives have played an important role in helping to uncover the processes that contribute to sexual orientation development. Research in this field has relied on a variety of populations, including community, clinical, and cross-cultural samples, and has commonly focused on female gynephilia (i.e., female sexual attraction to adult females) and male androphilia (i.e., male sexual attraction to adult males). Genetic, hormonal, and immunological processes all appear to influence sexual orientation. Consistent with biological perspectives, there are sexual orientation differences in brain development and evidence indicates that similar biological influences apply across cultures. An outstanding question in the field is whether the hypothesized biological influences are all part of the same process or represent different developmental pathways leading to same-sex sexual orientation. Some studies indicate that same-sex sexually oriented people can be divided into subgroups who likely experienced different biological influences. Consideration of gender expression in addition to sexual orientation might help delineate such subgroups. Thus, future research on the possible existence of such subgroups could prove to be valuable for uncovering the biological development of sexual orientation. Recommendations for such future research are discussed.

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> *. . .[I]n these chance utterances were involved two principles. . . That of perceiving and bringing together in one idea the scattered particulars, that one may make clear by definition the particular thing which he wishes to explain. . . [and] That of dividing things again by classes, where the natural joints are, and not trying to break any part, after the manner of a bad carver.—Socrates* (Plato, Phaedrus 265d-265e)

Over the last several decades, biological perspectives have been predominant in the scientific study of same-sex sexual orientation development, with various biological mechanisms hypothesized and multitudes of empirical data ushered to evaluate their merits (for reviews, see Bailey et al., 2016; Balthazart, 2020; Bogaert & Skorska, 2020; Roselli, 2018). Here, we briefly discuss why sexual orientation development is an important area of study, and then approach this literature in a manner that follows closely from the two principles articulated in the dialectic between Socrates and Phaedrus. In doing so, we first bring together the "scattered particulars" (i.e., characterize the phenotypic characteristics) of that we wish to explain (i.e., same-sex sexual orientation). Then, in examining its biological development (hereto *biodevelopment*), we grapple with the second principle and consider the possibility that same-sex sexually oriented individuals can be divided into classes (i.e., discrete categories). Specifically, we provide an overview of various hypothesized mechanisms and recent research bearing on whether these mechanisms reflect distinct biodevelopmental pathways. As such, our goal is to summarize the current state of knowledge on the biodevelopment of same-sex sexual orientation and ultimately illuminate how research on this topic can move closer to "carving nature at its joints."

17.1 Why is it Important to Study Sexual Orientation Development?

Sexual orientation profoundly influences numerous aspects of people's daily experiences. To name a few, these include sexual and romantic relationships (e.g., Diamond & Blair, 2018; Frederick et al., 2021; VanderLaan & Vasey, 2008), social networks and communities (e.g., Brennan-Ing et al., 2014; Hatzenbuehler et al., 2012), health (e.g., Caceres et al., 2017; Lucassen et al., 2017; O'Hanlan et al., 2018; Plöderl & Tremblay, 2015; Valencia et al., 2018), and—in many historical eras and modern societies—civil rights (Bailey et al., 2016). The centrality of sexual orientation to such a wide array of experiences behooves us to gain a deeper understanding of its origins. Uncovering the bases of psychological variations, especially those of significant consequence to people's lives, is at the very core of psychology as a scientific discipline.

In addition, variation in sexual orientation provides a valuable human model for investigating processes that contribute to sexual differentiation of the brain and behavior more generally. Sexual orientation is one of the largest psychological sex differences (Hines, 2020); the large majority of people are sexually attracted to the other sex. As such, when men exhibit a sexual orientation toward men and when women exhibit a sexual orientation toward women, they are displaying psychological traits that are generally more typical of the other sex (i.e., it is typically women who are sexually oriented toward men, and men who are sexually oriented toward women). Because same-sex sexual orientation is hypothesized to arise due to biodevelopmental processes that are more commonly experienced by the other sex, discerning these processes could also inform the origins of psychological sex differences (Balthazart, 2020; Roselli, 2018).

Insights regarding the origins of psychological sex differences hold value in at least two respects. First, sex differences and interest in them abounds in psychological research, with sex representing a major axis of variation in a range of domains, including brain structure and function (Raznahan & Disteche, 2021; Sacher et al., 2013; Wierenga et al., 2020), visuospatial cognition (Lauer et al., 2019), personality (Kaiser et al., 2020), and attachment (Del Giudice, 2019). Thus, any insights regarding the biodevelopment of sexually differentiated psychological traits could have wide-reaching implications within the field of psychology. Second, in recent years, there has been an emphasis on the importance of research that illuminates health-related issues that vary by sex or that are female- or male-specific (Galea et al., 2020; Johnson et al., 2009), which includes brain health. For example, there are sex-related differences in susceptibility to particular conditions such as depression (Altemus, 2006; Salk et al., 2017), autism (Loomes et al., 2017; Werling & Geschwind, 2013), and age-related cognitive decline (Li & Singh, 2014). There might also be sex-related differences in responses to treatments (Yu et al., 2016). Greater appreciation of the biodevelopmental processes that contribute to sex differences in the brain, behavior, and psychology may, therefore, provide more nuanced understanding of how sex might impact the emergence of these conditions as well as the efficacies of different treatments. By extension, given the relevance of biodevelopmental processes to sexual orientation, research in this area can provide a more nuanced understanding of brain health in relation to sexual orientation as well (e.g., Kinnunen et al., 2004).

With these points in mind, there is an important caveat. Some critics of research on the biodevelopment of sexual orientation might raise the concern that the information uncovered could at some point be used to prevent the development or expression of certain sexual orientations. This concern is valid in light of the many past and present examples of ways in which sexual minorities have experienced stigmatization and discrimination (e.g., laws prohibiting same-sex sexual behavior; defining homosexuality as a form of mental illness; lack of civil rights or protections for same-sex oriented people; Bailey et al., 2016). Although it would not be possible to discern or alter one's sexual orientation based on current knowledge regarding biodevelopmental mechanisms, scholars in this field must be aware that our work might give rise to this possibility at some point in the future. In our view, the possible

misuse of scientific understanding for such nefarious purposes should not preclude continued investigation of sexual orientation development. The merits of this work still stand; understanding sexual orientation variation is an important end in its own right because it brings us closer to a complete understanding of humanity, and insights regarding sexual differentiation of the brain and behavior could also yield important theoretical insights and health-related impacts. Rather than ceasing work in this area, it is incumbent on scholars in this field to continue their work while simultaneously being mindful of possible misuses. As part of this effort, it is essential to advocate for the rights of sexual minorities and against any indication of possible misuses of knowledge gained through biodevelopmental studies (e.g., Bogaert et al., 2019).

17.2 The "Scattered Particulars" of Sexual Orientation

17.2.1 Conceptualization and Measurement

In any field of study, the current state of knowledge hinges on the manner in which the construct under investigation has been defined and measured. The study of same-sex sexual orientation is no exception and, therefore, our current understanding of its development is necessarily shaped by how it has been conceptualized. Although many laypersons are likely to intuit what constitutes sexual orientation, attempting to characterize it scientifically has proven to be a complex endeavor. Decades of scholarly scrutiny and debate have shown that a clear, comprehensive, and widely agreed upon conceptualization is not easily come by (e.g., Bailey, 2009; Dembroff, 2016; Klein et al., 1985; Savin-Williams, 2016; Sell, 1997; Storms, 1980; van Anders, 2015). As a case in point, consider that a quinquennial scientific meeting that brings together many of the foremost researchers in the field is entitled *The Puzzle of Sexual Orientation* (Vasey, 2017; Vasey & Lalumière, 2012). This title is an apt and humbling admission. Despite recognition of the myriad ways in which sexual orientation intersects with the rest of human experience, the exact particulars of the construct elude us.

We acknowledge this elusiveness not as a prelude to any attempt to resolve it. To think doing so were possible within a subsection of a single book chapter would be hubris. Rather, our goal is to illuminate the aspects of sexual orientation that have been emphasized by those studying its biodevelopment. Doing so provides clarity regarding the phenotype—or, in Socrates's words, "the particular thing"—that researchers have wished to explain.

If one takes a snapshot of the field of sexual orientation biodevelopment, it is readily apparent that numerous operationalizations have been relied upon. Among them, studies have considered and measured sexual orientation as a matter of one or more of self-reported identity (e.g., self-labeling as gay, lesbian, bisexual, straight; e.g., Skorska & Bogaert, 2017b), sexual behavior (e.g., history of same- and/or other-sex sexual contact; e.g., Ganna et al., 2019), sexual attractions (e.g., in relation

to the same- and/or other-sex; e.g., Skorska et al., 2020), romantic attractions (e.g., Pattatucci & Hamer, 1995), and/or marital or relationship status (i.e., married to or in a romantic/sexual relationship with a same- or other-sex partner; e.g., Frisch & Hviid, 2006).

Studies that assess sexual orientation using more than one of these measures find that people's responses tend to correspond as one would expect (e.g., a person who reports stronger same-sex sexual attractions is likely to also report engaging in sexual behaviors with members of the same-sex); however, the responses do not correspond perfectly (e.g., Bogaert, 2003b; Diamond, 2005; Ganna et al., 2019; Igartua et al., 2009; Korchmaros et al., 2013; Mustanski et al., 2014; Pathela et al., 2006; Swift-Gallant et al., 2019a). At least part of the explanation for this lack of perfect correspondence is the probable influence of extraneous factors on some of these sexual orientation characteristics. For example, willingness to adopt an identity as gay or lesbian might depend on whether same-sex sexuality is associated with social stigma, and engaging in sexual behavior or relationships depends on the availability of suitable partners. For such reasons, measures such as sexual attractions, which are less constrained by factors beyond an individual's control, have been argued to provide more "pure" assessments of sexual orientation (Bailey et al., 2016).

Although such might be the case, inconsistencies across studies in how sexual orientation is conceptualized and measured has led to some limitations for the field. To begin with, if only certain sexual orientation characteristics are considered relevant whereas others are not—such as considering sexual, but not romantic, attraction to be relevant—then one will not be able to discern whether they have similar or different developmental underpinnings. Second, inconsistencies across studies in terms of defining and measuring sexual orientation could contribute to differences in whether studies support a particular developmental hypothesis (e.g., same-sex marital status might be too poor a proxy for providing strong tests of hypotheses about sexual orientation development; Blanchard & VanderLaan, 2015). As such, where possible, it can be important for researchers to measure multiple characteristics associated with sexual orientation and consider whether each produces similar or different results (e.g., Ganna et al., 2019; Swift-Gallant et al., 2019a).

17.2.2 Study Populations

The core phenotypic characteristics of interest to the field of same-sex sexual orientation biodevelopment are also reflected by the populations that have been relied upon to conduct studies in this area. Most often, studies have included cisgender (i.e., experienced gender and sex assigned at birth align) adults who vary in sexual orientation (e.g., gay men, lesbian women; Blanchard & Bogaert, 1996a, 1996b; Diamond et al., 2020; Kishida & Rahman, 2015; Martin & Nguyen, 2004; Pattatucci & Hamer, 1995; Xu & Zheng, 2017). It has also been quite common

for studies to include transgender (i.e., experienced gender and sex assigned at birth do not align) adults varying in sexual orientation (e.g., Blanchard & Sheridan, 1992; Green, 2000; VanderLaan et al., 2017a, 2017b) or children and adolescents seen in specialty gender clinics who were heterogeneous with respect to (presumed) sexual orientation and gender identity (e.g., Schagen et al., 2012; VanderLaan et al., 2014; Wallien et al., 2008). Cross-cultural samples of adults who identified with a culturally specific "third" gender group that was distinct from the categories of "men" and "women" have also been investigated as a way of assessing whether hypothesized biodevelopmental mechanisms apply universally across populations (e.g., Gómez Jiménez et al., 2020; Skorska et al., 2021a; VanderLaan & Vasey, 2011). More rarely, studies have compared adults with same- versus other-sex sexual attractions toward minors (i.e., pre- or peri-pubescent children and adolescents; Blanchard et al., 2000; Blanchard & Bogaert, 1998). Meta-analyses and narrative reviews in this field have typically combined one or more of these sample types (e.g., Bailey et al., 2016; Balthazart, 2020; Blanchard, 2018; Blanchard et al., 2020; Bogaert & Skorska, 2020; Lalumière et al., 2000; Roselli, 2018).

Thus, previous studies have relied on a diverse range of sample types. Although this range might appear to obfuscate the exact phenomenon of interest, there is a common thread. In all of the studies, the main interest has been to discern how biodevelopment relates to variation in sexual orientation toward members of the same- vs. other-sex. Thus, the sex to which one's sexual attraction is directed toward relative to their own sex assigned at birth has been the primary or core phenotypic characteristic under investigation, with other characteristics such as gender identity or the age(s) of targets of sexual attraction being of secondary or lesser interest.

17.2.3 Considerations Regarding Terminology

Given the various study populations focused on in studies of sexual orientation biodevelopment, it can be challenging for those who wish to synthesize this literature to arrive at an appropriate terminology. There is presently no universally accepted nomenclature that can be applied to capture all of this variability simultaneously in a satisfactory way. For example, terms that are familiar in Western culture such as "homosexual," "gay," and "lesbian" are culturally specific and do not always apply in non-Western cultures with "third" gender individuals (Bailey et al., 2016). With such heterogeneity in study populations in mind, our terminology follows common conventions in the literature on sexual orientation and transgender or third gender identity (e.g., Bouman et al., 2017; Sinnott, 2004; VanderLaan et al., 2013c). When describing specific individuals, samples, or groups of individuals who can be characterized accurately and appropriately by a particular identity term, then that term is used. When describing patterns that appear to apply across several groups that are heterogeneous with respect to identity and, thus, no common identity term can be employed accurately, then the following phenotypic descriptors are used: (1) Sexual orientation is denoted using the terms *gynephilia* (i.e., sexual attraction to

adult females) and *androphilia* (i.e., sexual attraction to adult males);[1] (2) *male* and *female* are employed in the biological, not sociocultural, sense to describe individuals according to the observable primary sex characteristics (i.e., genitals) with which they were presumably born; (3) *transgender* describes individuals whose gender identity aligns with completely, or closely to, the other-sex whereas *cisgender* describes individuals whose gender identity aligns with that of the same-sex; and (4) *masculine* and *feminine* denote gender expression that is male-stereotyped and female-stereotyped, respectively, relative to the prevailing norms of the particular culture under consideration. To be clear, these terms are used only as descriptors to communicate biodevelopmental patterns across populations that share certain characteristics. They are not intended to take the place of identity terms that could be more aptly applied to specific individuals or groups of people.

17.2.4 Summary of the "Scattered Particulars"

The above reflections on conceptualization and measurement of sexual orientation and on the populations relied upon to study its biodevelopment help make clear the phenotype that researchers in this area have wished to explain. Taking the scattered particulars into consideration, researchers appear to have primarily wished to explain sexual attractions, which happen to correspond with other characteristics such as sexual orientation identity, sexual behavior, and romantic attractions. Further, the study populations reflect an interest in understanding the biodevelopment of sexual attractions toward members of the same birth-assigned sex. Thus, at the core of research on sexual orientation biodevelopment to date, female gynephilia and male androphilia appear to have been the main phenotypes of interest.

17.3 Mechanisms of Sexual Orientation Biodevelopment

Having addressed the first principle captured in the dialectic between Socrates and Phaedrus (i.e., defining that which we wish to explain), we can proceed to the second principle and consider whether same-sex sexually oriented individuals can be divided into classes in relation to their development (i.e., discrete categories). There is relatively little evidence to suggest that socialization (e.g., parental rearing)

[1] We recognize that "gynephilia" and "androphilia" are terms that denote sexual attraction toward adults, and as such these terms do not apply in the case of those who are sexually oriented toward minors (i.e., children and/or adolescents). In studies of those sexually oriented toward minors, the terms "homosexual" and "heterosexual" have been used to denote attraction to the same- and opposite-sex, respectively (e.g., Blanchard et al., 2020). We, however, did not choose to use these terms because here we review to a greater extent the considerable cross-cultural literature on "third" gender populations for which gynephilia and androphilia have been the terms typically employed.

plays an appreciable role in the development of same-sex sexual orientation (for reviews, see Bailey et al., 2016; Wilson & Rahman, 2005), although one study reported that experiencing a lower quality parent-child relationship is associated with greater likelihood of nonheterosexuality in women (Xu et al., 2019). In contrast, research into biodevelopmental influences on sexual orientation has garnered considerable empirical support (for reviews, see Bailey et al., 2016; Balthazart, 2020; Bogaert & Skorska, 2020; Roselli, 2018). In this section, in order to facilitate subsequent discussion on the question of discrete categories, we provide a brief overview of the most commonly investigated biodevelopmental mechanisms (i.e., genetic, hormonal, and immunological).

These mechanisms have been investigated by comparing biodevelopmental factors in individuals with same- vs. other-sex sexual orientation using either direct or indirect approaches. Direct approaches measure the hypothesized biological mechanism of action (e.g., genes) and have been rarer, largely because they are often more time and cost intensive. Indirect approaches, in contrast, involve measuring traits that are putative markers of hypothesized biological mechanisms (hereto *biomarkers*). These biomarkers are thought, therefore, to provide a window on differences in biodevelopmental experiences. Given the relative ease with which biomarker data can be gathered, indirect approaches to studying sexual orientation biodevelopment have been more common. Here, we include both types of approaches in our overview of the literature.

17.3.1 Genetic Influences

Several lines of research indicate that sexual orientation is at least partially influenced by genes. Two of these lines have relied on indirect approaches: familiality and twin studies. Familiality studies examine whether same-sex sexual orientation clusters in particular families. As would be expected if there were a genetic component to same-sex sexual orientation, same-sex sexually oriented individuals report preponderances of same-sex sexually oriented relatives (e.g., siblings, and maternal and paternal cousins and aunts/uncles) compared with individuals who are sexually oriented to the other sex (e.g., Camperio Ciani et al., 2018; Gómez et al., 2018; King et al., 2005; Pattatucci & Hamer, 1995; Schwartz et al., 2010; Semenyna et al., 2017a). Twin studies examine whether genetically identical twins show greater correspondence in sexual orientation (i.e., both twins show the same sexual orientation) than fraternal twins, who have the same degree of genetic similarity as siblings with the same genetic parents and who are born apart. Consistent with the hypothesis that genes influence sexual orientation, identical twins show greater correspondence in sexual orientation than do fraternal twins (e.g., Alanko et al., 2010; Bailey et al., 2000; Burri et al., 2015; Långström et al., 2010). Of note, despite their greater genetic similarity, identical twins do not show perfect correspondence in sexual orientation, reflecting that epigenetic factors affecting gene

expression might be an important element in the relationship between genetics and sexual orientation (Ngun & Vilain, 2014).

Molecular genetics studies have investigated the association between sexual orientation and genetic variants more directly. Based on genome-wide studies, sexual orientation appears to be a polygenic trait (i.e., influenced by alleles at multiple genetic loci) associated with loci on autosomes as well as on the X-chromosome (e.g., Ganna et al., 2019; Hamer et al., 1993; Mustanski et al., 2005; Sanders et al., 2015, 2017). Female and male sexual orientation, as assessed by sexual behavior, appear to be associated mainly with distinct sets of genes; furthermore, each gene accounts for a small proportion of variability in same-sex behavior, with the aggregate genes only accounting for 8% to 25% of the variability (Ganna et al., 2019). As such, there does not appear to be a single gene responsible for influencing sexual orientation and it would likely be difficult to predict one's sexual orientation accurately based on genes alone. That said, some of the gene regions that have been linked to sexual orientation have a known or suspected function, allowing for some speculation regarding how these genes might influence sexual orientation development. For example, Sanders et al. (2017) reported that male sexual orientation was linked to genes associated with neurodevelopment as well as genes associated with thyroid stimulating hormone receptors that are expressed in some brain regions.

17.3.2 Hormonal Influences

The action of sex hormones, primarily androgens (testosterone), during pre/perinatal brain development is thought to be of critical importance to the organization of the brain and psychological sex differences. Androgens are hypothesized to be important for masculinizing the brain and behavior, whereas low androgen exposure leads to a more female-typical pattern (Balthazart, 2020; Hines, 2011). Progesterone and estrogen are also thought to be important for promoting a female-typical pattern of development (Beltz & Moser, 2020; Toffoletto et al., 2014). Experimental studies in nonhuman animals in which pre/perinatal androgen exposure is manipulated have tended to support this hypothesis (Balthazart, 2020; Roselli, 2018).

In humans, studies in which the relation between pre- or peri-natal sex hormone exposure and later sexual orientation could be examined in a direct fashion have been relatively scant. One study found that men and women exposed to exogenous progesterone or estrogen prenatally were less likely to identify as heterosexual and to have more same-sex sexual behavior and attractions than comparison groups (Reinisch et al., 2017). Other research has found that prenatal exposure to exogenous estrogen was associated with greater likelihood of androphilia in women (Ehrhardt et al., 1985; Troisi et al., 2020), but results were less robust for men (Troisi et al., 2020). There has also been relevant clinical research on congenital conditions. Congenital adrenal hyperplasia (CAH) is associated with exposure to excessive androgens prenatally, and in genetic females (i.e., XX sex chromosomes) CAH is

also associated with higher rates of bisexual or same-sex sexual orientation (Meyer-Bahlburg et al., 2008). Another condition, complete androgen insensitivity syndrome (CAIS), is caused by nonfunctional androgen receptors despite continued production of testosterone by the gonads (Hughes et al., 2012). In the absence of functioning androgen receptors, the action of androgens on physical development is limited. Interestingly, individuals with CAIS present with an almost entirely female-typical phenotype, identifying as women and likely sexual orientation toward men (Hines et al., 2003). Together, these studies suggest that prenatal sex hormones play a significant role in organizing male- and female-typical traits of the brain and behavior in humans, including sexual orientation.

Empirical tests of the hormonal perspective have relied heavily on biomarkers that are thought to give insight regarding the prenatal action of androgens on development. For example, finger length ratio—specifically the ratio of the length of the second-to-fourth digit (2D:4D)—has often been used as a somatic marker for prenatal androgen exposure, although genetic factors also play a role in its development (for review, see Ellis et al., 2015). Males tend to have lower 2D:4D than females, and this sex difference is apparent by the end of the first trimester of gestation. A meta-analysis found that lesbians had a lower, more male-typical 2D:4D than did heterosexual women, whereas gay and heterosexual men did not differ significantly in 2D:4D (Grimbos et al., 2010); however, findings regarding 2D:4D and male sexual orientation are mixed. Some recent cross-cultural and longitudinal cohort studies with relatively large samples indicated that digit ratio is more female-typical among androphilic, compared with gynephilic, males (Skorska et al., 2021a; Xu et al., 2019).

Various other physical characteristics are also sex-differentiated and reflect the prenatal action of androgens to some extent. These include standing height, long-bone length, and hand width-to-length ratio (Maresh, 1955; Tanner et al., 1976; Wolff & Steggerda, 1943). Martin and Nguyen (2004) identified sexual orientation differences on these measures. In men, same-sex sexual partner preference was associated with shorter long bones in the arms, legs, and hands, whereas in women the opposite was found. Similarly, other studies have found sexual orientation differences in height, but this appears to apply more so in men than in women (Blanchard & Bogaert, 1996a; Bogaert, 1998, 2010; Bogaert & Blanchard, 1996; Skorska & Bogaert, 2017b, 2017c). Face structure, which is also sex-differentiated and influenced by androgens (Bulygina et al., 2006; Meindl et al., 2012), also varies by sexual orientation (Skorska et al., 2015; Valentova et al., 2014). Certain face structure features are shifted in the direction of heterosexuals of the opposite sex in gay men (e.g., shorter nose) and lesbian women (e.g., marginally more masculine face shapes, noses that were turned up) (Skorska et al., 2015).

Cognitive abilities that are sex-differentiated and thought to be mediated by the organizational effects of prenatal androgens on the brain are also informative. The prime example is the visuospatial skill of rotating objects in one's mind. In the mental rotation task, participants mentally rotate target objects to discern whether they are the same or different from other stimuli, some of which are the same as the target but presented with a different orientation. On average, men outperform

women on this task by matching more items correctly (Voyer et al., 1995). Meta-analyses have shown that when examining performance in relation to sexual orientation, heterosexual men tend to outperform gay men (Xu et al., 2017, 2020) and lesbian women tend to outperform heterosexual women (Xu et al., 2017; cf. Xu et al., 2020). Thus, research on sexual orientation and mental rotation is consistent with other biomarker studies in providing some indirect support for the hormonal perspective on sexual orientation development.

17.3.3 Immunological Influences

The maternal immune hypothesis (Blanchard & Bogaert, 1996b; Bogaert & Skorska, 2011) proposes that male sexual orientation can be influenced by a mother's immune system during pregnancy. According to this hypothesis, the mother's immune system is triggered when a male fetus' cells or cell fragments enter her bloodstream during pregnancy or childbirth. The mother can then develop immune responses to proteins that are unfamiliar to her body because they are produced by the Y-chromosome and are, therefore, male-specific. Some of these male-specific proteins may be important for male-typical fetal brain development, including the development of brain areas that underpin sexual orientation. Thus, during subsequent pregnancies in which a mother is gestating a male fetus, if her immune system detects the presence of male-specific fetal proteins, her body may mount an immune response in which antibodies attach to these proteins and render them inert. As a consequence, brain areas associated with sexual orientation do not masculinize and a more female-typical sexual orientation (i.e., androphilia) is expressed.

This hypothesis has been supported both indirectly and directly. Regarding indirect tests, a key prediction is that male, but not female, sexual orientation should be associated with number of older brothers (i.e., male androphilia is associated with greater numbers of older brothers). This pattern is referred to as the *fraternal birth order effect* and has held in numerous studies (for review, see Bogaert & Skorska, 2011). Importantly, this effect appears to be specific to biological older brothers with the same birth mother, and not related to other kinds of brothers (e.g., adopted, stepbrothers) (Bogaert, 2006). Also, it appears to be prenatal in origin. Maternal immune activation during pregnancy is associated with relatively lower birth weight (Christensen et al., 2012; Kahn & Baltimore, 2010) and androphilic, compared with gynephilic, males with older brothers have lower birth weight (Blanchard & Ellis, 2001; VanderLaan et al., 2015). In a direct test of the mechanism, Bogaert et al. (2018) found that mothers of gay sons, and especially gay sons with older brothers, had elevated antibodies to neuroligin 4 Y-linked (NLGN4Y), which is a male-specific protein produced by the Y-chromosome thought to be involved in fetal brain development. Thus, the main tenets of the maternal immune hypothesis—influence of biological older brothers, altered development during the prenatal stage, and existence of maternal antibodies to male-specific fetal proteins related to sexual orientation—have received empirical support.

17.3.4 Brain Differences

Genetic, hormonal, and immunological influences are all thought to affect sexual orientation development via their effects on the brain. Identifying brain differences in relation to sexual orientation is, therefore, a key area of study within the field of sexual orientation biodevelopment. Evidence of sexual orientation differences in brain development come from studies of brain laterality as well as *in vitro* or *in vivo* measures of brain features.

Handedness (i.e., the degree to which an individual tends to use one hand over another to complete tasks) informs the degree to which one's brain functions are lateralized (i.e., [a]symmetrical across the left and right hemispheres) (Sun & Walsh, 2006). Although the exact causes of handedness are not fully known, it is thought that some combination of genetic, hormonal, and/or immunological factors influence its development (Arning et al., 2015; Galaburda et al., 1987; Geschwind & Behan, 1982; Geschwind & Galaburda, 1985; Gutwinski et al., 2011; Lust et al., 2011; Yeo et al., 1993). Further, the development of handedness is thought to take place prenatally (Gutwinski et al., 2011). As such, any association between sexual orientation and handedness would suggest differential development took place during the prenatal period. Compared to heterosexuals of the same sex, female gynephiles and male androphiles are more likely to be non-right-handed (i.e., left-dominant or ambidextrous) (Blanchard & Lippa, 2007; Ellis et al., 2017; Lalumière et al., 2000; Kishida & Rahman, 2015; Swift-Gallant et al., 2017; Swift-Gallant et al., 2019a; Xu & Zheng, 2017; cf. Miller et al., 2008; Rahman et al., 2009; Schwartz et al., 2010). In addition, male androphiles are more likely to be extremely right-handed than heterosexual men (Bogaert, 2007; Kishida & Rahman, 2015). These findings suggest that, to at least some degree, there are sexual orientation differences in brain biodevelopment that occur during the prenatal period.

With regard to the brain features that differ in relation to sexual orientation, post-mortem studies of brain tissue and *in vivo* studies using brain imaging techniques such as positron emission tomography (PET) or magnetic resonance imagining (MRI) have been informative. Structurally, a number of sexual orientation differences have been reported. Post-mortem, male sexual orientation differences have been reported in the suprachiasmatic nucleus (SCN; Swaab & Hofman, 1990), the third interstitial nucleus of the anterior hypothalamus (INAH-3; LeVay, 1991; partly replicated by Byne et al., 2001), and the anterior commissure (Allen & Gorski, 1992). The SCN, which is larger in gay than in heterosexual men, is involved in the regulation of circadian rhythm and is developmentally sensitive to prenatal testosterone (Swaab, 2008; Swaab & Hofman, 1990). INAH-3 is the human homologue of the sexually dimorphic nucleus (SDN) seen in other species (e.g., rodents) and is larger in males than in females (Allen et al., 1989; Gorski et al., 1978; Hines et al., 1985). Compared with heterosexual men, INAH-3 was smaller in gay men and heterosexual women (Byne et al., 2001; LeVay, 1991). The anterior commissure, which is larger in gay than in heterosexual men (Allen & Gorski, 1992), connects the left and right temporal cortices and may, therefore, be relevant to observed brain differences in lateralization (Swaab, 2008).

MRI studies that inform our understanding of brain structure in relation to sexual orientation have examined features such as cortical thickness, surface area, gray matter volumes (including subcortical structures), white matter tracts, and/or T1 relaxation time (generally reflecting brain tissue density). In cisgender participants, the structure of some brain regions in androphilic men and gynephilic women was found to be similar to that of heterosexuals of the other sex or in-between that of heterosexual men and women (Abé et al., 2014; Manzouri & Savic, 2017; Ponseti et al., 2007; Wang et al., 2020). Manzouri and Savic (2017) also found some regions in which androphilic men showed an exaggeration of the female-typical pattern in that their cortex was thicker than that of both heterosexual men and women. In studies of transgender individuals not receiving hormone therapy, results have been mixed. Some studies found regional brain patterns consistent with some alteration in brain sex differentiation. These include findings of regional brain masculinization among gynephilic transgender men (Simon et al., 2013; Zubiaurre-Elorza et al., 2013), feminization in androphilic transgender women (Luders et al., 2012; Simon et al., 2013; Zubiaurre-Elorza et al., 2013), or patterns in which gynephilic transgender men and androphilic transgender women were intermediate relative to cisgender men and women (Rametti et al., 2011a, 2011b). Other structural MRI studies found little-to-no differences between transgender and cisgender participants of the same sex assigned at birth (Hoekzema et al., 2015; Khorashad et al., 2020a). A study of 12- to 17-year-olds assigned female at birth who experienced gender dysphoria (i.e., distress related to an incongruence between sex assigned at birth and experienced gender) suggested it might be important to examine brain structure developmentally. For this group as well as for cisgender boys, the combination of gynephilia and being in later adolescence was associated (mostly) with greater cortical gray matter density (as reflected by T1 relaxation time), suggesting similarities in how brain structure changes with age (Skorska et al., 2021b).

Other studies have explored the functional neuroanatomy of sexual orientation, examining brain activation to sexually relevant stimuli in participants of varying sexual orientations. In a series of PET studies, putative pheromones were processed both by olfactory networks and the anterior hypothalamus, and the extent of hypothalamic activation varied according to sexual preference. That is, a compound present in male sweat induced a hypothalamic response in gay men and heterosexual women (Savic et al., 2005), whereas lesbians and heterosexual men responded to a compound found in female urine (Berglund et al., 2006). Similarly, in fMRI studies employing pictures of faces (Kranz & Ishai, 2006) and genitals (Ponseti et al., 2006) as sexual stimuli, the response in brain reward circuits was strongly biased toward one's preferred sex, with gay men and heterosexual women displaying male-favoring activations, and lesbians and heterosexual men showing female-favoring ones. Studies employing contextually rich (i.e., full-body) visual sexual stimuli have described similar activation patterns in lesbians and heterosexual men, both in reward regions and whole-brain networks (Safron et al., 2017, 2018, 2020). At the same time, they have described distinct patterns of activation in gay men and heterosexual women, suggesting that processing of sexual stimuli in gay men is not female-typical per se.

A separate but related line of research has mapped brain activation during sex-differentiated cognitive tasks, asking whether observed differences can be better attributed to sex or sexual orientation. In a study of emotional perspective-taking, Perry et al. (2013) found that activation in the tempo-parietal junction predicted the degree to which an individual was empathizing, but did not show a sex difference favoring females as one might expect. Instead, it differed according to sexual preference, with gay men and heterosexual women displaying more activation than lesbians and heterosexual men. Similarly, in an electroencephalography study of mental rotation (Wegesin, 1998), gay men, along with heterosexual women, showed less event-related potential slow-wave activity than heterosexual men, suggesting a female-typical processing strategy. Lesbians, by contrast, did not differ from either group, suggesting a partial “shift" in the male-typical direction. Even during rest, sexual orientation differences in brain function have been noted. For example, Savic and Lindström (2008) found that gay men resembled heterosexual women in their resting-state amygdala connectivity, whereas lesbians bore a closer (albeit less complete) resemblance to heterosexual men. Likewise, some research suggests that transgender participants not receiving hormone therapy show complete or partial similarities to cisgender participants who share the same experienced gender with respect to brain activation during sex-differentiated cognitive tasks (e.g., mental rotation) and resting-state functional connectivity of brain networks (for review, see Smith et al., 2015; Uribe et al., 2020).

17.3.5 Cross-cultural Research

Cross-nationally, prevalence rates of heterosexuality, bisexuality, and homosexuality appear to be relatively stable among women and men, suggesting that a common and stable set of factors underpin sexual orientation development across populations (Rahman et al., 2020).[2] Indeed, the genetic, hormonal, and immunological perspectives all posit mechanisms that could apply in any human population. Thus, evaluating whether findings bearing on these perspectives replicate across populations has been an important branch of research within the field of sexual orientation biodevelopment. Cross-national studies have helped establish sexual orientation biomarker patterns across broader sets of populations (e.g., Blanchard & Lippa, 2007; Manning et al., 2007; Peters et al., 2007). Other studies have focused on replicating effects seen among gay men and/or lesbian women in Western

[2] In the study by Rahman et al. (2020), prevalence rates varied depending on how sexual orientation was defined. For example, if sexual orientation was defined by heterosexual, bisexual, and homosexual identity, then prevalence rates were estimated at 90.7%, 7.2%, and 2.1% for women and 90.0%, 5.1%, and 4.9% for men. In contrast, if defined by sexual attractions that were predominantly not toward the same sex, moderately toward the same sex, or predominantly toward the same sex, then prevalence rates were estimated at 66.2%, 27.3%, and 6.5% for women and 82.6%, 10.2%, and 7.2% for men.

populations within non-Western populations less well represented in the literature (e.g., Bogaert & Liu, 2013; Li & Wong, 2018; Nila et al., 2019; Xu & Zheng, 2016). Among these are studies of non-Western "third" gender male androphiles, namely the markedly feminine Samoan *fa'afafine* (e.g., Vasey & VanderLaan, 2007), Istmo Zapotec *muxes* (e.g., Gómez et al., 2018), and Thai *sao praphet song* (e.g., Skorska et al., 2020). Recently, there has also been some relevant research on two Thai third gender groups of female gynephiles: markedly masculine *toms*, and feminine *dees* who engage in sexual and/or romantic relationships with *toms* (Skorska et al., 2021a; Thurston et al., 2021).

To date, this cross-cultural research has generally supported the universal applicability of biodevelopmental mechanisms more strongly in relation to male androphilia, whereas there has been less empirical work and more limited support in relation to female gynephilia. Regarding male androphilia, consistent with the genetic perspective, male androphilia appeared to cluster more so in the families of Samoan *fa'afafine* (Semenyna et al., 2017a; VanderLaan et al., 2013a, 2013b) and Istmo Zapotec *muxes* (Gómez et al., 2018) than in the families of their gynephilic male counterparts. Consistent with the hormonal perspective, compared with gynephilic males, androphilic males were shorter in height in China (Bogaert & Liu, 2013) and Thailand (Skorska et al., 2021a), had more feminine (i.e., higher) 2D:4D in China (Li et al., 2016; Xu & Zheng, 2016), Japan (Hiraishi et al., 2012), and Thailand (Skorska et al., 2021a), and showed poorer performance on the mental rotation task in Thailand (Thurston et al., 2021). Consistent with the maternal immune hypothesis, the fraternal birth order effect was documented in Hong Kong (Li & Wong, 2018), Samoa (VanderLaan & Vasey, 2011), Indonesia (Nila et al., 2019), Iran (Khorashad et al., 2020b), and among the Istmo Zapotec (Gómez Jiménez et al., 2020). Further, compared with male gynephilia, male androphilia has been associated with a greater likelihood of left-handedness or ambidextrousness in China (Xu & Zheng, 2017) and Thailand (Skorska et al., 2020) as well as of extreme right-handedness in Thailand (Skorska et al., 2020). Thus, male same-sex sexual orientation appears to be associated with differential prenatal brain development in non-Western populations as well.

The relatively smaller empirical literature bearing on the biodevelopment of female gynephilia across cultures has produced mixed findings. In cross-national studies, researchers have found no relation between 2D:4D and sexual orientation (Manning et al., 2007), but have found that female gynephilia was associated with left-handedness or ambidextrousness (Blanchard & Lippa, 2007). In studies that were focused more specifically on non-Western populations, female gynephilia was associated with non-right-handedness in China (Xu & Zheng, 2016) and more masculinized 2D:4D in Japan (Hiraishi et al., 2012). In Thailand, however, there do not appear to be female sexual orientation differences in physical characteristics such as height or 2D:4D (Skorska et al., 2021a), handedness (Skorska et al., 2019), or mental rotation abilities (Thurston et al., 2021). Overall, then, support for the universal applicability of biodevelopmental mechanisms in relation to female gynephilia across populations appears to be more limited, although further research is necessary.

17.3.6 Summary Regarding Biodevelopmental Mechanisms

Genetic, hormonal, and immunological perspectives have been forwarded to explain the development of same-sex sexual orientation. Although the precise mechanisms are not entirely clear, each of these perspectives has received some empirical support and holds promise. As would be expected based on these perspectives, some aspects of brain development do appear to unfold differently in relation to sexual orientation. Additionally, although cross-cultural research suggests that the biodevelopmental mechanisms influencing same-sex sexual orientation apply across populations in the case of male androphilia, the findings are less clear about whether the same is true of female gynephilia.

17.4 One Biodevelopmental Pathway or Many?

For the most part, the various biodevelopmental processes proposed to explain variation in sexual orientation have been investigated in isolation from one another. As a consequence, whether these processes are additive or orthogonal has remained an open question. If it could be demonstrated that genetic, hormonal, and/or immunological processes combine to affect sexual orientation development, then it would suggest their influences are additive. If, however, these processes were found to be independent of one another or that each process applied to only a subset of same-sex oriented individuals, it would suggest that the hypothesized mechanisms operate orthogonally. In this section, we summarize recent work bearing on these possibilities that aims to carve the biodevelopment of same-sex sexual orientation at its joints.

17.4.1 Evidence of Biodevelopmental Subgroups

A recent study by Swift-Gallant et al. (2019a) addressed the question of whether same-sex sexually oriented men belong to one or more biodevelopmental groups. Three biomarkers associated with male sexual orientation in past research were examined: fraternal birth order, handedness, and proportion of male relatives who showed same-sex sexual orientation (i.e., bisexual or gay). These biomarkers provided proxies for processes related to maternal immune responses, brain lateralization, and genetics, respectively. Using latent profile analysis, they examined whether these biomarkers clustered in the same individuals or were present in different subgroups. Their analysis revealed four subgroups of participants who showed either: (1) no indication of any biomarker patterns associated with same-sex sexual orientation, (2) later fraternal birth order, (3) greater non-right-handedness, or (4) higher proportion of same-sex sexually oriented male relatives. Whereas the

participants in the first subgroup were disproportionately heterosexual, those in the latter three subgroups were disproportionately nonheterosexual (i.e., bisexual or gay). Thus, these biomarkers apply more so to nonheterosexual men—as would be expected—and each biomarker applies to a particular subgroup of men, suggesting that the processes underpinning these biomarkers operate orthogonally. Of note, these results are in line with prior work indicating that the fraternal birth order effect is independent of sexual orientation effects associated with handedness (Blanchard, 2008a; Bogaert & Skorska, 2011) and familiality (Blanchard & Bogaert, 1997).

In another recent study, Ganna et al. (2019) reported on correlations between genotypes that distinguished those who had versus had not engaged in same-sex sexual behavior and physical characteristics of putative relevance to hormonal influences on sexual orientation such as height and 2D:4D. Genotypes distinguishing those who had versus had not engaged in same-sex sexual behavior were not associated with these physical characteristics. The lack of associations suggests that hormonal mechanisms do not overlap with genetic influences on sexual orientation development. Genetic and hormonal biodevelopmental processes might, therefore, operate orthogonally. However, a study comparing androphilic transgender women (male androphiles) and gynephilic transgender men (female gynephiles) with heterosexual cisgender men and women found differences in genetic polymorphisms that affect androgen and estrogen receptors (Fernández et al., 2018), suggesting that genes might exert influences by affecting the action of hormones via receptors. As such, further research on the possible links between genetic and hormonal mechanisms is warranted.

Another approach to evaluating whether there are biodevelopmental subgroups with respect to same-sex sexual orientation has involved investigating whether biomarkers apply to particular subsets of individuals. For example, Cantor et al. (2002) developed a mathematical formula for estimating the proportion of gay men who owe their sexual orientation to the fraternal birth order effect. Using this formula in conjunction with birth order data from national probability samples, this proportion was estimated to be 15% to 29% (Blanchard & Bogaert, 2004).

Other studies have delineated subgroups of gay men on the basis of anal sex role orientation and compared these subgroups on biomarkers associated with male sexual orientation. This approach was suggested by Wampold (2013), who reasoned that the fraternal birth order effect might apply more so to gay men with a receptive (i.e., bottom) anal sex role orientation. Specifically, Wampold suggested such might be the case because bottoms tend to score as more feminine on measures of gender expression (Moskowitz & Hart, 2011; Zheng et al., 2012, 2015) and the fraternal birth order effect was apparent in a number of studies of transgender male androphiles (e.g., Gómez-Gil et al., 2011; Green, 2000; VanderLaan & Vasey, 2011). This prediction was supported in subsequent studies showing the fraternal birth order effect applies to bottoms, but not to gay men with an insertive (i.e., top) anal sex role or those who take either an insertive or receptive role (i.e., versatile) (Swift-Gallant et al., 2018; Wampold, 2018).

Gay men's anal sex roles have also been investigated in relation to handedness and physical characteristics influenced by the action of androgens. The association

between non-right-handedness and sexual orientation applied more so to gay men with a receptive (bottom or versatile) anal sex role than it did to tops (Swift-Gallant et al., 2017), suggesting brain lateralization varies according to these subgroups. Regarding physical characteristics, gay men with a top anal sex role orientation showed patterns of physical development indicating greater action of androgens; tops tended to be taller, had harrier bodies, and began puberty earlier than other gay men and heterosexual men (Swift-Gallant et al., 2019b). In contrast, bottom gay men reported having less body hair than tops and heterosexual men, suggesting lower action of androgens (Swift-Gallant et al., 2019b). Thus, the patterns of physical development among tops and bottoms are consistent with the hypothesis that both higher and lower levels of androgen action during development could be related to male androphilia, as explained further in this chapter's Spotlight Feature by Swift-Gallant and Monks (see also Bogaert & Hershberger, 1999; Skorska & Bogaert, 2017a).

This series of studies raises questions about the causal links between biodevelopment and anal sex role orientation. One possibility is that in addition to influencing sexual orientation, biological processes directly influence one's predilection for receptive or insertive anal sex. Alternatively, biodevelopment and anal sex role might be linked indirectly. Because topping is stereotyped as masculine in gay male subculture (Dangerfield II et al., 2017), and there are differences between tops and bottoms in gender expression, it may be that gender expression is the more proximal factor linked to biodevelopment that drives the observed subgroup patterns. For further discussion of this complex issue, see this chapter's Spotlight Feature by Moskowitz.

17.4.2 Does Gender Expression Reflect Distinct Same-Sex Sexual Orientation Biodevelopmental Pathways?

Brain sexual differentiation is thought to result in a range of phenotypes that vary along a continuum from female- to male-typical (Hines, 2020). With respect to brain areas underpinning sexual orientation, biological perspectives posit that same-sex sexually oriented individuals are "shifted" along this dimension in the direction of the other sex (Balthazart, 2020; Bogaert & Skorska, 2020). Such shifts might also influence other aspects of brain and behavior. Gender expression— i.e., the degree of masculine and/or feminine gender role behavior and/or identification—has been studied in-depth in relation to sexual orientation. Across cultures, sexual orientation differences have been observed in gender (non)conformity (i.e., the degree to which an individual's gender expression conforms to cultural norms or stereotypes associated with their sex). Compared with their other-sex sexually oriented counterparts, female gynephiles tend to be less feminine and/or more masculine, whereas male androphiles tend to be less masculine and/or more feminine (Bailey & Zucker, 1995; Cardoso, 2005; Li et al., 2017; Petterson et al., 2017; Rieger et al., 2008;

VanderLaan et al., 2016, 2017a, 2017b; VanderLaan & Coome, 2018; Whitam & Zent, 1984). These findings suggest that "shifts" in brain development associated with sexual orientation extend to other domains, with gender expression being a particularly important one within the literature.

However, sexual orientation differences in gender expression are not absolute. Not every same-sex sexually oriented individual displays gender nonconformity. Rather, people who vary in sexual orientation differ in gender expression on average. Thus, although there is a tendency for same-sex sexually oriented people to be gender-nonconforming on average, there is overlap in gender expression among members of the same sex who belong to different sexual orientation groups (for further discussion on interpreting group differences, see Del Giudice, n.d.). It might be the case, then, that only some subsets of same-sex sexually oriented individuals undergo a "shift" in brain development along the female-male continuum in domains beyond sexual orientation.

Indeed, whether variation in gender expression among same-sex sexually oriented individuals is meaningful with respect to biodevelopment has long interested researchers in this field (e.g., Blanchard, 1989; Gooren, 2006). Figure 17.1 depicts three theoretical possibilities regarding the ways that gender expression might relate to sexual orientation biodevelopment. The first and simplest possibility is that gender expression is not related to sexual orientation biodevelopment. In this case, biomarkers associated with sexual orientation would be related to sexual orientation, but not to gender expression (Fig. 17.1a).

Second, variability in gender expression among same-sex attracted individuals of the same sex might reflect differences in the "dose" or amount of exposure to a particular biological process that shifts brain development along the female-male continuum (Fig. 17.1b). It is thought that a higher dose of exposure would be associated with wider impact on the brain and behavior and, therefore, lead to a phenotype consisting of both same-sex sexual orientation and gender nonconformity (Blanchard, 1989). Thus, a possible dosage effect would be reflected in cases where a biomarker is evident among same-sex sexually oriented individuals who are gender-conforming, but especially among those who are more markedly gender-nonconforming or transgender.

The third theoretical possibility is that multiple, distinct biological mechanisms influence same-sex sexual orientation and that these mechanisms have varying effects on gender expression (Fig. 17.1c). In this scenario, one or more developmental pathways involve biological processes that only affect sexual orientation, while there are also one or more other pathways in which both sexual orientation and gender expression are affected. If so, when delineating same-sex sexually oriented individuals into subgroups on the basis of gender expression, biomarkers associated with sexual orientation would either apply to only certain subgroups or would show different patterns of association across the subgroups.

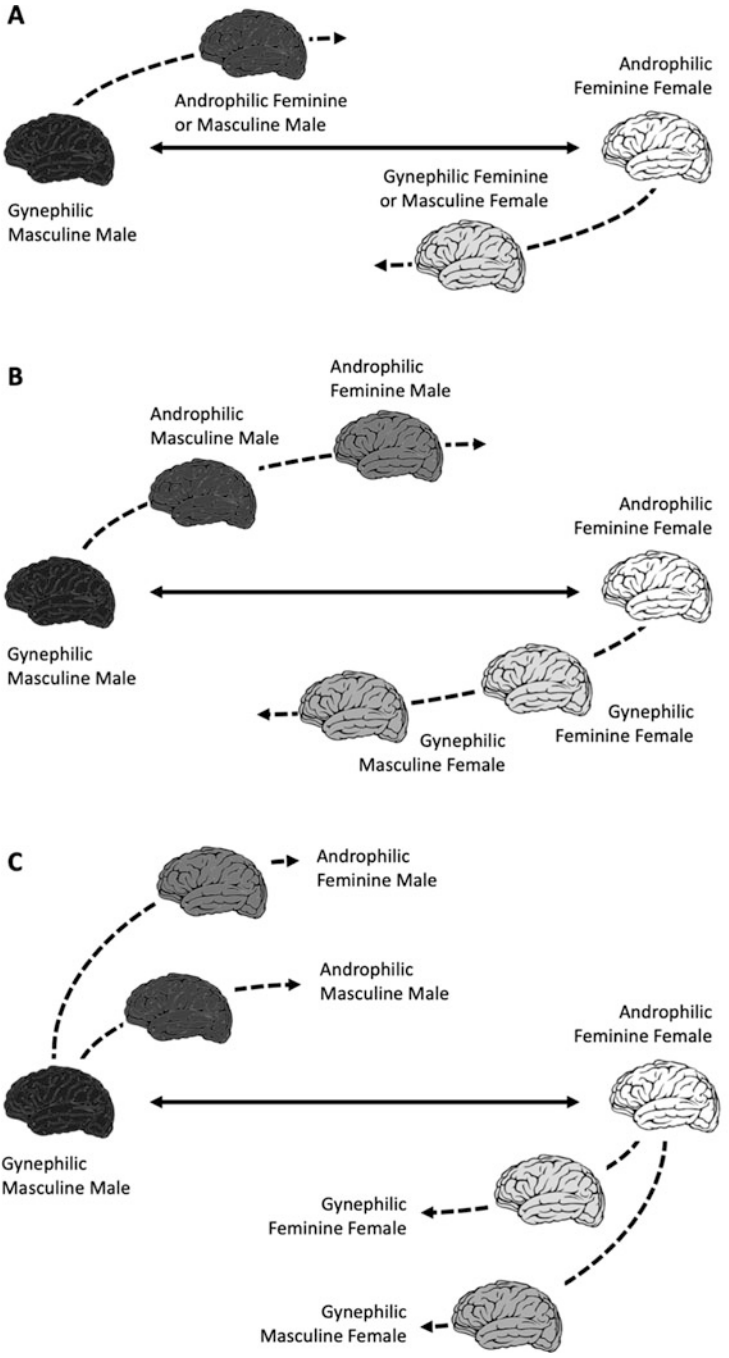

Fig. 17.1 Biodevelopmental pathways of gender expression variability in same-sex sexual orientation. The panels depict different theoretical possibilities. Variation in masculine-feminine gender expression could (**a**) be independent from biodevelopmental mechanisms influencing same-sex

17.4.3 Research on Gender Expression and Sexual Orientation Biodevelopment

This subsection provides an overview of research bearing on the three theoretical possibilities described above in the areas of genetics, neuroendocrinology, immunology, and brain development, respectively. To preface, the current state of the field is equivocal with regard to which of these three possibilities is most accurate. Research on this topic is still very much a work in progress and no firm conclusions can be drawn at this time. Our immediate goal here is to illustrate approaches to evaluating these possibilities and detail the evidence bearing on them. In doing so, we aim to highlight the potential value of considering gender expression along with sexual orientation as a way to help move the field forward.

Regarding genetic influences, there have not been any findings to date that clearly suggest variation in gender expression delineates different same-sex sexual orientation pathways. Based on research with twins, common genetic factors appear to underlie both adulthood sexual orientation and degree of recalled childhood gender (non)conformity (Alanko et al., 2010; Burri et al., 2015), suggesting that these traits do vary together to some extent based on heritability. Other twin research suggests that childhood gender nonconformity is most heritable when it is more marked, particularly for girls (Knafo et al., 2005); however, no studies to date have reported that the heritability of same-sex sexual orientation increases as the degree of gender nonconformity increases.

Studies of familial clustering of same-sex sexual orientation tend to suggest it is unlikely to do so. For example, in Swift-Gallant et al.'s (2019a) study of biodevelopmental subgroups, the subset of participants with higher proportions of same-sex sexually oriented male relatives were relatively more gender-conforming compared with other biodevelopmental subgroups. Also, an Istmo Zapotec study found that third gender androphilic male *muxes* had more same-sex sexually oriented family members than did gynephilic men, but there were no familiality differences between markedly feminine transgender *muxes* and relatively more masculine cisgender *muxes* (Gómez et al., 2018). As such, with regard to genetic influences on sexual orientation, clear evidence indicative of a dosage effect or multiple, distinct pathways is lacking. In other words, there is no evidence to suggest that genes influence variation in gender expression among male androphiles or female gynephiles. That said, there have been few studies on this topic and more research is warranted.

Research on putative biomarkers of hormonal mechanisms has produced mixed findings regarding same-sex sexual orientation biodevelopmental pathways related to gender expression. Some studies of physical characteristics have supported the

Fig. 17.1 (continued) sexual orientation, (**b**) reflect the amount or "dose" of exposure to a biodevelopmental mechanism influencing same-sex sexual orientation, or (**c**) reflect exposure to different biodevelopmental mechanisms influencing same-sex sexual orientation

existence of multiple, distinct pathways. One example is the aforementioned difference between gay male tops and bottoms. Tops—who tend to be more masculine—are taller and harrier on average, whereas bottoms—who tend to be more feminine—have less body hair (Swift-Gallant et al., 2019b). Findings regarding 2D:4D have been inconsistent. Although a meta-analysis found no effect of male sexual orientation in relation to 2D:4D (Grimbos et al., 2010), other meta-analytic research has suggested that digit ratio is more female-typical among transgender women (i.e., males who identify as women) than in cisgender men (Siegmann et al., 2020). Thus, female-typical 2D:4D might be more apparent in more markedly feminine male androphiles. Cross-culturally, however, recent research comparing Thai gynephilic men, gay men, and *sao praphet song* (transgender male androphiles) does not align with these findings. Compared with Thai gynephilic men, *sao praphet song* are shorter and both gay men and *sao praphet song* have more female-typical digit ratios, but the height and 2D:4D of gay men and *sao praphet song* does not differ from each other (Skorska et al., 2021a). Likewise, compared with Thai gynephilic men, gay men and *sao praphet song* perform more poorly on the mental rotation task, but do not perform differently from each other (Thurston et al., 2021).

Findings pertaining to female sexual orientation have also provided inconsistent results. For example, some research has reported that, compared with more feminine (femme) lesbians, more masculine (butch) lesbians have more male-typical 2D:4D (Brown et al., 2002), have higher circulating levels of testosterone (Singh et al., 1999), have higher scores on measures of child and adult gender nonconformity (Singh et al., 1999; Zheng & Zheng, 2016), are more likely to be tops (Singh et al., 1999), have higher (more masculine) waist-to-hip ratios (Pearcey et al., 1996), and perform better on tests of mental rotation (Zheng et al., 2018). In contrast, a meta-analysis of transgender men (i.e., females who identify as men) found no difference in 2D:4D from a comparison group of cisgender women (Siegmann et al., 2020). In addition, Thai research found that groups of female gynephiles—including lesbian and bisexual women, *dees*, and *toms*—tended to be similar to heterosexual women with regard to 2D:4D and height/long-bone growth (Skorska et al., 2021a). The same pattern was found for mental rotation test performance (Thurston et al., 2021). Yet, there were some differences found between groups of Thai female gynephiles. *Toms* and lesbian women showed evidence of greater long-bone growth than *dees* (Skorska et al., 2021a), and lesbian and bisexual women outperformed *dees* on the mental rotation test (Thurston et al., 2021). These patterns might reflect gender expression differences given that *dees* tend to be more gender-conforming than these other groups of Thai female gynephiles (VanderLaan & Coome, 2018). Thus, although some studies relevant to hormonal mechanisms support the possibility of dosage effects or multiple, distinct same-sex sexual orientation biodevelopmental pathways delineated by gender expression, other studies do not. Given the existing literature is inconsistent regarding which pattern is more supported for both male and female sexual orientation, further research on this topic is required in both sexes.

Regarding maternal immune influences, there has been some evidence to suggest a dosage effect in relation to gender expression. The clearest demonstration was

provided in a meta-analysis by Blanchard (2018), who examined the magnitude of the fraternal birth order effect in two groups: cisgender gay/homosexual men and more markedly feminine or transgender male androphiles. The fraternal birth order effect was evident in both groups, but stronger in the latter group. This pattern is consistent with studies described previously in which the fraternal birth order effect applies more so to bottom gay men, who tend to be more feminine (Swift-Gallant et al., 2018; Wampold, 2018). It is also consistent with Swift-Gallant et al.'s (2019a) finding that the biodevelopmental subgroup of men with later fraternal birth order tended to be more feminine than other subgroups.

Several other studies of fraternal birth order have not produced results consistent with a dosage effect. Many of these studies found no correlation between fraternal birth order and gender expression among male androphiles at the individual level (Bogaert, 2003a; Kishida & Rahman, 2015; Semenyna et al., 2017b; Swift-Gallant et al., 2018; but also, see Coome et al., 2018). Also, although there does appear to be a fraternal birth order effect among Istmo Zapotec *muxes*, the magnitude of the effect does not appear to differ between transgender and cisgender *muxes* (Gómez Jiménez et al., 2020). The results of these studies would suggest that fraternal birth order influences sexual orientation but not gender expression; however, the lack of support for a dosage effect in these studies might reflect that they had weaker statistical power to detect a dosage effect than the meta-analytic study by Blanchard (2018).

Last, there is some research to suggest that considering gender expression along with sexual orientation can provide insight concerning brain development. More gender-nonconforming or transgender expressions of male androphilia are associated with greater likelihood of extreme right-handedness or non-right handedness/extreme left-handedness, whereas more gender-conforming or masculine expressions of male androphilia are associated with more extreme right-handedness only (Kishida & Rahman, 2015; Skorska et al., 2020; Swift-Gallant et al., 2017). Extreme right- or left-handedness has been associated with lower prenatal testosterone (Lust et al., 2011). As such, Skorska et al. (2020) speculated that these handedness patterns could indicate that lowered prenatal testosterone is associated with brain development among more feminine male androphiles, whereas some alternate mechanism (s) might apply in the case of more masculine male androphiles.

MRI studies have also reported findings consistent with the notion that brain development among same-sex sexually oriented individuals varies according to gender expression. In a study of brain white matter tracts in which heterosexual sex differences in tissue microstructure were observed, homosexual participants showed little to no difference from same-sex heterosexuals; however, differences were more pronounced when heterosexual men and women were compared with transgender women (androphilic males) and men (gynephilic females), respectively (Burke et al., 2017). In another study, Manzouri and Savic (2019) examined both brain structure and resting-state functional connectivity. Among their cisgender and transgender participants, attraction to the same birth-assigned sex was associated with cortical thickness that was intermediate relative to other-sex attracted cisgender controls, but transgender participants were unique in that they showed a different pattern of functional connectivity within a brain network thought to be involved in

body representation. Further, in an fMRI study of regional brain activation while performing a mental rotation task, several regions were found to show differential activation between heterosexual men and women; in these regions, gender-nonconforming, but not gender-conforming, gay men showed more female-typical activational patterns when compared with heterosexual men (Folkierska-Żukowska et al., 2020). Together, these studies suggest there are structural and functional brain differences among same-sex sexually oriented individuals who vary in gender expression. The available brain research is consistent, therefore, with the hypothesis that variation in gender expression among same-sex attracted individuals of the same sex reflects differences in biodevelopment.

17.4.4 Summary Regarding Biodevelopmental Pathways

In this section, we provided an overview of research that is relevant to carving the biodevelopment of same-sex sexual orientation at its joints. Although research attempting to do so has been limited in several respects, a few tentative conclusions can be drawn. Namely, there is some evidence to suggest that the biodevelopmental processes underpinning sexual orientation can operate independent of one another—although more research is needed to discern which mechanisms, if any, combine in an additive fashion to influence sexual orientation and which are truly orthogonal. Further, subgroups of male androphiles and female gynephiles might owe their sexual orientations to different mechanisms. Investigating the possible existence of such biodevelopmental subgroups can be aided by considering whether traits that vary among same-sex sexually oriented individuals help delineate subgroups. Such traits include anal sex role orientation and gender expression. Using these traits to delineate subgroups can illuminate different kinds of biodevelopmental pathways, including pathways that reflect dosage effects or the existence of multiple, distinct processes. At present, the evidence bearing on which of the possible biodevelopmental pathways applies is mixed and also varies depending on the mechanism under consideration (e.g., genetic, hormonal, immunological). Thus, further research in this area is needed.

17.5 Future Directions

To date, theory and research regarding the existence of varying biodevelopmental pathways to same-sex sexual orientation has been relatively limited. Here, we summarized past theorizing and laid some additional philosophical groundwork. We also described where the empirical literature stands. Current evidence suggests that the possibility of varying biodevelopmental pathways holds promise. Thus, advancing empirical research on this topic could be an important step toward

uncovering the complexity of same-sex sexual orientation biodevelopment. Going forward, then, how might we better carve its biodevelopment at its joints?

Early in the chapter, we acknowledged that current understanding of sexual orientation biodevelopment is necessarily constrained by the manner in which the construct itself has been defined and investigated. As a consequence, current understanding pertains primarily to the biodevelopment of female gynephilia and male androphilia. There are, however, a number of additional parameters of sexual orientation that have been raised in the literature. For example, these other parameters include age groups that one is attracted toward (Seto, 2017); the degree to which sexual orientation toward different categories of people is "fluid" or varies over time (Diamond et al., 2020); romantic attractions (e.g., Diamond, 2003; Savin-Williams, 2016); gender role presentation (Maybach & Gold, 1994); the degree to which attractions are directed toward others versus oneself (Hsu & Bailey, n.d.) or toward others versus no one (Brotto & Milani, n.d.); and one's interest in monogamous versus non-monogamous relationships (Hamilton & Winward, n.d.). Each of these parameters might be biodevelopmentally dissociable from the dimension of androphilia-gynephilia and, thus, identifying if and how would help carve the nature of sexual orientation at its joints. Of course, in investigating these other parameters, we must be cognizant of the possibility that some of them could very well go hand-in-hand with androphilia and/or gynephilia. In that case, to again draw on Socrates's metaphor, we must be careful not to break any part, in the manner of a bad carver.

Even within the androphilia-gynephilia dimension, certain sexual orientation groups have received less attention. Biodevelopmental research has tended to focus on male androphilia more often than on female gynephilia. In the case of studies related to the maternal immune hypothesis, this discrepancy is understandable because the hypothesis pertains to male, but not female, sexual orientation, and empirical data support this point (Bogaert & Skorska, 2011). Otherwise, this discrepancy represents an aspect of the literature that could be improved upon through greater efforts to ensure that future research considers both male and female sexual orientation. Additionally, biodevelopmental research has often been inconsistent in the way it approaches those who experience sexual attractions to both males and females (i.e., bisexual or *ambiphilic* individuals, as well as individuals who report being mostly, but not exclusively, heterosexual or homosexual). Studies have either combined such participants with exclusively same-sex sexually oriented participants to form nonheterosexual groups (e.g., Blanchard, 2008b; Bogaert & Blanchard, 1996; Swift-Gallant et al., 2019a), compared them to both heterosexual and homosexual participants (e.g., Camperio Ciani et al., 2018; Ganna et al., 2019; Peters et al., 2006), or discarded their data from analyses (e.g., Schwartz et al., 2010; Skorska et al., 2015). People whose sexual orientation is bisexual/ambiphilic show patterns of sexual arousal that differ from those of members of the same sex who are exclusively androphilic or gynephilic (Jabbour et al., 2020; Lippa, 2013; Rieger et al., 2015; Safron et al., 2017; Safron et al., 2018). As such, it is conceivable that the biodevelopment of bisexual/ambiphilic, mostly heterosexual, and mostly homosexual individuals is unique in some way(s). Future research should investigate this possibility at greater depth.

Research on sexual orientation biodevelopment should also expand its scope to include consideration of a broader range of mechanisms. Even in studies that consider multiple mechanisms, it is common for participants to not have any of the biomarkers associated with hypothesized biodevelopmental processes; for example, the majority of same-sex sexually oriented men do not have a preponderance of older brothers, display ambidextrous or left-handedness, or show an elevated proportion of gay or bisexual relatives (Swift-Gallant et al., 2019a). Of course, these biomarkers are merely proxies of biodevelopmental processes. As such, one has to be mindful that the absence of these biomarkers does not necessarily mean that genetic, hormonal, or immunological processes did not impact one's sexual orientation development. Yet, there is still room to integrate other kinds of mechanisms into biodevelopmental research. For example, possible epigenetic processes whereby sex hormones differentially impact gene expression have been described (e.g., Ngun & Vilain, 2014). Also, some research shows that the combination of male androphilia and being an only child is associated with a lower birth weight, possibly indicating a second type of maternal immune mechanism separate from the one associated with the fraternal birth order effect (Blanchard, 2012; Skorska et al., 2017; Skorska & Bogaert, 2020; VanderLaan et al., 2015). Additional mechanisms may be awaiting discovery.

Perhaps most important for propelling the field forward will be the acquisition of datasets capable of facilitating the detection of different biodevelopmental pathways. This area of research would benefit tremendously from studies that obtain data on as many biological mechanisms as possible from each participant. Information on traits such as gender expression that might be useful for delineating subgroups will also be key. With a large number of variables, detecting different pathways will depend on the use of multivariate analytic techniques. Such techniques typically require large sample sizes for adequate statistical power. It would be especially beneficial if these were nationally representative samples with large numbers of same-sex attracted participants, thus allowing for greater generalizability of the findings.

Last, given that the pre- and peri-natal periods are often the focus of biodevelopmental theories of sexual orientation, longitudinal follow-up studies are ideal. Some unique cohort studies have made it possible to investigate the effects of prenatal exposure to exogenous progesterone or estrogen (Ehrhardt et al., 1985; Reinisch et al., 2017; Troisi et al., 2020) or other relevant early-life factors such as birth weight (e.g., Xu et al., 2019) related to sexual orientation. Future longitudinal research that measures a large number of relevant biological variables during the prenatal period and through development, gender expression from early childhood onward, and adolescent and/or adulthood sexual orientation and brain structure and function in a large number of participants would provide the ideal opportunity to further carve the biodevelopment of sexual orientation at its joints. Such a study would undoubtably be an immense challenge. It would require assembling teams of researchers with a wide variety of expertise as well as substantial time and monetary resources. As such, smaller-scale versions of this vision would be more realistic. Still, we mention such a large-scale longitudinal study here because it represents the field's holy grail.

17.6 Conclusions

The biodevelopment of sexual orientation is an important area of study. It helps expand our understanding of a core aspect of human experience. Also, the knowledge gained can inform other important fields, including research on the origins of sex differences in psychology and brain health. Here, we engaged in a Socratic exercise that guided our discussion of two key aspects of research on same-sex sexual orientation biodevelopment. First, regarding the phenotypes of primary interest, studies in this field have been most focused on explaining the biodevelopment of female gynephilia and male androphilia. Second, regarding the issue of discerning discrete categories, there has been some research to suggest that biodevelopmental subgroups of same-sex sexually oriented individuals exist. Thus, it is plausible that different biodevelopmental processes influence sexual orientation independent of one another. Certain variables such as anal sex role orientation and gender expression have the potential to help delineate biodevelopmental subgroups.

In light of our theoretical discussion and review of empirical studies, further study of this topic holds merit as a potentially fruitful avenue of future research. Such research could benefit from considering additional parameters of sexual orientation beyond androphilia-gynephilia as well as from making greater efforts to focus on sexual orientations that have received relatively less attention in the past (e.g., bisexuality). In our view, acquiring information on various biologically relevant variables from a large number of participants will be especially key to discerning different biodevelopmental pathways. We expect that doing so would be a challenging but extremely worthwhile endeavor. Indeed, it may represent our best opportunity to further carve the biodevelopment of same-sex sexual orientation at its joints.

Spotlight Feature: Born to Bottom?

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Questions surrounding the origins and mutability of the sexual self-identities of gay, bisexual, and other men who have sex with men have always played understudy to those surrounding the origins and mutability of sexual orientation and gender identity. Few scholars will argue that sexual orientation and gender identity are "nurtured," or are strictly developed from childhood and adolescent socialization. It is almost unanimously recognized that both sexual orientation and gender identity are influenced, at least in part, by a confluence of prenatal biological factors (O'Hanlan et al., 2018). However, where sexual self-identities come from is still a mystery, and the debate continues into whether men who identity as tops, bottoms, or versatiles are born that way, or made that way. Since early work by Joseph Carrier 50 years ago (Carrier, 1971, 1977), researchers have recognized the existence of anal sex roles. Initially, the theoretical framework (up until the early 2000s) was that, given men have the same genitals, an implicit or explicit decision is made as to who would be receptive versus insertive during anal sex; and that decision could be predicted largely by "active, activo, dominant" or "passive, passivo, submissive" personas adopted by partners (Hickson et al., 1993; Ho & Tsang, 2000; Wegesin & Meyer-Bahlburg, 2000; Weinrich et al., 1992). These were to a reliable degree, transmitted to, and perceived by, sex partners prior to the sexual encounter and thus, facilitated the anal sex.

Over the past 15 years, scientific inquiries have focused on the contributing factors to men's orientations towards bottoming or topping, and the degree to which it permeates into other sexual realms (Hart et al., 2003). Many studies, including my own, began exploring the social influencers of sexual self-identity adoption, the most consistent being gender typicality (i.e., outward gender presentation as masculine or feminine) and self-reported penis size (Brennan, 2018; Grov et al., 2010, 2015; Moskowitz & Hart, 2011). My more recent study, exploring a larger model predicting preferences for topping or bottoming, found far more nuanced and indirect relationships at play (Moskowitz & Roloff, 2017). For example, smaller penis size was actually a predictor of sexual anxiety when topping, which led to more bottoming; gender typicality was actually a partner-oriented trait that acted to signal sexual self-identity to other men. These findings pointed to sexual self-identity being learned. Moreover, the same study found men self-reported adopting sexual self-identities, on average, about 2.6 years after beginning to have anal sex, or around 24.6 years old, further suggesting that having sex socialized men into their identities (see Fig. 17.2).

At the same time as the above findings were published, researchers were reporting compelling results to suggest that biological markers were correlated with different sexual self-identities (Swift-Gallant et al., 2017, 2018). This forced the question: If

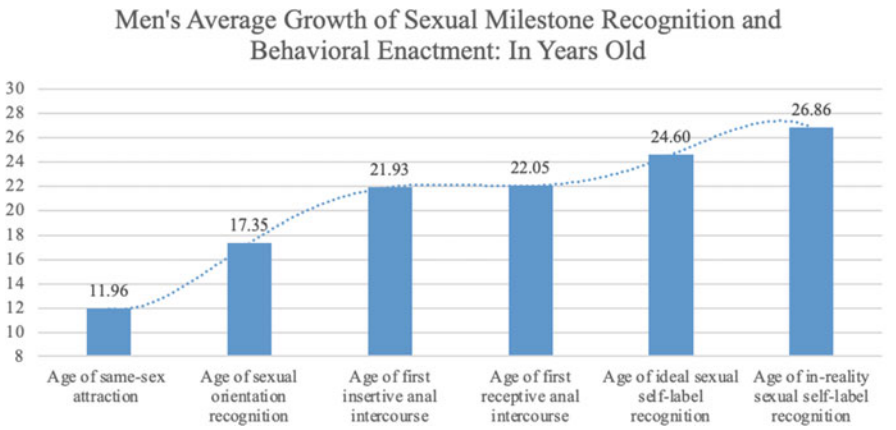

Fig. 17.2 From Moskowitz and Roloff (2017), men's average growth of sexual milestone recognition and behavioral enactment by their ages. The data represent the mean ages at specific milestones from 282 men, ages 18–76

biological markers were differentially exhibited, could that indicate an underlying biological mechanism that made men more or less likely to adopt a top, bottom, or versatile identity? In response, we conducted a study with 15- to 18-year-olds, both sexually experienced and inexperienced, to see whether they were already developing a sexual self-identity (see Moskowitz et al., 2022). After all, if there was a biological predisposition at play, pubescent teenagers, regardless of sexual experience, should report some gravitation to a sexual self-identity. Of the over 300 teenagers surveyed, only nine did not yet identify with a sexual self-identity. Moreover, of the 56 teenagers who reported never having anal sex in their lives, 48 (85.7%) reported already having a sexual self-identity. Besides testing for degree of early adoption of a sexual self-identity, this study also retested the previous findings about penis size and gender typicality as socialized signaling tools reported by Moskowitz and Roloff (2017). Specifically, in that sample of sexually active adult men, penis size, and gender typicality impacted anal sex role because of sociosexual reactions (i.e., by causing role anxiety and by causing partner selectivity to increase anal sex compatibility). Yet, when comparing sexually active (i.e., having had anal sex) and sexually inactive (i.e., never having anal sex) teenagers, the relationships between having a larger penis and topping, and being more masculine and topping, were significant for both groups. These new findings suggested that penis size and gender typicality may not be activated by the experience of having sex to create a top or a bottom and may instead be influenced by biological influences on sexual self-identity formation.

Origins aside, there remains the question of sexual self-label mutability, which is far less controversial. Research has shown that one's ideal sexual self-label and their actual enacted sexual behaviors, while generally reliable, can deviate (Dangerfield et al., 2018; Johns et al., 2012; Moskowitz & Hart, 2011; Pachankis et al., 2013). These deviations are usually a function of their partners and not necessarily the men

themselves. My own study into sexual self-identities among men in relationships highlights this fact (Moskowitz & Garcia, 2019). In our sample, an overwhelming majority (63%) of the men in romantic partnerships reported acting as a sexual self-identity different than their ideal one. In a different sample of men, many of whom were single, the number reporting different (but current) ideal and enacted sexual self-identities was 35% (Moskowitz & Hart, 2011). Finally, unpublished data from the sample of men described by Moskowitz and Roloff (2017) showed that, when asked whether their sexual self-label had changed over time, 69% reported some degree of movement; however, the majority (55%) reported only one degree of movement (e.g., from being an exclusive top to a versatile top, from being an exclusive versatile to a versatile bottom).

There is the temptation to want to categorize sexual self-identity mutability as evidence of labels being socialized. For if individuals migrate, even one degree, perhaps that means they have decided to move identities for themselves, in reaction to their environment. Yet, humans routinely behave in ways that may be counterintuitive, self-sacrificing, and unexpected, especially regarding sex. Even as I have found some evidence to suggest being a top or bottom may be learned over time, I have found equally compelling data to suggest it is nested in a biological basis for sexual orientation and gender development. In all likelihood, if sexual self-identity is nested in biology, it will only be through more complete scientific understanding of the relationships between sexual orientation, gender identity and gender role progression, and *all* of their biological correlates that we will be able to identify who is born to top and who is born to bottom.

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Spotlight Feature: Evidence for a Curvilinear Androgen Dose Response in Sexual Differentiation of Brain and Behavior

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For over 60 years, we have known that gonadal testosterone is a primary endocrine factor shaping sex differences in brain and behavior (Phoenix et al., 1959; reviewed in Swift-Gallant & Monks, 2017). Testosterone does so both as an androgen that acts directly on androgen receptors (AR) or indirectly via estrogen receptors (ER α or β) after conversion to estradiol in the brain. Providing androgens to females during early critical periods in development increases male-typical behaviors, including sexual preference for female cues and copulatory behavior (i.e., mounting and thrusting) towards receptive females. Conversely, taking androgens away from males during early critical periods, or in adulthood prior to sexual experience, or knocking-out AR or ERs, are all manipulations that lead to dramatic decreases in preferences for female cues and male-typical copulatory behaviors.

These findings support the long-standing traditional theory of sexual differentiation, which holds that androgens act to masculinize and defeminize the brain and behavior; however, this theory is vague on the significance of androgen dose, beyond the assumption that male-typical and female-typical androgen doses are essentially discontinuous and androgen dosing in the male range is required for masculinizing and defeminizing actions. This question is important for understanding variation within both male and female populations. Here, we present converging lines of evidence suggesting that the relationship between androgens and masculine phenotype is not always linear. Instead, the evidence supports a nonlinear relationship such that both low and high androgen levels lead to a reduction in male-typical phenotype, and there is an optimal level of androgen that is required for the display of full male-typed behaviors (Swift-Gallant & Monks, 2017; see Fig. 17.3).

A plethora of studies have evaluated the consequences of reducing androgen signaling in males, overwhelmingly finding that reducing androgens reduces male-typical behaviors. Far fewer studies have asked what happens when you increase androgens above the typical range (Cruz & Pereira, 2012; Diamond et al., 1973; Henley et al., 2010; Zadina et al., 1979). These studies have found that high levels of androgen exposure during early development leads to a paradoxical decrease in male-typical copulatory behaviors and/or preferences. We recently took the approach of increasing androgen signaling by overexpressing AR in male mice to levels 3–4× higher than in their wildtype counterparts. With this approach, we found that male-typical copulatory behaviors were increased in males with AR overexpression, suggestive of a linear relationship, while sexual preferences were

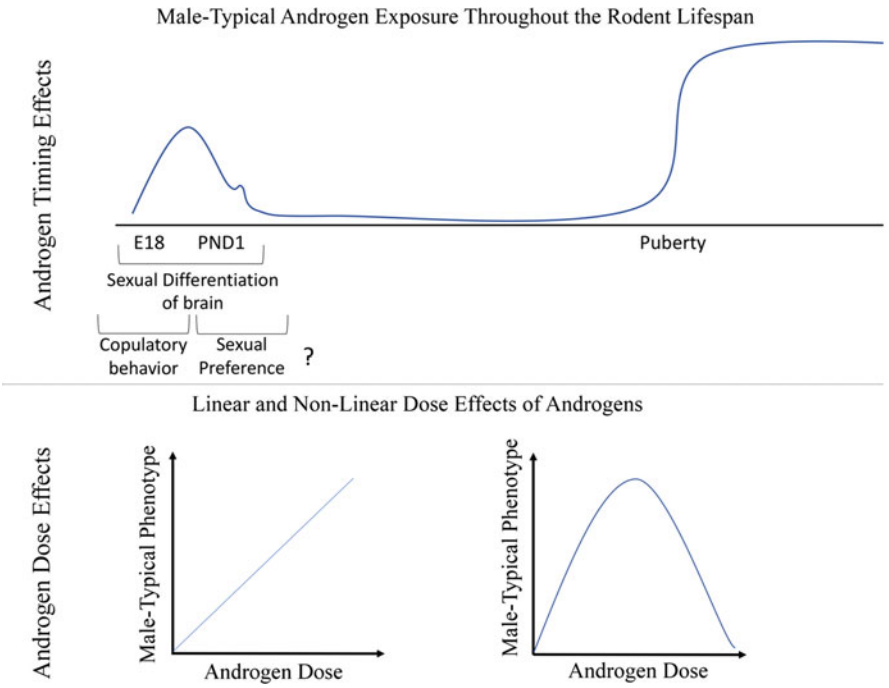

Fig. 17.3 Androgens act in a time- and dose-dependent manner to affect the development of male-typical brain and behavior. In rodent development, androgens spike around embryonic day 18 (E18) in males, followed by a smaller peak around the day of birth/postnatal day 1 (PND1). Androgens then subside and remain low until puberty, at which time androgens increase to adulthood levels and remain relatively high until the aging process leads to gradual declines in androgen production. The evidence presented herein indicates that androgens can have dissociable effects on components of sexual behavior, such that in some cases the dose response is linear whereas for other behaviors the relationship is curvilinear. Thus, androgen dose effects can be both linear and nonlinear; further work is needed to understand whether there are timing by androgen dose effects on male-typical phenotype

altered such that these males show increased androphilic preferences (Swift-Gallant et al., 2016a, 2016b), suggestive of an inverted-U shape relationship. Specifically, male mice with ubiquitous overexpression of AR exhibited an increase in number of thrusts per mount in response to a receptive female but displayed an increased preference for anogenital investigation of a male partner and an increased preference for same-sex odor stimuli compared to wildtype littermates (Swift-Gallant et al., 2016a, 2016b). This behavioral change was accompanied by a decrease in neural activity in response to female odors along the accessory olfactory pathway (Swift-Gallant et al., 2016b). These results together with the findings from studies of systemic administration of supraphysiological androgen doses suggest that increases in androgenic signaling can lead to a decrease in male-typical behaviors. Notably, some male-typical behaviors remained unchanged or exhibited an increase in the male-typical direction (i.e., copulatory behaviors), while other behaviors exhibited a

decrease in male-typical behavior (preference for opposite-sex stimuli), providing further evidence that androgens can have dissociable effects on components of sexual behavior and furthermore suggesting that the relationship between androgen dose and masculine phenotype can be both linear and curvilinear.

Future studies examining the timing of supraphysiological doses of androgen or enhanced androgen signaling may delineate distinct critical periods for copulatory behaviors vs. sexual preferences. Such research might help explain the discrepancy between studies suggesting that high androgen signaling decreases male-typical copulatory behaviors and preferences while others only report declines in male-typical preferences but not copulatory behaviors. Indeed, studies that enhanced androgen levels *after* birth report decreases in male-typical copulatory behavior (Diamond et al., 1973; Henley et al., 2010; Zadina et al., 1979), whereas supraphysiological doses of androgens administered during embryonic development (Cruz & Pereira, 2012) or lifelong increases in androgen sensitivity (Swift-Gallant et al., 2016b) altered sexual preferences in male rodents.

Based on work in non-human animals, the neuroendocrine hypothesis was the first proposed explanation for the development of same-sex sexual orientation among humans (reviewed in Swift-Gallant et al., 2020). Briefly, it was hypothesized that high prenatal androgens in females would increase same-sex sexual orientations, whereas low prenatal androgens in males would result in increased same-sex sexual orientations. While measuring prenatal androgens (i.e., during brain sexual differentiation) in humans is not practical (i.e., amniotic fluid may be available in some cases, but would only tell us about androgens at a single time point, and subjecting pregnant women to multiple amniotic tests is unethical), there have been attempts to capture the prenatal androgen environment via retrospective markers such as the second-to-fourth digit ratio (2D:4D, i.e., length of the index relative to ring finger). The evidence in women has been fairly consistent—lesbians have a more *male*-typical finger digit ratio suggesting they were exposed to higher androgens in the womb compared to heterosexual women. Conversely, numerous reviews and meta-analyses have concluded that there is *no link* between prenatal androgens (as measured via 2D:4D) and sexual orientation in men. However, given the emerging evidence in non-human animals, it is possible that there is a nonlinear relationship, such that both low and high androgens contribute to sexual orientation in men (Swift-Gallant, 2019), which could be masked by unaccounted for diversity within the populations of gay men studied. Indeed, we have recently found evidence for multiple distinct biodevelopmental pathways of same-sex sexual orientation among men, supporting this idea that there may be multiple factors that promote same-sex orientations in men (e.g., both low and high prenatal androgen exposure, immunological mechanisms, genetic; Swift-Gallant et al. 2019).

Androgens shape the brain and behavior in a time- and dose-dependent manner. We are also beginning to see that there can be dissociations in the presentation of sex-typed behaviors such that one can be more male-typical in some behaviors and more female-typical in others. Still, many questions remain unanswered about the relationship of androgen dose and timing on the development of male-typed

behaviors. At this time, the emerging evidence suggests that more androgens do not always produce a more masculine phenotype.

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Chapter 18
Mental Health Among LGBT Youth

Sophia Choukas-Bradley and Brian C. Thoma

Abstract Lesbian, gay, bisexual, and transgender (LGBT) youth report disproportionately high rates of mental health problems when compared to their heterosexual and cisgender peers, including suicidality, depression, and substance use. These mental health disparities likely result from experiences of minority stress, such as bullying and victimization, discrimination, and internalized homo/transnegativity. Many of these stressors are modifiable, as are the protective factors and coping strategies that provide most LGBT youth with resilience in the face of minority stress. A comprehensive review of the literature on LGBT youth mental health is beyond the scope of this brief chapter, and we do not provide a systematic review here. Rather, our goal is to provide an overview of the state of this emerging literature. Specifically, we will provide an overview of minority stress theory as it relates to the experiences of LGBT youth, review current knowledge of mental health disparities among LGBT adolescents, describe how minority stress experiences are related to the mental health of LGBT youth, and summarize our current understanding of resilience and protective factors within this population.

Keywords LGBT youth · Adolescence · Mental health disparities · Sexual minority · Gender minority · Depression · Suicidality · NSSI · Substance use

Lesbian, gay, and bisexual (LGB) youth report disproportionately high rates of mental health problems when compared to their heterosexual peers, including suicidality, depression, and substance use (Institute of Medicine, 2011; Marshal et al., 2011; Marshal et al., 2008). Current estimates indicate that while only around

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4% of US adults identify as LGB (Gallup, 2017), approximately 15% of adolescents identify as LGB or questioning (Kann et al., 2018). It is possible that these prevalence rates underestimate the number of sexual minority adolescents, given that contemporary sexual minority youth use a variety of labels beyond "lesbian, gay, and bisexual," such as "pansexual" and "mostly heterosexual"; furthermore, some youth who identify as "heterosexual" report same-sex attraction and/or behavior (e.g., Stewart et al., 2019). Health disparities research has documented higher rates of mental health problems among youth who identify as LGB, among youth who report sexual or romantic attraction to individuals of the same sex, and also among youth who engage in same-sex sexual behavior (Marshal et al., 2011). While the mental health of transgender adolescents (adolescents who identify with a gender identity that diverges from their gender assigned at birth) has been examined less frequently, initial evidence indicates that transgender adolescents experience very high rates of suicidality and depressive symptoms (Connolly et al., 2016; Thoma et al., 2019; Toomey et al., 2018). Prevalence rates for transgender youth are difficult to estimate, as the number of adolescents seeking treatment at gender care clinics has increased in recent years (Handler et al., 2019), but recent estimates suggest that 1.8% of US adolescents identify as transgender, with higher endorsement of transgender identities among adolescents assigned female at birth (Johns et al., 2019; Zucker, 2017). Mental health disparities among lesbian, gay, bisexual, and transgender (LGBT) adolescents likely result from their experiences of minority stress in the form of discrimination and stigmatization. This chapter will provide an overview of minority stress theory as it relates to the experiences of LGBT adolescents, review current knowledge of mental health disparities among LGBT adolescents, describe how minority stress experiences are related to the mental health of LGBT youth, and summarize our current understanding of resilience and protective factors within this population.

18.1 Minority Stress Experiences of LGBT Adolescents

Researchers theorize that experiences of minority stress underlie health disparities between LGB and heterosexual individuals (Meyer, 1995, 2003). LGB individuals encounter stress within their social environments in the form of discrimination based upon known or perceived sexual orientation, and LGB people also internalize negative societal and cultural messages about their minority group (Meyer, 1995, 2003). Meyer (2003) theorized minority stressors fall into two distinct categories: distal stressors and proximal stressors. Distal stressors include experiences and perceptions of anti-gay discrimination within a person's social environment (Meyer, 2003). Discrimination can include verbal harassment, physical violence, property crimes, housing or employment discrimination, and sexual assault (Katz-Wise & Hyde, 2012). LGB adolescents report more frequent experiences of bullying and victimization by peers than heterosexual adolescents (Berlan et al., 2010; Fedewa & Ahn, 2011; Friedman et al., 2011; Zaza et al., 2016). In recent nationally

representative data from adolescents in the United States, 34% of LGB adolescents reported being bullied at school during the past year compared with 19% of heterosexual adolescents (Zaza et al., 2016). Victimization disparities based on sexual orientation have been detected in children as young as 8 and 9 years old (Martin-Storey & Fish, 2019).

Proximal minority stressors are internal processes that can be harmful for LGB individuals, including internalized homonegativity, expectations of rejection within social interactions, and concealment of sexual orientation from others (Meyer, 2003). LGB individuals with higher levels of internalized homonegativity report more negative attitudes about themselves because they are LGB (DiPlacido, 1998; Meyer, 2003; Shidlo, 1994). Furthermore, LGB individuals may experience anxiety or fear that they will experience rejection by others because of their sexual orientation (Meyer, 2003; Pachankis et al., 2008). Because sexual orientation is a concealable stigmatized identity and LGB individuals' minority status might not be readily apparent in many social interactions (Pachankis, 2007; Quinn & Chaudoir, 2009), LGB individuals must decide when to conceal and disclose their sexual orientation to others and may have to repeatedly disclose their minority status, causing additional stress (Meyer, 2003; Pachankis, 2007). Many studies indicate that bisexual youth are at even higher risk for mental health issues than lesbian and gay youth (Marshal et al., 2011; Marshal et al., 2008), with minority stress theories highlighting the role of stressors related to "double discrimination" (i.e., rejection from both the heterosexual and LGBT communities) and invalidation of one's identity as "just a phase" (Dyar et al., 2019; Dyar & London, 2018).

While minority stress has been directly linked to mental health (Meyer, 2003), researchers have also established a psychological mediation framework to describe mechanisms through which minority stress affects mental health among LGB individuals (Hatzenbuehler, 2009). Hatzenbuehler (2009) theorized that stressful experiences negatively affect the health of LGB individuals by causing emotion dysregulation and creating interpersonal and social problems that can impoverish social support. In addition, LGB individuals who experience minority stress are more likely to report feelings of hopelessness and low self-esteem, and these cognitions and beliefs may leave LGB people more susceptible to negative outcomes in the face of stress (Hatzenbuehler, 2009). Other factors, such as more liberal social norms about substance use in the LGB community, may also contribute to health disparities (Hatzenbuehler, 2009).

While minority stress theory is a useful lens through which to understand the experiences of LGB individuals, Meyer (2003) did not explicitly address the developmentally specific experiences and social contexts of adolescents (Goldbach & Gibbs, 2017). Adolescence is a developmental period during which individuals are highly attuned to feedback from peers, and peer rejection and victimization can cause great distress (Choukas-Bradley & Prinstein, 2014). LGB youth often first disclose their sexual orientation during adolescence (Katz-Wise et al., 2017), and others' reactions to their disclosure can cause further stress. LGB adolescents who report negative reactions to their sexual orientation disclosures have higher rates of mental health problems (Heatherington & Lavner, 2008). Adolescence is a unique

developmental period in that, although peer relationships and peer feedback reach paramount importance, parents also remain important for adolescents' basic needs and psychological well-being. Parental rejection of sexual orientation is common among LGB adolescents, and parental rejection during adolescence has been linked with increased risk for suicidality and depression during young adulthood among LGB individuals (Ryan et al., 2009). Furthermore, some evidence indicates LGB adolescent mental health is related to broad societal attitudes related to sexual orientation. For example, LGB adolescents who live in counties in the United States where there is a positive environment for sexual minority individuals (including a higher proportion of same-sex couples and more schools with anti-bullying policies and gay-straight alliances) report lower levels of victimization, suicidality, and depressive symptoms as compared to LGB adolescents in less supportive counties (Hatzenbuehler, 2011).

It is also important to consider that minority stress theory as described by Meyer (2003) applies specifically to the experiences of LGB individuals, and minority stress experiences of transgender individuals likely differ in important ways (Hendricks & Testa, 2012). Like LGB adolescents, transgender adolescents experience higher rates of peer victimization than their non-transgender peers (Perez-Brumer et al., 2017; Sterzing et al., 2017). Victimization is a common experience for transgender adolescents, and 69% of transgender adolescents report they have been harassed because of their gender identity during the past year (Veale et al., 2017a). More research is needed regarding the role of victimization in transgender adolescents' suicidality, but in one online sample of US transgender and gender-nonconforming young people ages 14–30 years, gender-related and sexual orientation-related victimization were found to be associated with higher likelihood of past-year suicide attempt (Kuper et al., 2018). However, less is understood about transgender individuals' proximal experiences of minority stress (Hendricks & Testa, 2012). In particular, having one's gender identity perceived accurately by others within social contexts, or passing as one's true gender identity, is an important interpersonal construct that is related to distress and mental health among transgender individuals (Bockting et al., 2013; Dubois, 2012). Transgender individuals often initiate a social gender transition during adolescence, including disclosing their gender identity to parents and peers, asking others to refer to them by a chosen name, using different pronouns that align with their true gender identity, and changing their hairstyle and/or clothing to express their gender in a way that accords with their true gender identity (Connolly et al., 2016; Grossman & D'augelli, 2007; Russell et al., 2018). Many questions remain regarding whether and how progression through these transition steps is related to transgender adolescents' mental health. Further research is required to understand how the minority stress experiences of transgender adolescents differ from the experiences of LGB individuals.

18.2 Mental Health Disparities Among LGBT Adolescents

In this section, we provide an overview of the empirical literature regarding mental health disparities related to adolescents' sexual and gender minority identities. A comprehensive review of the literature on LGBT youth mental health is beyond the scope of this brief chapter, and we do not provide a systematic review here. Rather, our goal is to provide an overview of the state of this emerging literature.

18.2.1 Suicidality

Suicide is the second leading cause of death among adolescents (Kochanek et al., 2016), and LGB adolescents are at high risk for suicidality. Compared with heterosexual adolescents, LGB adolescents have two times the odds of suicidal ideation (Marshal et al., 2011). Disparities are even larger when examining more severe forms of suicidality, as LGB adolescents have much higher odds of suicide attempts (OR = 3.18) and suicide attempts requiring medical attention (OR = 4.17) than their heterosexual peers (Marshal et al., 2011). Recent nationally representative adolescent health data from the 2015 Youth Risk Behavior Surveillance System (YRBSS) indicate 43% of US LGB adolescents have seriously considered suicide in the past year, 38% have made a suicide plan, 29% have attempted suicide in the past year, and 9% have made an attempt requiring medical attention (Zaza et al., 2016). Data from the same survey revealed especially high levels of suicidality among bisexual girls, with 35% attempting suicide in the past year and 12% making a suicide attempt requiring medical attention (Taliaferro et al., 2017). Comparatively, only 6% of heterosexual adolescents within the same sample reported attempting suicide during the past year (Zaza et al., 2016). LGB adolescents also report higher levels of non-suicidal self-injury (self-harm behaviors, such as cutting oneself, without intent to end one's life) when compared to their heterosexual peers (Almeida et al., 2009).

Researchers have linked experiences of minority stress to higher levels of suicidality among LGB adolescents, and peer victimization is the most commonly examined stressor. Peer victimization is typically operationalized as experiencing verbal or physical aggression from peers. LGB adolescents who report more frequent experiences of peer victimization report higher rates of suicidality (Espelage et al., 2018), including suicidal ideation (Birkett et al., 2009; Espelage et al., 2008), suicide attempts (Bontempo & D'Augelli, 2002; Fedewa & Ahn, 2011), and non-suicidal self-injury (Almeida et al., 2009; Liu & Mustanski, 2012). Researchers have also examined whether peer victimization accounts for differences in suicidality outcomes between LGB and heterosexual adolescents. Bontempo and D'Augelli (2002) found that victimization experiences mediated the association between LGB-status and suicidality among adolescents. Within this study, LGB adolescents who reported high levels of victimization reported more suicide attempts during the past year when compared with heterosexual adolescents who experienced

high levels of victimization (Bontempo & D'Augelli, 2002), indicating that victimization experiences have an especially deleterious effect among LGB adolescents. Similarly, peer victimization predicted higher levels of suicidality among LGB adolescents over the next 6 months in a longitudinal study, and victimization mediated the association between LGB-status and suicidality (Burton et al., 2013). Finally, victimization was found to predict increases in both future suicidality and self-harm behavior within a sample of LGBT youth ages 16–20 years (Liu & Mustanski, 2012).

Suicidality has been examined less frequently among transgender adolescents, but initial results indicate transgender adolescents experience high rates of suicidal ideation and attempts when compared to their cisgender peers (Becerra-Culqui et al., 2018; Connolly et al., 2016; Eisenberg et al., 2017; Perez-Brumer et al., 2017; Peterson et al., 2017; Toomey et al., 2018; Veale et al., 2017b). Sixty-one percent of transgender adolescents report a lifetime history of suicidal ideation, and 31% report attempting suicide during their lifetime (Eisenberg et al., 2017). In one recent study, rates of suicidality were higher among transgender adolescents than both their cisgender heterosexual and cisgender sexual minority peers (Fox et al., 2020). Recent work indicates that rates of suicidal behavior may be even higher among some subgroups of transgender adolescents, with 51% of female-to-male adolescents reporting a lifetime history of suicide attempts (Toomey et al., 2018). However, inadequate measurement of gender assigned at birth and current gender identity has hampered empirical efforts to estimate rates of suicidality among transgender adolescents, and additional research that uses comprehensive measures of gender identity within nationally representative adolescent health datasets is required.

Additional research examining psychosocial factors related to suicidality among transgender adolescents is needed as well. Initial evidence indicates transgender adolescents who experience higher levels of victimization report higher rates of suicidal ideation, suicidal behavior, and non-suicidal self-injury (Clements-Nolle et al., 2006; Hatchel et al., 2019; Perez-Brumer et al., 2017; Veale et al., 2017a, 2017b). Additional psychosocial factors could protect against or confer risk for suicidal behavior among transgender adolescents. Initial evidence from one cross-sectional study indicates that completing social transition steps within multiple social contexts (i.e., using a chosen name at home, at school, and at work) is associated with fewer mental health problems, including suicidal ideation and behavior (Russell et al., 2018). Further research is required to understand how progressing through gender transition milestones is related to the severity of suicidality during adolescence among transgender youth.

Finally, several studies of LGBT youth have provided evidence consistent with the interpersonal-psychological theory of suicidal behavior (Joiner Jr., 2005). According to this theory, the desire for suicide is developed through a combination of perceived burdensomeness and low belongingness. In several studies, perceived burdensomeness has been found to mediate the association between several minority stressors and depressive symptoms among LGBT adolescents in the USA and the Netherlands, including sexual orientation victimization, internalized homonegativity, and coming-out stress (Baams et al., 2018; Baams et al., 2015).

Regarding low belongingness—in other words, social alienation—several of the studies regarding interpersonal stressors above (e.g., victimization) may provide indirect support for this part of the theory.

18.2.2 Depression and Other Internalizing Symptoms

In addition to the disparities discussed above related to suicidality, LGBT adolescents are significantly more likely than their cisgender heterosexual peers to report depressive symptoms. A meta-analysis found an overall weighted effect size for the association between sexual orientation and depression of $d = 0.33$ (Marshal et al., 2011). In one study, 15% of LGBT youth met diagnostic criteria for Major Depressive Disorder (Mustanski et al., 2010). Higher levels of depressive symptoms during adolescence could negatively influence the long-term mental health of LGB individuals, as longitudinal studies indicate that depressive symptoms among LGB individuals persist from adolescence into adulthood (Marshal et al., 2013; Needham, 2012). Disparities also likely begin prior to adolescence, as higher levels of depressive symptoms were detected by age 11 among sexual minority girls in one Dutch study (la Roi et al., 2016). Several studies indicate that transgender youth also experience high levels of depressive symptoms (see Connolly et al., 2016).

As with studies focused on suicidality, research suggests that minority stressors mediate the association between sexual minority identity and depressive symptoms. A recent systematic review found that key risk factors for LGB youth depression include internalized sexual orientation-related oppression, stress from hiding and managing one's identity, parental rejection, and victimization (Hall, 2018). With regard to distal stressors, many studies have highlighted the roles of victimization, parental rejection, and discrimination in LGBT youth depressive symptoms. In a previously mentioned longitudinal study, sexual minority-specific victimization mediated the association between sexual minority identity and both depressive symptoms and suicidality (Burton et al., 2013). Other studies have also found both victimization and parental rejection to partially mediate the association between sexual minority identity and depressive symptoms (la Roi et al., 2016; Martin-Storey & Crosnoe, 2012; Mittleman, 2019; Robinson et al., 2013; Toomey et al., 2010). Results from a school-based study indicate that perceived discrimination accounted for the higher levels of depressive symptoms among LGBT youth (Almeida et al., 2009). Other studies suggest that the discrimination experiences that lead to depressive symptoms may be subtle, such as in the form of microaggressions (Kaufman et al., 2017).

Proximal minority stressors have also been linked to depression and other internalizing symptoms. For example, internalized homonegativity has been found to be associated with higher levels of anxiety and depressive symptoms in samples of youth across several countries, including the USA, Belgium, and Israel (Cox et al., 2010; Page et al., 2013; Shilo & Savaya, 2012). Additionally, in a sample of transgender adolescents seeking care at a US gender clinic, those with higher levels

of internalized transnegativity were more likely to meet diagnostic criteria for both major depressive disorder and generalized anxiety disorder (Chodzen et al., 2019). Other studies have found that internalized homonegativity mediates the association between environmental stressors and internalizing symptoms. For example, in a community sample of US sexual minority youth, religious stress related to sexual orientation and other sexual orientation-related stressors were associated with symptoms of depression and anxiety, and these associations were mediated by homonegativity (Page et al., 2013).

18.2.3 Substance Use

LGB adolescents use substances at high rates, with a meta-analysis suggesting these rates are almost three times that of their heterosexual peers (Marshal et al., 2008). A recent study using state-representative data from California found that substance use was 2.5–4 times higher among transgender youth compared to cisgender peers (Day et al., 2017). Examining data from the National Longitudinal Study of Adolescent to Adult Health (Add Health), Dermody et al. (2014) found disparities between sexual minority and heterosexual individuals over time in hazardous drinking, from adolescence through participants' late 20s and early 30s; disparities increased as participants reached young adulthood. LGB youth have higher rates of cigarette, alcohol, marijuana, cocaine, and injection drug use when compared to heterosexual peers (Marshal et al., 2008), and recent evidence indicates LGB adolescents have higher rates of vaping as well (Coulter et al., 2018). The vast majority of studies have used brief measures to assess substance use among LGB youth and their peers (Marshal et al., 2008), and more research is required to examine disparities in substance use disorder diagnoses between LGB and heterosexual youth.

As with suicidality and internalizing problems, a growing body of research highlights the important role of minority stressors in LGBT adolescents' substance use. A meta-analysis found that victimization, negative reactions to adolescents' coming out, and sexual orientation-related stress were each associated with higher levels of adolescents' substance use (Goldbach et al., 2014). Although the data are now more than two decades old, a study using 1995 YRBSS data found that the combination of LGB status and high levels of at-school victimization predicted the highest levels of substance use, as well as suicidality and sexual risk behavior; importantly, at low levels of victimization, LGB youth's substance use, suicidality, and sexual risk behaviors were similar to those of their heterosexual peers (Bontempo & D'Augelli, 2002). Updated data from the 2015 YRBSS revealed that bisexual adolescents specifically were higher in alcohol use and binge drinking than their heterosexual peers, and bullying mediated the association between sexual minority identity and alcohol use only among bisexual girls (Phillips et al., 2017). Furthermore, a longitudinal study using a community sample of adolescents recruited from adolescent health clinics found support for the mediating role of victimization in the longitudinal association between LGB status and substance use

(Dermody et al., 2016). Fewer studies have examined substance use disparities among transgender youth. However, both the California-wide study discussed above (Day et al., 2017) and a large-scale national US study (Reisner et al., 2015) also revealed that victimization mediated the association between transgender identity and substance use.

18.2.4 Protective Factors, Coping, and Prevention

It is critically important to note that many LGBT youth do not experience mental health problems. Protective factors and coping strategies have been identified that may help mitigate against the risks posed by minority stressors. In this section, we provide a brief overview of some of the protective factors and coping strategies that have received research attention and that may aid the development of prevention and intervention programs.

Several studies highlight the importance of social support from friends and the LGBT community in promoting positive identity development (Bruce et al., 2015). For example, a large-scale study of schools in Wisconsin found that LGBT youth in schools with Gay-Straight Alliances (GSAs) reported lower levels of truancy, substance use, suicide attempts, and risky sexual behaviors, as compared to youth in schools without GSAs (Poteat et al., 2013). Additionally, in qualitative interviews, sexual minority adolescents highlighted the importance of having LGBT centers and organizations for support, as well as the protective effects of having close relationships with other individuals who identify as LGBT (Goldbach & Gibbs, 2015). Furthermore, across many studies, support from parents and peers has been found to be important in protecting against substance use, depression, and psychological distress (Goldbach et al., 2014; Hall, 2018; McConnell et al., 2015, 2016; Mustanski et al., 2011).

With regard to transgender youth, more well-designed longitudinal research studies are needed, but the work of Olson and colleagues suggests that children and adolescents who are socially transitioned have similar levels of depression, and marginally higher anxiety, when compared to their siblings, age- and gender-matched-controls, and nationally representative samples (Durwood et al., 2017; Olson et al., 2016). Socially transitioned children's psychosocial well-being also appears to be similar to that of age- and gender-matched cisgender gender-nonconforming children (Wong et al., 2019). Another cross-sectional study found that youth who used their chosen name in more contexts (i.e., a proxy for gender affirmation) reported lower levels of depressive symptoms, suicidal thoughts, and suicidal behavior (Russell et al., 2018). Thus, engaging in a social gender transition within supportive social contexts might have the potential to ameliorate mental health disparities among transgender youth, but more research on this topic is required.

Throughout this chapter, we have highlighted the important role of victimization in helping to explain why LGBT youth have higher levels of suicidality, depression,

and substance use than their peers. It is heartening to note that, overall, experiences of victimization may decrease over time for LGBT youth, both with regard to historical trends and developmental trajectories. First, a study of 11 YRBSS cohorts from 1995 to 2015 revealed that rates of school-based victimization decreased among all students, and especially steep declines were revealed among LGBT youth (Olsen et al., 2017). Additionally, a community study of adolescents and young adults using an accelerated longitudinal study design found that while experiences of victimization predicted increases in psychological distress over time, overall, both victimization and distress decreased over time (Birkett et al., 2015).

18.3 Limitations and Future Directions

In this chapter, we provided an overview of the state of the literature on mental health among LGBT youth. Tremendous advances have been made in recent years in our understanding of both mental health disparities and the minority stressors that may underlie them. That said, the research literature has been characterized by several substantial limitations that must be addressed in future work. First, the majority of studies on sexual minority youth use cross-sectional study designs and focus on older adolescents and young adults, with fewer studies following youth longitudinally over the course of adolescence, and a strikingly limited number of studies focused on pre-adolescent children (although see this chapter's Spotlight Feature for a description of recent research on pre-adolescent children). With youth coming out at younger ages (Dunlap, 2016), it may be more feasible for future studies to recruit samples of children and younger adolescents who identify as LGBT and to follow their developmental outcomes over time.

Another challenge of research on LGBT youth mental health involves disentangling developmental effects and historical change, as has been discussed by Mustanski (2015). Within the US specifically, support for LGBT individuals and couples has increased dramatically, both with regard to personal attitudes and public policies (Pew Research Center, 2017). That said, there is substantial variability in support and protections across geographical regions and based on religious, political, and other identities (GLAAD, 2018; Pew Research Center, 2017). Furthermore, at the time of our writing this chapter (in 2019), several protections for sexual and gender minority individuals are at risk of being weakened or removed in the USA (e.g., Goodnough et al., 2019). Youth's experiences of minority stressors and mental health sequelae may vary based on such structural and cultural shifts. Questions related to the sociocultural context of LGBT youth development remain critically important avenues for future research.

Another emerging area of scholarship in this field that warrants further study concerns intersectionality. Although many studies included in this chapter included racially and ethnically diverse samples and some directly addressed issues related to intersectionality, a thorough discussion of intersectionality was beyond the scope of

the current chapter. According to minority stress theories, belonging to multiple minority groups may be associated with unique stressors and experiences of discrimination (Cole, 2009; Else-Quest & Hyde, 2016). Based on these theories, we would expect that LGBT youth who also identify as racial/ethnic minorities may experience more minority stressors (e.g., higher levels of discrimination) and may be more at risk for mental health issues. However, research is mixed regarding whether such intersecting identities confer greater risk, and it is possible that racial/ethnic minority LGBT youth may be better equipped to cope with minority stress related to their LGBT identity, which emerges during later childhood and adolescence, because they have previously developed effective strategies to cope with racist discrimination and stigmatization earlier in development (c.f., Fox et al., 2020; Thoma & Huebner, 2013; Velez et al., 2015). Future research with LGBT youth should prioritize collecting sufficiently large and diverse samples of youth, allowing us to build a stronger understanding of how mental health and minority stress experiences differ across racial/ethnic subgroups of LGBT youth. Finally, the vast majority of existing research examining health disparities between LGBT adolescents and their peers has been conducted with samples collected in North America, Europe, and Australia (Marshal et al., 2008). Given cultural differences in acceptance of and attitudes toward diverse sexual and gender identities across the globe (Kite et al., 2018; Smith et al., 2014), as well as limited legal protections for LGBT individuals in many countries, we cannot generalize using existing evidence of LGBT youth mental health derived largely from Western societies. Additional international research on the health and well-being of LGBT youth across the globe is required.

This chapter aimed to provide a concise overview of research on mental health among LGBT youth, with an emphasis on internalizing symptoms, substance misuse, and suicidality. This chapter did not address mental health disparities related to autism spectrum disorder (but see the Spotlight Feature in this chapter by Anna van der Miesen), eating disorders, externalizing problems and health risk behaviors beyond substance use, or severe psychopathology such as bipolar disorder or schizophrenia. Connolly et al. (2016) provide a review of the mental health of transgender youth, but in this evolving field, many new studies have since emerged, and will likely continue to emerge between the writing and publishing of this chapter.

A critically important area for future work involves the development of evidence-based prevention and intervention efforts. Many researchers have called for mental health interventions tailored to the unique minority stress experiences of LGBT youth. Mustanski (2015) outlined the need for the development of interventions that "promote and build on natural resiliencies in the face of chronic [sexual minority] stressors" (p. 212) and that emphasize prevention and health promotion. A special challenge concerns how to reach young LGBT adolescents during the processes of identity development during which vulnerability may be high (Mustanski, 2015). Online recruitment and interventions may help with this effort (Mustanski, 2015). Finally, successful interventions will likely need to address the complex sociocultural and interpersonal systems in which adolescents are embedded, and

interventions delivered online, including family-based interventions (e.g., Huebner et al., 2013), may provide fruitful avenues for these important efforts.

18.4 Conclusion

In conclusion, recent advances in basic research on LGBT youth mental health highlight disparities between LGBT youth and their non-LGBT peers, and identify minority stressors that may contribute to those disparities. Many of these stressors are modifiable, as are the protective factors and coping strategies that provide most LGBT youth with resilience in the face of minority stress. It is now vital for the field to develop, test, and disseminate prevention and intervention programs to further mitigate these risks and allow LGBT youth to thrive.

Spotlight Feature: Mental Health and Minority Stress Experiences Among Gender-Nonconforming Children

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Recently, there has been increased research attention devoted to the psychological well-being of gender-nonconforming children (i.e., children whose gender expression and/or identity differ from culturally defined gender norms based on their sex assigned at birth; Adelson, 2012; Turban & Erhensaft, 2018). Community-based studies using either parent-report or child-interview measures of children's gender expression indicate that approximately 0.9–16.3% of children assigned female at birth (AFAB) and 1.0–7.8% of children assigned male at birth (AMAB) are gender-nonconforming (Martin et al., 2017; van Beijsterveldt et al., 2006; van der Miesen et al., 2018). As such, gender-nonconforming children appear to represent a substantial minority among children overall.

Similar to its application in LGB youth, the minority stress model (Hendricks & Testa, 2012; Meyer, 1995, 2003) provides an important foundation upon which one can understand the mental health challenges faced by gender-nonconforming children. Relatedly, it is vital to consider how proximal factors, such as peer and parental relations, impact gender-nonconforming children's psychological well-being. Research has shown that children often appraise violations of gender norms negatively and respond to their gender-nonconforming peers with social rejection and derision (e.g., Kowalski, 2007; Wallien et al., 2010). In addition, adults have been shown to negatively appraise gender-nonconforming children and discourage children from behaving in gender-nonconforming ways (e.g., Coyle et al., 2016; Langlois & Downs, 1980; Sullivan et al., 2018). These proximal factors, discussed further below, place gender-nonconforming children at risk of poor mental health outcomes.

Previous research has shown that gender-nonconforming children have elevated scores on measures of clinical-range behavioral and emotional challenges (van der Miesen et al., 2018) and internalizing and externalizing difficulties (e.g., van Beijsterveldt et al., 2006). Past research also shows that children who identify with the "other" gender show high levels of social anxiety (Martin et al., 2017). A particularly key mental health concern for gender-nonconforming children is self-harm/suicidality. In a study on self-harm/suicidality in 6- to 12-year-old children clinic-referred for gender dysphoria, children with gender dysphoria had significantly higher scores on measures of self-harm/suicidality than siblings and non-referred children (Aitken et al., 2016). Specifically, 19.1% of the children referred for gender dysphoria had a history of suicidal ideation and 6.5% had self-harmed and/or attempted suicide (vs. 1.8% and 0.2%, respectively, of 6- to 12-year-old comparison children based on parent-report using the Child Behavior Checklist; Achenbach & Rescorla, 2001; Aitken et al., 2016). Further, a recent study found that self-harm/suicidality was also heightened in a non-clinical, community sample of 6-

to 12-year-old gender-nonconforming children who did not have a diagnosis of gender dysphoria (MacMullin et al., 2020). Specifically, among children who expressed gender nonconformity most markedly, 9.1% had attempted suicide and/or self-harmed and 6.8% had suicidal ideation. These rates were not statistically different from those reported by Aitken et al. for children who experienced gender dysphoria.

Importantly, findings in several studies have highlighted that shared experiences of minority stress put children who express gender nonconformity at increased risk of mental health challenges, including self-harm/suicidality. Risk and protective factors for gender-nonconforming children include aspects of both peer and parental relationships. Poor peer relations have been consistently related to behavioral and emotional challenges as well as self-harm/suicidality in community (e.g., MacMullin et al., 2020, 2021; Jewell & Brown, 2014) and clinical (e.g., Aitken et al., 2016; Cohen-Kettenis et al., 2003; Steensma et al., 2014) samples of gender-nonconforming children and adolescents. Relatedly, in children, feeling low levels of contentment to one's sex assigned at birth is related to lower scores on measures of both acceptance by peers and global self-worth (Yunger et al., 2004). Importantly, clinical and community studies have found that gender-nonconforming children AMAB (vs. those AFAB) are rated less favorably by peers and are more likely to be rejected (e.g., Braun & Davidson, 2017; Cohen-Kettenis et al., 2003; Steensma et al., 2014). Further, children AMAB (vs. those AFAB) are subject to more pressure to behave in gender-stereotypical ways (e.g., Spivey et al., 2018). These findings may be explained by the fact that stereotypically masculine traits and behaviors are afforded with social value (Braun & Davidson, 2017; Coyle et al., 2016).

As it relates to parental attitudes, recent research relying on a community sample identified authoritative parenting, closeness in the parent-child relationship, parental willingness to serve as a secure base, and low levels of gender-stereotypical parenting attitudes as protective factors in the relationship between gender nonconformity and separation anxiety in children (Santarossa et al., 2019). Further, less gender-stereotypical parental attitudes and willingness of the parent to provide a secure base for their child were protective factors in the relationship between gender nonconformity and poor psychological well-being among 6- to 12-year-olds (MacMullin et al., 2021). Relatedly, another study found that parents of gender-nonconforming children who contacted an affirmative program (vs. a community sample of parents and university students) reported more tolerant and accepting attitudes of gender nonconformity, and gender nonconformity was not a predictor of children's behavioral and emotional challenges in this sample (Hill et al., 2010).

Given previous findings highlighting the impact that social variables have on the relationship between gender nonconformity and poor psychological well-being in children, it is vital that future work aim to increase societal acceptance. In particular, intervention work is needed to improve children's appraisals of gender nonconformity as well as to support parents in providing a secure base for their child and implementing gender-liberal parenting practices (MacMullin et al., 2021). A recent study found that children who had undergone a social gender transition experienced comparable rates of behavioral and emotional challenges to children who were

cisgender and gender-nonconforming (Wong et al., 2019). Thus, it is important that efforts made to reduce the mental health risks faced by gender-nonconforming children apply to all children who vary in their gender expression and/or identity, independent of their transition status.

Notably, Kwan et al. (2020) recently showed that it is possible to improve 8- to 9-year-old children's appraisals of gender-nonconforming peers. Kwan et al. implemented an experimental vignette design that involved showing children hypothetical peers who displayed some gender-nonconforming preferences, some gender-conforming preferences, and gender-neutral positive attributes. This experimental vignette design was associated with more positive appraisals of gender-nonconforming peers (see the Spotlight Feature in Chapter 10 for more details). Additionally, Lamb et al. (2009) taught children to challenge peers' sexist remarks, which led children to challenge peers' sexist remarks more frequently. Future intervention work aiming to build off of these approaches may be one important means of enhancing social acceptance and well-being of gender-nonconforming children.

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Spotlight Feature: Gender and Sexual Diversity in Autism

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As described in the fifth version of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5), autism spectrum disorder (ASD) is defined as persistent deficits in social communication and interaction along with restricted, repetitive patterns of behavior, interests, or activities (APA, 2013). ASD is often considered a heterogeneous neurodevelopmental condition with a great variety of manifestations depending on developmental level and severity. The prevalence of ASD in youth is estimated at around 1% with a higher prevalence in youth assigned male at birth as compared to those assigned female at birth (Elsabbagh et al., 2012; Lai et al., 2014; Raina et al., 2017).

The views on gender identity and sexuality in autism have drastically changed over the past decades along with an increasing amount of research, media, and clinical attention to gender identity and sexuality in autistic[1] people (e.g., Dewinter et al., 2013; van der Miesen et al., 2016). While it was at one time questioned whether autistic children could develop a sense of their own gender identity (Abelson, 1981), and sexuality was considerably ignored as a healthy part of autistic people's lives (e.g., Torisky & Torisky, 1985), nowadays sexuality development and sexual health are considered natural aspects of all individuals and human rights (World Health Organization, 2006). Related, attention to gender identity and sexuality has become more and more part of, for example, education programs for autistic youth (Pugliese et al., 2020) and autism research (Dewinter et al., 2020). This change in views and research attention has resulted in increased knowledge with the main consistent findings of increased gender nonconformity/gender diversity (an umbrella term to capture broad ranges of gender identity variations; Adelson, 2012) and sexual diversity in autistic people as compared to allistic (i.e., non-autistic) individuals (e.g., Byers et al., 2013; Dewinter et al., 2017; van der Miesen et al., 2016).

Research on the apparent co-occurrence of autism and gender diversity in youth has been highlighted in a series of studies, with the start of the literature going back to the 1990s with case descriptions (e.g., Landen & Rasmussen, 1997) of autistic people expressing gender nonconformity or identifying as transgender (an umbrella term for individuals who identify with a gender identity that diverges from their birth-assigned gender). The first systematic study was published in 2010 and found a prevalence of an ASD diagnosis of 7.8% using a diagnostic interview in transgender children and adolescents referred to a gender identity specialty service, which is

[1]This Spotlight Feature uses identity-first language in accordance with calls from autistic self-advocates (e.g., Kenny et al., 2016).

considerably higher as compared to the estimated general population prevalence rate of ASD (de Vries et al., 2010). More recent studies found even higher prevalence rates of ASD diagnoses in transgender youth, with the most recent systematic study reporting a prevalence rate of 22.5% (Strauss et al., 2017). Other studies employed autism screening questionnaires in transgender youth (e.g., Leef et al., 2019) and found percentages of 13.1–68% using cut-off scores indicative of clinical-range autistic characteristics (for an overview of these studies, see Øien et al., 2018; van der Miesen et al., 2016). Conversely, studies focusing on gender diversity in autistic youth found increased parent-reported and self-reported gender diversity as compared to general population rates (e.g., Strang et al., 2014; van der Miesen et al., 2018a). In addition, one study found a link between gender nonconformity and autistic characteristics in a sample of children from the community (Nabbijohn et al., 2019), which confirmed the previous findings in clinic-based samples. Until now, most studies have focused solely on prevalence rates of the co-occurrence of gender diversity and autism and, therefore, it is unclear why this elevated co-occurrence might exist.

With regard to sexual diversity, most studies on lesbian, gay, and bisexual (LGB) orientations in autistic people have been performed in adults (e.g., George & Stokes, 2018) with a considerable body of research citing a higher prevalence of non-heterosexual or LGB orientations in autistic people as compared to general population rates (for an overview, see Pecora et al., 2020). The studies performed in autistic youth are limited but the first study in autistic adolescents confirmed the findings in autistic adults of LGB orientations being more frequently reported as compared to the general population (Hellemans et al., 2007). Other studies found comparable results with autistic adolescents reporting higher rates of non-heterosexual attractions (May et al., 2017). Similar to the apparent co-occurrence of autism and gender diversity, it is unclear why this increase in sexual diversity is found in autistic people.

The findings of increased gender nonconformity/gender diversity and sexual diversity in autistic people have clinical implications (e.g., Strang et al., 2018). Clinicians who work in gender specialty services should screen for autism and/or autistic characteristics, and those clinicians working with autistic youth should be aware of gender and sexual diversity and should have open conversations about these topics (Strang et al., 2018). It is also important to recognize that gender diversity and sexual diversity might each be disproportionately associated with higher rates of mental health challenges (e.g., Marshal et al., 2011; van der Miesen et al., 2018b). Further, initial findings suggest that being both autistic *and* gender or sexually diverse might be associated with elevated vulnerability for mental health challenges (e.g., van der Miesen et al., 2018b). Clinicians working with autistic gender and sexually diverse youth should, therefore, be attuned to mental health challenges and the health care needs of the individuals within these layered minority groups.

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Chapter 19
Asexuality: When Sexual Attraction Is Lacking

Lori A. Brotto and Sonia Milani

Abstract In the past decade, human asexuality has garnered much attention and emerged as an empirically documented sexual orientation. Asexuality is generally defined as an absence of sexual attraction and approximately 1% of the general population report not feeling sexually attracted anyone. In this chapter, we examine the evolving definition of asexuality and diversification of individuals who identify as asexual. We provide an overview of gender differences and review the extant literature on human asexuality, which has mainly focused on exploring how to best conceptualize asexuality. Various theories have been proposed to classify asexuality as a mental disorder, a sexual dysfunction, or a paraphilia. However, we challenge these speculations and pose that asexuality may best be thought of as a sexual orientation as it is likely a normal variation in the experience of human sexuality. We discuss factors that make the study of asexuality challenging and propose possible solutions for researchers to consider. Future research into asexuality is necessary and might inform our understanding of sexuality in general. Researchers need to examine and understand the biological correlates of asexuality and directly test asexuality as a sexual orientation.

Keywords Asexuality · Sexual attraction · Sexual desire · Sexual orientation · Romantic attraction

In recent years, interest in human asexuality has increased among lay individuals, popular culture, and researchers alike. Prior to 2004, asexuality was a term that was

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mainly used to describe the reproductive patterns of many single-celled organisms. Since then, academic attention on the topic of human asexuality has burgeoned. The development of the largest international online community of asexual individuals, known as the "Asexuality and Visibility Education Network" (AVEN), in conjunction with the publication of a large, population-based study ignited interest in the construct of asexuality from theoretical, academic, clinical, and feminist perspectives. Despite the upsurge of interest in the topic, which has led to a flurry of empirical research, much remains unknown about factors contributing to the development of asexuality and how to best classify this phenomenon or people who identify as asexual.

In this chapter, we start by providing an overview of the most commonly used definitions of asexuality and we review literature that has sought to conceptualize asexuality and characterize those who identify as asexual across a variety of online and face-to-face studies. Where possible, we speculate on the developmental issues that may pertain to different facets of what is known about asexual persons. We conclude this chapter by discussing the implications of conceptualizing asexuality as a sexual orientation and suggest a number of future research directions necessary to advance the science of understanding asexuality. Among those directions is a grave need to explore and understand the developmental pathways that lead to a lack of sexual attraction and pave the way for an asexual identity.

19.1 What Is Asexuality?

19.1.1 Definition

Asexuality was first reported in 1948 by Alfred Kinsey and colleagues when they recognized the existence of asexual (or nonsexual) people and included a category "X"—defined as having no socio-sexual contacts or reactions—to the Kinsey one-dimensional model of sexual orientation. In 1980, Storms described asexuality using a two-dimensional model of erotic orientation and his definition focused on the absence of sexual orientation. According to Storms's model (see Fig. 19.1), asexuality is characterized by low homoeroticism and low heteroeroticism; thus, asexual individuals lack a basic attraction towards others (Storms, 1980). Because of its emphasis on sexual attraction/eroticism over behavior, along with its ability to accommodate asexuals when two dimensions are utilized, Storms's model has been argued to be an advance over Kinsey's traditional, one-dimensional model. It is important to note that a lack of sexual attraction does not necessarily imply a lack of sexual experience, as there is evidence that some asexuals engage in sexual intercourse and many masturbate (Brotto et al., 2010; Yule et al., 2017). Others, however, have employed differing definitions that have either focused on behavior and characterized asexuals as individuals who engage in few or no sexual behaviors (Rothblum & Brehony, 1993), or used a model of sexual excitation and inhibition

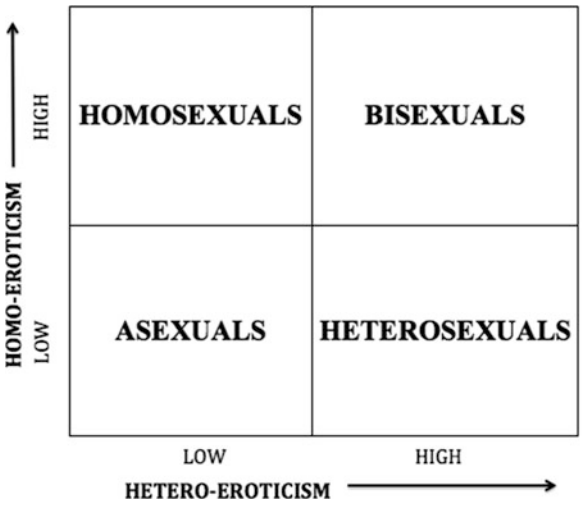

Fig. 19.1 Storms model of sexual orientation

and characterized asexuals along these two dimensions as having low levels of sexual excitement (Prause & Graham, 2007).

Although a variety of definitions are proposed, asexuality is defined by AVEN as "a person who does not experience sexual attraction" (AVEN, 2018). Nevertheless, as awareness about asexuality has grown, the definition of asexuality on AVEN has evolved over time and there is increasing recognition that there may be variations such that each asexual individual experiences relationships, attraction, and arousal somewhat differently. This recognition has brought forth new terminologies. For instance, "gray-asexual" (or gray-A) refers to an individual who may experience sexual attraction in isolated instances, or only under specific circumstances; whereas, "demisexual" refers to an individual who can only experience sexual attraction or desire after an emotional bond has been formed (AVEN, 2018). The term asexual umbrella, or "Ace," is used broadly to include asexuality and identities similar to asexuality (i.e., demisexuality or gray-A) that are affiliated within a broader community. "Ace" is the asexual parallel to "queer" used among sexual minority classifications. Researchers have generally used the term "asexual person" to refer more narrowly to the individual who identifies with a lack of sexual attraction. For the purposes of this review, we will adopt the most commonly used definition—that of lack of sexual attraction—however, we acknowledge that this definition is not universally accepted, nor employed in the entire body of research that follows.

19.1.2 Prevalence

The lack of a universally agreed upon definition of asexuality poses a challenge to research seeking to establish its prevalence. The most widely cited prevalence estimate of asexuality originates from a large, national probability study of

$n = 18{,}681$ individuals in the United Kingdom, indicating that approximately 1% of the population reported never feeling sexually attracted to anyone (Bogaert, 2004). When Bogaert repeated this analysis in the second wave of the British national probability study, the prevalence of asexuality was found to be 0.5% (Bogaert, 2013). In a different sample using data from high school students in New Zealand, 1.8% reported a lack of sexual attraction (Lucassen et al., 2011). A more recent study found 3.3% of women and 1.5% of men from a Finnish population had not experienced sexual attraction within the past year (Höglund et al., 2014). Because the latter two studies are limited in the age range of participants and in the time span of interest, respectively, 1% appears to be a reasonable estimate of the prevalence rate of asexuality.

Difficulty determining a precise prevalence rate is potentiated not only by the evolving definition of asexuality and diversification of individuals who identify as Ace, but also by sampling and recruitment complexities. As of December 2015, there were approximately 120,000 registered members on AVEN from around the world, and AVEN has been a central source for recruiting asexuals to research. While there are many advantages to having such a platform with a large number of individuals who fall under the asexual spectrum, using self-identified asexuals recruited from AVEN alone for research that is aimed at better understanding asexuality draws from a very select segment of the asexual population (i.e., those who have already adopted the asexual label), and inadvertently ignores the experiences of those who have yet to identify with the asexual label. Nevertheless, recruiting asexual participants can be challenging for reasons such as: a lack of motivation and interest for asexual individuals to participate in sexuality-based research, asexual individuals wanting to keep their identities secret due to perceived societal disapproval, and individuals not self-identifying as asexual either because they are not familiar with the concept or they use a different label.

A 2010 study based on a sample recruited from AVEN found that a sizeable proportion of the sample indicated "other" instead of "asexual" when presented with a forced-choice question about their sexual orientation (Brotto et al., 2010). Of those who self-identified as asexual, 73% had never engaged in sexual intercourse and the other 27% maintained that they lacked sexual attractions despite engaging in sexual intercourse (Brotto et al., 2010). Interestingly, the majority of asexual men and women (80% and 73%, respectively) reported engaging in masturbation and there was a strong sentiment that "sex with oneself" can exist without sexual attraction, and is therefore different from sex with another individual (Brotto et al., 2010). Taken together, the above estimates further elucidate the degree of variability in identification and behavior among this population, which can consequently impact prevalence rates more generally. Chasin (2011) cautions us from taking existing prevalence figures as conclusive given that most of the research has been based on providing respondents with a fixed definition of asexuality. Chasin argues that research must allow for the self-identification as asexual, which may or may not map nicely onto those who endorse "yes" to a categorical option of asexuality on a questionnaire. Nonetheless, as indicated by Hinderliter (2013), the definition of asexuality forwarded by AVEN is broad enough to be inclusive of people who

lack sexual attraction but who may still have other experiences that may be considered sexual, such as sexual behavior, masturbation, and nonsexual attractions.

19.1.3 Gender Differences

In Bogaert's (2004) analysis of the National Survey of Sexual Attitudes and Lifestyles-I ($n = 18{,}681$ respondents obtained from national probability sampling, aged 16–59), participants were asked about their gender and provided the binary options of male and female. A total of 70.8% of the asexual participants endorsed female versus 56.8% of the sexual participants. Bogaert speculated that women's tendency to have a more flexible sex drive, and men's higher likelihood of internalizing sex role stereotypes may be contributing to these findings. Bogaert also speculated that compared to men, women's less frequent conditioning experiences (e.g., masturbation frequency and awareness of sexual arousal), which are relevant to sexual orientation development, may result in women being more likely to identify as asexual.

Bogaert repeated these analyses 10 years later in the second wave of the National Survey of Sexual Attitudes and Lifestyles-II study (Bogaert, 2013), this time based on $n = 11{,}080$ individuals aged 16–44. This time, a gender difference (in male vs. female) did not emerge even though only 32% of the asexual sample identified as male. When the analyses were weighted due to the sampling method, the previously found gender difference, with women being more likely to be asexual than men, emerged. Prause and Graham (2007) examined a convenience sample recruited based on their self-identification as asexual (not on the basis of a fixed definition provided by the researchers) and did not find any gender differences in the prevalence of asexuality.

As demonstrated by the longitudinal and developmental research by Diamond (2012), a larger proportion of women, compared to men, exhibit fluidity in their sexual orientation. Although Diamond did not include the category of asexual in her research, future research should examine whether asexual persons identifying as female remain in that category over time or move to another sexual orientation category.

Anecdotal reports and online discussions on AVEN suggest that Ace persons reject sex and gender binaries at rates higher than the general population and, therefore, male-versus-female comparisons within asexuals might be viewed as an artificial endeavor. In the 2014 Asexual Community Census of $n = 10{,}880$ Ace survey participants, only 75% identified as "woman/female" or "man/male" (Ginoza et al., 2014). Another study of $n = 66$ asexual persons found that 27% identified as non-binary, gender-neutral, androgynous, or genderqueer (MacNeela & Murphy, 2015). Approximately 12% of 214 participants in yet another study declined to provide information on gender, suggesting that the options "male" or "female" did not fit for them (Brotto et al., 2010), and 20% of participants in a smaller study reported gender identities other than male or female (Gazzola & Morrison, 2012).

This finding that there may be a sizable proportion of asexual-identifying persons who reject the gender binary deserves further understanding. For some, it may be that they identify with genders other than male/female, and including: trans*, genderqueer, agender, two-spirit, or non-binary. Support for this stems from the AVEN Census Project (Ginoza et al., 2014) which found that 28% of respondents endorsed a current gender identity that did not align with their assigned sex at birth. However, only 11% of the total respondents identified as trans*, and an additional 8% reported that they were "unsure" whether they were trans or cis. Of those who identified as a non-binary gender, 31% self-classified as trans, 41% did not identify as trans, and 28% were unsure. Examining this relationship between transgender identity and asexuality from a different perspective, one study of transgender identified individuals found that 11% identified as asexual (Bockting et al., 2005). Only associations between these diverse gender categories and sexuality have been documented to date; no research exists on the causes of this overlap.

Given that research methodologies often provide fixed gender categories based on a binary norm, researchers likely have not adequately captured the diversity of gender identities/expressions among Ace-identified individuals. As a consequence, studies have been essentializing gender, reinscribing the gender binary, and excluding individuals who do not fall under traditional gender categories (Lorber, 1996), including in some cases significant proportions of participants who identify as asexual but who do not identify as male or female (Chasin, 2011). Future research on asexuality should ask about both current and birth-assigned gender over two questions (Tate et al., 2013). Instead of focusing research on comparisons of male versus female asexuals, and in the spirit of not contributing to the rampant problem of missing data, researchers should seek to provide inclusive category options, including an option for free response, in asexuality research. Moreover, almost nothing is known about the possible developmental trajectories that give rise to a higher proportion of asexuals who identify as women over men (if, indeed, this gender difference is true), and to the sizable proportion of asexual persons who identify as trans (if, indeed, this higher proportion relative to the sexually identifying population is true).

19.1.4 Sexual Activity and Asexuality

As introduced earlier, a lack of sexual attraction is not synonymous with a lack of sexual activity, and there is considerable evidence that asexual individuals engage in both partnered and solitary sexual activity (Brotto et al., 2010; Yule et al., 2014). Indeed, asexual individuals described feeling like they "could not relate" to friends during discussions about sexual activity in adolescence (Brotto et al., 2010). Among romantically identifying asexuals, some do engage in sexual activity, but most of their relationships do not include sex (Brotto et al., 2010). Over 85% of asexuals in the study by Brotto et al. (2010) indicated that their ideal intercourse frequency was less than twice per year, and over 75% had never engaged in kissing or petting. In

contrast to asexuals, sexually identifying individuals who meet criteria for a sexual desire disorder, like *hypoactive sexual desire disorder* (American Psychiatric Association [APA], 2000), continue to engage in sexual activity despite their distressing low desire (Brotto et al., 2015). The motivations behind sexual activity may have nothing to do with sexual attraction, and may relate to being in a romantic relationship with a sexually identifying partner (Van Houdenhove et al., 2015). Moreover, there may be developmental pressures among younger asexual persons to engage in culturally-sanctioned sexual activity as a "rite of passage" into adulthood, even in spite of their lack of attraction to or wanting of such sexual activity.

19.1.5 Romantic Attractions

Brotto et al. (2010) found that asexual participants described their relationship orientations as either hetero-romantic, homo-romantic, a-romantic, or bi-romantic, and this finding raised the possibility that the development of sexual and romantic attractions may be independent processes. Asexuals who experience romantic desire are generally termed "romantic asexuals" and include a variety of romantic orientations (e.g., heteroromantic, panromantic), reflecting the gender of the person to whom they experience romantic attraction. By contrast, those who do not experience romantic attraction self-identify as "aromantic asexuals." AVEN's 2014 census found that 22% of asexuals identify as heteroromantic, 5.1% homoromantic, 32.2% bi- or panromantic, 19% aromantic, and 21.7% selected other options (Ginoza et al., 2014). A recent study conducted in China found a similarly broad distribution with 31.7% of asexuals identifying as heteroromantic, 14.1% homoromantic, 26.0% biromantic, and 28.2% aromantic (Zheng & Su, 2018). The finding that sexual attraction is distinct from romantic attraction among asexuals is in line with Diamond's (2003) theory of romantic attraction, which posits that the genderedness of attraction stems purely from sexual orientation while romantic attraction only appears gendered as romantic bond formation is facilitated by sexual desire and encounters.

Within her theory, Diamond (2003) concludes that there are independent underlying processes that lead to the development of sexual desire and affectional bonding. There is evidence for different underlying systems giving rise to sexual desire (the sexual mating system) and romantic love (attachment or pair-bonding system), and there are countless examples in the human as well as nonhuman animal literature of pair bonding in the absence of mating (and presuming sexual desire and attractions). From here, Diamond posits that individuals are capable of loving someone they are not sexually attracted to, and provides the example of a heterosexually identifying person who is able to fall in love with a same-gender partner, and a lesbian or gay identifying person who is able to fall in love with an opposite-gender partner. Though Diamond does not mention whether this theory would extend to an asexually identifying person falling in love, the existence of

independent sexual and romantic identity development suggests that this possibility is entirely feasible.

Only three studies have explored the prevalence of romantic versus aromantic attractions among asexual persons, and none of those have sought to compare the distinguishing features between the romantically inclined versus aromantic asexuals. In a recent analysis across seven asexuality studies (Brotto et al., 2020), 26.6% of $n = 1229$ asexual participants identified as aromantic and the remaining identified with a romantic orientation. They found no differences between the romantic and aromantic asexuals in gender identification, levels of solitary sexual desire, or on measures of depression. However, romantic asexuals were 6.4 times more likely to report being in a relationship than the aromantic asexuals, and to have significantly more past romantic and sexual partners. Romantic asexuals kissed significantly more often than aromantic asexuals when controlling for demographic variables but there were no group differences on frequency of sexual fantasies, or in the frequency of masturbation (Brotto et al., 2020).

Chasin (2011) emphasizes the importance of paying attention to the sexual attraction versus romantic attraction dimensions of asexuals and notes that people may identify not only by the gender of the person to whom they are attracted, but also the degree to which they experience this attraction and the ways in which they do. Chasin goes on to urge the field to consider sexual and romantic attractions separately in broader approaches to measuring sexual orientation.

19.2 Overview of Alternative Explanations

Given that asexuality challenges the ubiquitous notion that sexuality is a universal human experience, early reactions to this surge in attention to and the existence of asexuality ranged from curious to highly skeptical. Opinions of some sex therapists insinuated that asexuality was nothing more than an extreme version of a sexual desire disorder (Asexuality on 20/20, 2006). Public media figures teased asexual spokespeople that they must want to have sex when they see an attractive person walk by (e.g., Carlson, 2006; Williams, 2007). These criticisms have generally fallen into three broad themes: (i) asexuality is a manifestation of underlying psychopathology (Johnson, 1977); (ii) asexuality represents an extreme variant of sexual desire disorder (Childs, 2009; Pagan-Westfall, 2004); and (iii) asexuality is a variant on the spectrum of paraphilia (Bogaert, 2006). In this section, we review the relevant data that support or refute each of these hypotheses.

19.2.1 Asexuality as a Mental Disorder

Although there is evidence that certain mental health issues, such as anxiety and interpersonal problems, are elevated among asexual individuals, the association

between asexuality and psychological symptoms is ambiguous because the causes of such elevated rates are unclear and debated. A large quantitative study found that self-identified asexuals had the same rates of depression as population norms (Brotto et al., 2010), but were more likely to endorse symptoms of social withdrawal, anxiety, suicidality, and report more interpersonal difficulties compared to sexual participants (Yule et al., 2013). Social inhibition and withdrawal are elevated among asexuals, and Schizoid Personality Disorder, characterized by emotional coldness, limited capacity to express warm feelings towards others, and lacking desire for close, confiding relationships (APA, 2000), may be associated to asexuality (Brotto et al., 2010). An online study exploring mental health correlates and interpersonal functioning found significant differences between asexual, nonheterosexual (bisexual and homosexual), and heterosexual men and women on multiple psychological symptoms (Yule et al., 2013). Compared to their nonheterosexual counterparts, asexual men scored higher on measures of somatization, depression, and psychoticism (Yule et al., 2013). Asexual women scored higher on measures of phobic anxiety and psychoticism than heterosexual women and had scores similar to nonheterosexual women (Yule et al., 2013). On items assessing suicidality, asexual men and women scored significantly higher than heterosexual individuals (Yule et al., 2013). This study further corroborates previous research with the finding that asexual men and women endorsed several interpersonal problem domains, including cold, socially avoidant, and non-assertive personality styles compared to their heterosexual counterparts (Yule et al., 2013). The latter association coupled with the fact that one-third of asexual individuals have never engaged in a relationship suggests atypical social functioning appears to be more widespread than just related to sexual relationships.

There is also some support for an association between autism spectrum disorder (ASD) and asexuality. In semi-structured, in-depth interviews, 7 out of 15 asexual individuals from AVEN discussed the potential relationship between Asperger Syndrome and asexuality, and felt that they personally met the criteria for Schizoid Personality Disorder (Brotto et al., 2010), which resembles ASD with respect to traits such as social withdrawal, and difficulty with social skills and relating to others. Additional evidence for this potential relationship is bolstered with higher rates of asexuality reported among autistic participants compared to community control groups. Ingudomnukul et al. (2007) found that 17% of women with ASD reported they were asexual compared to none of the women in the control group. Data presented by Gilmour et al. (2012) further shows that approximately 6% of autistic men and women reported having no sexual interest for anyone. As pointed out by Pecora et al. (2016), it may be that individuals on the autism spectrum show a more diverse range of sexual interests (homosexual, bisexual, and asexual) as well as having a higher representation of gender dysphoria than in the general population. There is ongoing research aimed at exploring whether and how asexuality and autism spectrum may be related to an underlying neurodevelopmental process, and in so doing, we need to pay attention to what such findings mean, if anything, to persons on the autism spectrum (Chasin, 2017).

Despite evidence for higher rates of psychopathology in asexual individuals, asexuality should not be classified as a mental disorder, nor conceptualized as a psychiatric condition. It has been suggested that at least some of the symptoms described above may be explained by the stigmatization and dehumanization experienced by asexual individuals (Scherrer, 2008). Membership in a sexually marginalized group and the associated experiences of prejudice and discrimination may account for the elevated rates of mental health issues found among asexuals. In fact, those who identify as asexual may experience more stigma than other nonheterosexual orientations because they experience a lack of sexual attraction in a society that is arguably dominated by sexuality—that all people experience sexual desire is one of the most pervasive assumptions of our society (Cole, 1993; Przybylo, 2011). For example, college students provided the most negative evaluations for asexual individuals compared to other sexual orientation groups and viewed asexuals as least likely to possess "human nature traits" (MacInnis & Hodson, 2012). Thus, the contention that asexuality may be an expression of a psychiatric illness is not supported and should not be used to pathologize asexual individuals and asexuality more broadly. Evidence for asexuality as a mental disorder is equivocal at best and additional research further elucidating this relationship is required.

19.2.2 Asexuality as a Sexual Dysfunction

Given that asexual persons report a lack of sexual attraction, and relatedly, a lack of sexual desire, often for the entire duration of their lives, there has been a reasonable speculation that asexuality represents an extreme end of the low desire continuum, thereby suggesting asexual individuals experience disorders such as Hypoactive Sexual Desire Disorder (HSDD) and Sexual Interest/Arousal Disorder (SIAD) included in the fourth and fifth editions of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM; APA, 2000, 2013), respectively.

One key difference between asexuals and those with a sexual desire disorder is the experience of distress. A diagnosis of HSDD or SIAD requires the presence of clinically significant levels of distress, in addition to the symptom(s) of low sexual desire. On the other hand, asexuals maintain that they do not experience personal distress nor do they want to be "fixed" (Brotto et al., 2010; Pagan-Westfall, 2004). In a recent study, Brotto et al. (2015) used measures of sexual desire and behavior, distress, personality, and psychopathology to explore similarities and differences between an asexual group, which included individuals who scored above the cutoff on the *Asexuality Identification Scale* (AIS; Yule et al., 2015), and sexual groups, which contained a control group, a HSDD group, and a group with symptoms of low desire that were non-distressing. Not only did their findings indicate that those with HSDD had the highest levels of sex-related distress, but many of those with HSDD (93.2%) and those in the control group (96.4%) also reported that they wanted to engage in sexual intercourse and other sexual behaviors, while 83.9% of asexuals reported that they would prefer not to engage in sexual activities (Brotto et al., 2015).

This is not surprising given that those with a sexual desire disorder continue to experience sexual attraction for others, are distressed by their low desire, and often continue to engage in sex in spite of their low desire; asexual persons, however, do not have the same motivations to engage in sex. Interestingly, sexual desire and sexual distress were positively correlated for asexual men and women such that distress increased with increasing desire scores (Brotto et al., 2010). This paradoxical correlation suggests that the presence of desire is distressing for asexuals, whereas the lack of desire is distressing for those who have a sexual dysfunction. Compared to those with HSDD who had a higher frequency of seeking treatment for their sexual difficulty, asexual individuals unanimously rejected the option when asked whether they would accept an effective treatment for improving their sexual desire (Brotto et al., 2010).

Another notable difference is the duration of the low or absent desire between those with HSDD or SIAD and asexual persons. Although HSDD and SIAD are formally categorized as either lifelong (existing for the entirety of the person's sexual life) or acquired (a change from a somewhat higher to a somewhat lower or absent level of desire), most of the literature has focused on the acquired subtype of HSDD or SIAD. Similarly, in the clinical setting, most people seeking treatment for low or absent desire have experienced it in the past. On the other hand, there is evidence that asexual persons report a lifelong pattern to their absent sexual attractions.

Another lens through which to test the prediction that asexuality is a type of sexual dysfunction is to examine genital sexual arousal patterns. The devices researchers use to measure male and female genital arousal are a penile plethysmograph (Janssen, 2002) and a vaginal pulse amplitude (VPA; Laan et al., 1995), respectively. Penile plethysmography uses a mercury-in-rubber strain gauge to measure changes in the circumference of the penis as erection develops, and VPA provides a measure of vaginal vasocongestion specific to sexual response (Chivers et al., 2004). One study carried out with asexual women attempted to explore sexual arousal patterns by measuring genital sexual response as participants viewed sexually explicit erotic films (Brotto & Yule, 2017). The authors found no evidence of differences in genital sexual arousal response between the asexual and sexual groups of women (Brotto & Yule, 2017). Although there are no published data available on genital arousal patterns in asexual men, there is one completed study which found, consistent with predictions, that men in the study showed a pattern of genital arousal response that was concordant with their self-reported sexual preferences. In other words, heterosexual men showed the highest penile arousal response to erotic films depicting an opposite sex couple, and gay men showed the highest response to erotic films depicting two male actors. On the other hand, asexual men showed a reduced genital arousal response to all sexual stimuli, consistent with the predictions of target specificity (Chivers et al., 2004; Chivers et al., 2015), which suggest that men will show a genital arousal response consistent with their self-reported erotic preferences. Taken together, asexuality should be differentiated from a diagnosis of sexual desire disorder, and as such, the DSM-5 makes this distinction clear and explicitly requires that asexuality be ruled out when one is considering a diagnosis of HSDD or SIAD (APA, 2013).

Despite findings that clearly separate these two constructs, there appears to be a potentially large amount of overlap and the conflation between asexuality and sexual dysfunction is problematic because the asexual community's goal is, in part, for asexuality to be viewed as a normal variation on the spectrum of human sexuality (Hinderliter, 2013). The implications of this conflation are significant given the increase in focus on sexual pharmaceuticals, as well as diagnosing, treating, and curing low sexual desire. From a clinical standpoint, it is notable that level of engagement in sexual behaviors and age of first intercourse do not differentiate these groups (Brotto et al., 2015); thus, when classifying between asexuality and a sexual dysfunction, a clinician must assess a broad range of sex-related domains and not focus exclusively on the frequency of sexual behavior. The extent of the overlap between these groups requires more research and needs to be investigated further.

19.2.3 Asexuality as a Paraphilia

Another hypothesis places asexuality within the realm of paraphilias, which are defined as atypical or non-normative sexual attractions (APA, 2013). A paraphilia itself is not considered a disorder. According to the DSM-5, an individual's atypical sexual interests must cause significant personal distress or create distress for someone else in order to meet criteria for a paraphilic disorder (APA, 2013). Given that paraphilia without human interest is rare (but asexual individuals do not experience attraction towards others), and paraphilic tendencies more frequently occur in men (whereas asexuals are more common among women), how can asexuality be classified as a paraphilia?

Evidence that approximately 50% of asexuals masturbate monthly (Yule et al., 2014) suggests that asexual individuals might possess a non-partner-oriented sexual desire underlying their masturbatory behaviors, and that this may be understood to be a paraphilic sexual interest. An in-depth exploration of masturbation and contents of sexual fantasy among asexual and sexual individuals found that asexual women were significantly less likely to masturbate at least monthly than sexual women and asexual men (Yule et al., 2017). Asexual men and women were also significantly more likely to report that they had never had a sexual fantasy than their sexual counterparts (Yule et al., 2017). Of those who indicated having had a sexual fantasy, asexual men and women were more likely to report that their fantasies did not involve other people compared to sexual men and women (Yule et al., 2017). Notably, asexual women had higher rates of reporting never experiencing a sexual fantasy compared to asexual men, but they were also more likely to report having sexual fantasies involving fictional characters (Yule et al., 2017).

A type of paraphilia known as autochorissexualism was described by Bogaert (2012), and defined as a perceived "disconnect between an individual's sense of self and sexual object/target" or "identity-less sexuality." Those who experience autochorissexuality view their identity as being separate from sexual acts that they might engage in or fantasize about. Hence, that 33% of asexual women and 19% of

asexual men reported that their sexual fantasies do not depict images of themselves supports this overlap between asexuality and autochorissexualism (Yule et al., 2014). Asexuals are also more likely to report feeling disconnected and/or dissociated from the contents of their fantasies (Brotto & Yule, 2017).

It is notable to mention that asexual men and women were significantly less likely to report masturbating for sexual pleasure or fun than their sexual counterparts (Yule et al., 2017). Thus, masturbation is a physiological act unrelated to sexual pleasure for some asexual individuals who indicated their motivation for masturbation is more functional in nature, such as to relieve tension and "clean out the plumbing" (Brotto & Yule, 2017). Nevertheless, the presence of masturbation coupled with sexual fantasies, which characterizes at least a subgroup among asexuals, raises the possibility that there is a great deal of variability across asexual individuals in their motives for masturbation, with some potentially having a paraphilic component. Additional research is required to examine the existence, persistence, and pervasiveness of paraphilic fantasies with respect to asexuality.

19.2.4 How Is Asexuality Different from Celibacy?

Some religions view complete sexual abstinence as a virtue, preventing some religious individuals from developing a strong attraction to others and giving in to arousal. Although asexuals may find acceptance in certain religious communities that value restricted sexuality, religiosity is not necessarily a causal factor in the development of an asexual identity, and asexuality (defined by lack of attraction) is not synonymous with those who are chaste (waiting for marriage) or celibate (actively eschew sex). Studies have found strong associations between lifetime abstinence and religiosity (Eisenberg et al., 2009; Haydon et al., 2014). A study examining sexual inactivity in the general population found that sexlessness was more prevalent among those who were religiously observant compared to their sexually active counterparts (Kim et al., 2017). That the proportion of long-term sexlessness among those who had never been married was much higher (8.7% for men and 11.3% for women) than prevalence estimates reported for asexuality suggests that the avoidance of sexual activity has strong sociological dimensions beyond lack of sexual attraction towards others (Kim et al., 2017). Celibacy among these individuals is a religious choice supported by a unique set of religious community norms and expectations (as well as consequences). The sexual inactivity experienced by (some) asexual persons likely represents an innate characteristic stemming from a lack of sexual attraction (Brotto & Yule, 2017). Whereas asexual persons do not desire sex, a celibate identity implies the presence of sexual desire that is repressed and not acted on. As such, asexuality and sexual inactivity/inexperience are not one and the same and this provides further evidence of the complex relationship among sexual identity, sexual attraction, and sexual behavior, as previously mentioned in this chapter.

19.3 Challenges in Asexuality Research

It is generally agreed upon that asexuality is currently not a comprehensively understood entity and research on asexuals' experiences is nascent. Despite a generally accepted definition of asexuality as a lack of sexual attraction, much diversity exists and asexuals derive different meaning from being asexual. This leads to considerable nuance and variation in what it means to be a part of the asexual community and makes efforts by researchers who are attempting to achieve a more rigorous definition of asexuality more challenging. In this section, we will discuss factors that complicate the study of asexuality and propose possible solutions for researchers to consider.

19.3.1 Developing a Validated Measure of Asexuality

Much more attention to how we are measuring and classifying asexuality needs to be undertaken by researchers and, as noted by Hinderliter (2009), there are potentially serious limitations in using existing measures of sexual desire/attraction/function that were developed for and validated among sexually identifying individuals. Specifically, existing measures tend to assume that sexual attraction and desire are universal, and they tend to devalue low or absent sexual desire. Yule et al. (2015) sought to develop a validated measure of asexuality over a series of stages that included initial item development, factor analysis, and validity and reliability testing. The resulting *Asexuality Identification Scale (AIS)* is a 12-item brief self-report measure that captured 93% of asexuals by using a cutoff score of 40 out of 60, while 95% of non-asexuals scored below this cutoff. Although the development of this measure may get around the problem of self-identification and may allow for standardization across different studies of asexuality, unfortunately it is not routinely used in asexuality research. We recommend, therefore, that in addition to other methods of identifying asexuals—such as self-identification—researchers employ the AIS, which may contribute to additional data on how well this validated measure maps onto the diversity of self-identified labels expressed by asexual individuals. Moreover, how the AIS fits for romantically oriented versus aromantic asexuals is a future area of research that is needed.

19.3.2 Capturing Sexual Orientation and Gender Identities

That self-identified asexuals are a heterogeneous group with respect to sexual attractions and gender identities poses a challenge for researchers and encourages us to be mindful about the groups researchers are recruiting—whether they are recruiting a broad group of "Ace" persons, or a more specific subgroup of

demisexual, gray-A, or purely asexual individuals. Moreover, the growing recognition that a sizable number of asexuals identify as trans*, non-binary, or agender (AVEN, 2015) suggests that researchers need to be inclusive of these categories. It is important to recognize that some asexuals can experience sexual attraction to varying degrees. We encountered the fluidity of sexual attraction when we previously defined Gray-A and demisexual, yet there are still other terms that might be used within the asexual community to classify a person who experiences very little sexual attraction, such as "semi-sexual," "asexual-ish," and "hyposexual." Thus, depending on the circumstance, individuals may not consider themselves strictly asexual. Across these categories, it is also important to bear in mind that asexual persons may or may not engage in a range of sexual activities and masturbation. Thus, researchers should seek to include measures of sexual activity, and yet not falsely assume that the presence of activities typically classified as sexual undermine one's identification as asexual. The category coined "libidoist" has been used to describe asexuals who still have a libido for masturbation, yet beyond this description, little is known about asexuals who adopt that label.

As Chasin (2011) notes, it is not sufficient to compare sexual to asexual persons given the diversity of romantic and sexual orientations among asexual persons. Chasin goes on to recommend that asexuality be considered as a continuous variable, not a categorical one, and that conceptualizing asexuality as categorical may have significant implications; in this way, asexuality might be conceptualized as a meta-category, just as sexuality is. For instance, depending on the nature of the generalization being sought, categories of representation may include either two relevant sub-samples (e.g., asexuals who experience romantic attraction and those who do not) or four relevant sub-samples (e.g., asexuals who have engaged in sexual behaviors with men, with women, with both, with neither). Chasin (2011) recommends that asexuality research should always seek to include self-identified asexuals regardless of how closely they align with available definitions. We agree with Chasin and recommend that research should also seek to characterize demographic similarities/differences between the self-identified asexual and the potential asexual populations.

As introduced earlier, an increase in the diversity of gender expressions also brings challenges to this line of research. As terms such as agender (without gender) and non-binary (identities which are outside the gender binary) become increasingly used to describe gender identity, the question of gender differences in the prevalence of asexuality is more complicated than simply assessing men versus women, and should be taken into account.

19.3.3 Measuring Sex-Related Distress

Researchers need to carefully distinguish between lack of sexual attraction/desire with or without the presence of personal distress. As reviewed earlier, a sexual desire disorder hinges upon the presence of clinically significant personal distress, whereas

asexuals do not experience such distress. However, we also cannot rule out the possibility that at least some individuals who are diagnosed with a lifelong sexual desire disorder may be better classified as asexual or vice versa, but are incorrectly classified due to insufficient measurement steps in research. One potential solution to this is including a measure of sex-related distress such as the *Female Sexual Distress Scale-Revised* (DeRogatis et al., 2008), which has also recently been validated in men (Santos-Iglesias et al., 2018).

19.4 Where the Research on Asexuality Needs to Go

19.4.1 Is Asexuality a Lifelong Pattern?

Similar to the often-reported sense among many gays and lesbians of always "being different" from the heterosexual majority, a high percentage of asexual individuals reported that they have "always felt different" (Van Houdenhove et al., 2015). Brotto et al. (2015) compared 14 individuals with lifelong lack of distressing sexual desire to 193 asexual persons and found that the asexual group scored significantly higher on the validated measure of asexuality (AIS) and significantly lower on a measure of sexual distress. However, the two groups did not differ on measures of sexual behavior or desire. They concluded that these two groups share more overlap than do the individuals with more recent loss of low desire and the asexual participants, and they speculated that some individuals with lifelong low desire may in fact better fit within an asexual identity. This area of distinction versus overlap has clinical implications given that a person who may better fit within asexuality conceptualization may find themselves in a therapy room at the request of a distressed (sexual) partner. In such cases, the source of the distress (whether it belongs to an individual versus the couple) needs to be explored and clinicians need to be armed with the information to be able to differentiate these groups. Much more research is therefore needed on how lifelong low sexual desire may or may not be different from asexuality, and what developmental pathways may lead to the concurrent experience of distress (among those with a desire disorder) versus no distress (among those identifying as asexual).

19.4.2 Understanding the Biological Correlates of Asexuality

Several researchers have noted that asexuality is likely the result of early, potentially prenatal, influences. Initial evidence for this stems from the finding by Bogaert (2004, 2013) that asexual men and women have, on average, a shorter stature relative to sexual individuals, and asexual women have, on average, atypical menstrual characteristics compared to sexual women (Ingudomnukul et al., 2007). Furthermore, non-right-handedness in both men and women and the number of older

brothers in men has been found to be associated with asexuality (Yule et al., 2014). Handedness, in particular, having also been linked to other (nonheterosexual) sexual orientations (Lalumière et al., 2000), is a biological marker of prenatal development and is relevant to explanations of early biological determinants in asexual development. The number of older brothers may also point to prenatal influences on sexual orientation development, with an elevated number of older brothers being linked to homosexuality in men (Blanchard, 2018; Blanchard & Bogaert, 1996). This fraternal birth order effect is explained by the maternal immune hypothesis: A mother exposed to one or more male pregnancies develops an immune response against a male-specific protein relevant to fetal brain development, thereby affecting the sexual orientation of later-born sons (Blanchard & Bogaert, 1996; Bogaert et al., 2018). These correlates are suggestive of early biological influences on asexuality and provide indirect evidence for asexuality as a sexual orientation.

Given that asexuality shares essential characteristics of being a unique sexual orientation vis-à-vis other sexual orientation groups, more research is needed to further our understanding of correlates and features of asexuality. Research methods such as brain imaging and eye tracking should be (and are currently) employed given the growing evidence that these methods reveal key differences between sexual orientation groups that shed light on the biological basis of sexual orientation. More specifically, assessing visual attention and cognitive processing of sexually preferred and non-preferred cues among asexual persons and ascertaining neuroanatomic features of asexuals using neuroimaging will lead to further investigations into biological and neural correlates associated with a lack of sexual attraction and asexuality, and further our understanding of sexuality as a whole.

19.4.3 Further Research that Directly Tests Asexuality as a Sexual Orientation

Despite the position of Brotto and Yule (2017) that there is compelling and converging evidence for asexuality as a unique sexual orientation, Scherrer and Pfeffer (2017) state that asexuality is best understood as an identity and a community, rather than as a sexual orientation. Identity, defined as "the way that people understand themselves and the language they use to explain themselves to others" (Scherrer & Pfeffer, 2017, p. 645) provides individuals with both a social and internal place from which to understand themselves. Community allows the broader understanding of this identity in the context of relationships and social interactions. They go on to state that conceptualizing asexuality as an identity and a community will allow us (non-asexuals) to avoid pathologizing a lack of sexual attraction, and to extend and explore further our understanding of sexuality and gender on a wider scale (Scherrer & Pfeffer, 2017).

In support of this, Scherrer (2010) posits that asexuality challenges and extends our understanding of the relationships of sexual persons. In examining qualitative

data from 102 self-identified asexuals, Scherrer (2010) challenged problematic assumptions about sex and sexuality in relationships among sexual minorities. Their analysis revealed a wide range of definitions of "relationship" and underscored the conflation of sex and intimacy. Traditionally, sex is used to delineate romantic relationships from friendships, and asexuality blurs this boundary. When understanding asexuality as an identity that is used to navigate relationships, we understand that there are a wide range of possible relationships, aside from the binary options of "in a relationship" or "single."

It seems that research examining which of these classifications best fits the asexuality entity, whether it is as a sexual orientation, an identity, a community, or some other framework, is greatly needed. Furthermore, the developmental trajectories that lead asexuality into such a framework must be explored.

19.5 Conclusion

Although a wide range of sexual diversity has been recognized throughout human history, asexuality remains an understudied phenomenon. Asexuality is likely a normal variation in the experience of human sexuality, and future research is required to inform our understanding of not only asexuality, but also sexuality in general. A developmental approach that seeks to test hypotheses about developmental origins and different developmental trajectories of asexual persons is greatly needed. A deeper understanding of the origins of asexuality and its development, as well as conceptualizing asexuality as a sexual orientation, will help eliminate stigmatization and dehumanization of this sexual minority.

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Chapter 20
Erotic Target Identity Inversions

Kevin J. Hsu and J. Michael Bailey

Abstract *Sexual orientation* is conventionally understood as relative attraction to men versus women. It has recently been argued that male sexual orientation in particular can be extended to include other dimensions of sexual attraction besides gender. One such dimension is sexual maturity, or relative attraction to children versus adults. A less familiar dimension is location, or relative attraction to other individuals versus sexual arousal by the fantasy of being one of those individuals. *Erotic target identity inversions* (ETIIs) refer to some men's sexual arousal by the fantasy of being the same kinds of individuals to whom they are sexually attracted. Thus, ETIIs reflect the movement from external attraction to internal attraction on the dimension of location. ETIIs can motivate men to change their appearance and behavior to become more like the individuals to whom they are sexually attracted. ETIIs also provide a compelling theoretical explanation for otherwise puzzling phenomena, such as cross-dressing among heterosexual men, desire for limb amputation, and the furry phenomenon. Despite its scientific and clinical value, the concept of ETIIs has been underappreciated and understudied. This chapter reviews the ETIIs that have been previously identified in the literature, addresses important issues related to ETIIs, discusses the causes and development of ETIIs, and proposes future directions for research.

Keywords Erotic target identity inversion · Autogynephilia · Apotemnophilia · Autopedophilia · Paraphilia · Sexual orientation

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Most people understand *sexual orientation* to mean relative attraction to men versus women. Some researchers (Blanchard, 2015; Hsu & Bailey, 2017; Seto, 2017) have recently argued that the meaning of sexual orientation can be extended to include other dimensions of sexual attraction besides gender, at least in men. For example, men vary in the extent to which they are attracted to sexually mature adults (*teleiophilia*) compared with prepubescent or pubescent children (*pedohebephilia*) (Bailey et al., 2016; Seto, 2012, 2017). It has been argued that important aspects of this dimension of sexual attraction—early onset, strong arousal by some but not all gender-age categories, and stability across time—are identical to the reasons why we refer to relative attraction to men versus women as sexual orientation.

In addition to gender and sexual maturity, another dimension of men's sexual attraction may comprise sexual orientation. This dimension is likely to be less familiar and more puzzling: the degree to which men are sexually attracted to other individuals or instead sexually aroused by the fantasy of being one of those individuals (Blanchard, 1991; Freund & Blanchard, 1993; Lawrence, 2009b). Although most men are sexually attracted to other individuals (e.g., women) and thus have external erotic targets, some men are sexually aroused by the fantasy that they are one of those individuals and thus locate an erotic target within their own body. In the latter case, their sexuality comprises an *erotic target identity inversion* (ETII; Freund & Blanchard, 1993).

Men with ETIIs vary in the extent to which they retain attraction to other individuals (Blanchard, 1989b, 1992). Indeed, some men with ETIIs are *anall*oerotic, or exclusively sexually aroused by fantasizing about themselves as another individual. Because they do not experience sexual attraction to others, analloerotic men with ETIIs may report that they are asexual (Bogaert, 2012; Brotto & Yule, 2017). Those unfamiliar with ETIIs may also assume that they lack any kind of sexual attraction at all. Among men with ETIIs who retain sexual attraction to others, the external and internal erotic targets are similar. For example, men sexually aroused by the fantasy of being a woman are sexually attracted to actual women, if they are attracted to other individuals at all. Thus, ETIIs reflect the extent to which men's sexual attraction is external versus internal on a dimension that may be considered an erotic target's location (Blanchard, 2015; Hsu & Bailey, 2017).

ETIIs can motivate men to change their appearance and behavior to become more like their internalized erotic target (Bailey, 2003; Blanchard, 1989a, 1991; Freund & Blanchard, 1993; Lawrence, 2006, 2009b, 2013). For example, men sexually aroused by the fantasy of being a woman are often motivated to cross-dress and to act like women (Bailey, 2003; Blanchard, 1991; Blanchard et al., 1986; Brown et al., 2020; Hsu et al., 2015; Hsu et al., 2017; Lawrence, 2013). Some men are so strongly motivated by ETIIs that they seek expensive and irreversible medical procedures to make their bodies more like their internalized erotic target. For example, some natal males sexually aroused by the fantasy of being a woman are motivated to seek gender confirmation surgery in order to make their bodies more like those of women (Bailey, 2003; Blanchard, 1991; Freund & Blanchard, 1993; Lawrence, 2009b, 2013). Recently in Western countries, most natal males who have completed gender confirmation surgery appear to be motivated by ETIIs (Lawrence, 2010a).

In the following sections, we review the ETIIs that have received scientific or clinical attention thus far. We then address ETIIs as paraphilias, ETIIs in natal females, and sexual masochism as an alternative explanation to ETIIs. Finally, we discuss the causes and development of ETIIs and propose future directions for research. In our proposal for future directions, we introduce a few more potential ETIIs for consideration.

20.1 Autogynephilia

Autogynephilia is a natal male's propensity to be sexually aroused by the thought or image of being a woman (Blanchard, 1989a), and it is the best studied example of a possible ETII (Blanchard, 2005; Lawrence, 2013). Autogynephilia occurs in natal males who are sexually attracted to women (Blanchard, 1991, 1993a; Freund & Blanchard, 1993; Lawrence, 2007). However, autogynephilic males' attraction to women has been internalized to some degree, such that they are also sexually aroused by the fantasy of being a woman. Although autogynephilia usually coexists with sexual attraction to women, sometimes the internalization is so complete that the autogynephilic male does not experience sexual attraction to women. Because women are the preferred erotic targets of most men, autogynephilia is likely to be the most common form of ETII (Blanchard, 1993b).

Most commonly, autogynephilia manifests as erotic cross-dressing, usually by adolescence (Bailey, 2003; Blanchard, 1991; Blanchard et al., 1986; Brown et al., 2020; Hsu et al., 2015, 2017; Lawrence, 2013). The specific erotic interest in cross-dressing is called *transvestic fetishism* (sometimes shortened to *transvestism*). Cross-dressing is a relatively easy, impermanent, and inexpensive way for a man to make himself look more like a woman. Thus, autogynephilic males often cross-dress to satisfy their sexual fantasy of being a woman. Some find it erotic to fantasize about having female-typical anatomy like breasts or a vagina. These anatomically autogynephilic males are more likely to experience *gender dysphoria*, or recurrent and intense feelings of discontent with being male (Blanchard, 1993a, 1993c). For some autogynephilic males, gender dysphoria and motivation to become a woman are so strong that they pursue gender confirmation surgery (Blanchard, 1991; Lawrence, 2004). The first row of Table 20.1 lists autogynephilia and its related phenomena as they pertain to the concept of ETIIs.

Studies that have examined the co-occurrence of autogynephilia and sexual attraction to women among gender dysphoric natal males or male-to-female transgender women provide indirect evidence supporting the idea that autogynephilia is an ETII. These studies have converged on the general finding that gender dysphoric natal males (Blanchard, 1985, 1989b, 1992; Blanchard et al., 1987; Freund et al., 1982; Zucker et al., 2012) and transgender women (Lawrence, 2005; Nuttbrock et al., 2011; Smith et al., 2005; Veale et al., 2008) who are sexually attracted to women report higher levels of autogynephilia or erotic cross-dressing, compared with those who are exclusively sexually attracted to men. Conversely, men with

Table 20.1 Sexual attraction to erotic targets, erotic target identity inversions, and their related phenomena in men

Erotic targets	Sexual attraction to erotic targets	Erotic target identity inversion	Manifestation of erotic target identity inversion	Related identity dysphoria
Women	Gynephilia	Autogynephilia	Cross-dressing (Transvestism)	Gender dysphoria
Amputees	Acrotomophilia	Apotemnophilia	Pretending	Body integrity dysphoria
Children	Pedohebephilia	Autopedophilia	Dressing in children's clothing (Pedovestism)	Age dysphoria
Anthropomorphic animals	Anthropomorphozoophilia	Autoanthropomorphozoophilia	Fursuiting	Species dysphoria
Real animals	Zoophilia	Autozoophilia	Unknown	Species dysphoria
Men	Androphilia	Autoandrophilia	Homeovestism	Masculinity dysphoria
Corpses	Necrophilia	Autonecrophilia	Unknown	Unknown

transvestic fetishism overwhelmingly report at least some attraction to women, with the majority identifying as heterosexual (Docter & Fleming, 2001; Docter & Prince, 1997; Långström & Zucker, 2005; Zucker et al., 2012).

An online study of 149 men who endorsed items explicitly assessing autogynephilia found that 81% identified as heterosexual and 15% as bisexual, further suggesting that this population is near exclusively comprised of men sexually attracted to women (Hsu et al., 2015). A more recent online study, using a much larger sample of 522 men who endorsed an item assessing autogynephilia, found that 63% identified as heterosexual and 30% as bisexual (Brown et al., 2020). Such findings would be predicted if autogynephilia is an ETII involving the internalization of sexual attraction to women. Although Brown et al.'s (2020) study required that autogynephilic men also reported sexual arousal by the thought of having sex with a woman, it did not appear to have inflated the combined prevalence of heterosexual and bisexual identities, which was similar to that in Hsu et al.'s (2015) study.

Consistent with the concept of ETIIs, gender dysphoric natal males and transgender women sexually attracted to women tend to report much more autogynephilia than do those not attracted to women (e.g., Blanchard, 1992). There is also a strong tendency for autogynephilic men to report sexual attraction to women (e.g., Hsu et al., 2015). Because men have such a high base rate of sexual attraction to women, these findings are neither entirely surprising nor strong evidence for the concept of ETIIs. Indeed, some transgender women insist that they are "lesbians trapped in a man's body" and vehemently oppose the idea that their sexual attraction to women is related to autogynephilia (Dreger, 2008). If these individuals admit to experiencing autogynephilia, they argue that it is an expression of their latent feelings of being female, rather than an ETII. There are other, less common but more perplexing phenomena that provide more persuasive evidence for the concept of ETIIs. We review the most compelling example next.

20.2 Apotemnophilia

Lawrence (2006) argued that men who desire limb amputation are motivated by an ETII. Their desire is, according to Lawrence, analogous to some autogynephilic men's desire for gender confirmation surgery. For men who desire limb amputation, the motivation is *apotemnophilia*, or sexual arousal by the thought or image of being an amputee (Money et al., 1977), which can be conceptualized as the ETII that occurs in men with *acrotomophilia*, or sexual attraction to amputees (Money, 1986). In this case, their attraction to amputees has been internalized to some degree, such that they are sexually aroused by the fantasy of being an amputee.

In a study conducted by First (2005), 67% of 52 participants who desired limb amputation reported sexual arousal from the fantasy of being an amputee, and 87% reported sexual attraction to amputees. More recent surveys of primarily men who desire limb amputation have also found large percentages reporting sexual arousal from the fantasy of being an amputee and sexual attraction to amputees (Blom et al.,

2012, 2017; Pregartbauer et al., 2014). Thus, following the concept of ETIIs, men who desire limb amputation tend to report both apotemnophilia and acrotomophilia. The tendency for apotemnophilic men to be especially attracted to amputees cannot plausibly be explained by high base rates, in contrast to the tendency for autogynephilic males to be especially attracted to women.

There are other parallels between those with apotemnophilia and those with autogynephilia (Lawrence, 2006). For example, in First's (2005) study, 92% of participants reported that they engaged in *pretending*, which is temporarily presenting as an amputee through prosthetics or other means. Pretending may involve binding or otherwise concealing a limb, and using crutches or a wheelchair to impersonate an amputee. Similar to cross-dressing in autogynephilic males, pretending is a relatively easy, impermanent, and inexpensive way for apotemnophilic men to look more like amputees and to thus satisfy their sexual fantasy of being an amputee. Some apotemnophilic men also experience *body integrity dysphoria*,[1] or distress over having an intact body, which is often accompanied by a desire for limb amputation. Among participants in First's study, 17% successfully had a limb amputated. Similarly, some autogynephilic males experience gender dysphoria and the desire for gender confirmation surgery. Taken together, the parallels between apotemnophilia and autogynephilia provide evidence that both belong to the same dimension of sexual orientation, one best explained by the concept of ETIIs. The second row of Table 20.1 lists apotemnophilia and its related phenomena as they pertain to the concept of ETIIs.

Most of the participants in First's (2005) study were heterosexual men. The concept of ETIIs raises the question of whether apotemnophilic men sexually attracted to female amputees are also likely to have autogynephilia (Lawrence, 2006). After all, their preferred erotic targets are women as well as amputees. First found elevated rates of various manifestations of autogynephilia in his sample, including cross-dressing (29%), transvestic fetishism (15%), and desire for gender confirmation surgery (12%). The rate of transvestic fetishism in First's sample is five times the rate of only 3% reported in the general male population by Långström and Zucker (2005).

20.3 Autopedophilia

Until recently, no other putative ETII besides autogynephilia and apotemnophilia had received systematic empirical study. Freund and Blanchard (1993) provided at least one good lead by presenting several cases of pedohebephilic men who were sexually aroused by fantasizing about being a child or dressing in children's clothing. These men appear to have been motivated by an ETII involving sexual arousal

[1] The condition has also been called *body integrity identity disorder* (First, 2005), but we refer to it here as body integrity dysphoria to be consistent with gender dysphoria.

by the thought or image of being a child, which Lawrence (2006, 2009b) has called *autopedophilia*.[2] In this case, pedohebephilic men's attraction to children has been internalized to some degree, such that they are sexually aroused by the fantasy of being a child.

Following the seminal publication by Freund and Blanchard (1993) and two other case reports on autopedophilia (Dickey, 2007; Howitt, 1995), Hsu and Bailey (2017) examined whether autopedophilia exists and can be conceptualized as an ETII in a non-forensic, non-clinical sample of pedohebephilic men recruited anonymously from the Internet. They found that a greater percentage of 475 pedohebephilic participants reported some degree of autopedophilia (49%) than some degree of autogynephilia (32%). Furthermore, pedohebephilic participants were more intensely autopedophilic than they were autogynephilic, $d = 1.50$, based on continuous measures that assessed both autopedophilia and autogynephilia. These results were consistent with the concept of ETIIs: Because pedohebephilic men are preferentially attracted to children rather than to women, they should be more autopedophilic in prevalence and degree than autogynephilic, despite the fact that autogynephilia is likely the more common ETII in general. Like the tendency for apotemnophilic men to be especially attracted to amputees, the tendency for pedohebephilic men to be especially autopedophilic cannot be explained by high base rates.

Hsu and Bailey (2017) presented additional results that suggest parallels between autopedophilia and autogynephilia. For example, the degree of autopedophilia was related to the frequency of dressing in children's clothing in their sample, and 13% of their autopedophilic participants reported that they had dressed in children's clothing as an adult. The specific erotic interest in wearing children's clothing is called *pedovestism* (Lawrence, 2006, 2009b). Dressing in children's clothing is a relatively easy, impermanent, and inexpensive way for autopedophilic men to look more like children, and it appears analogous to both cross-dressing in autogynephilic males and pretending in apotemnophilic men. In addition, just as some autogynephilic males experience gender dysphoria and the desire for gender confirmation surgery, and some apotemnophilic men experience body integrity dysphoria and the desire for limb amputation, some autopedophilic men experience *age dysphoria* (distress over being an adult) and the desire to physically become a child (Freund & Blanchard, 1993; Hsu & Bailey, 2017). Although the desire to physically become a child cannot be actualized, Freund and Blanchard described a pedohebephilic man who wished to have his foreskin reconstructed to look like a young boy's. The parallels between autopedophilia and autogynephilia, in addition to those between

[2] The term *autopedohebephilia* would be more accurate, but it is cumbersome and inconsistent with existing terminology. Thus, we use the term *autopedophilia* to mean sexual arousal by the thought or image of being either a prepubescent or a pubescent child.

both phenomena and apotemnophilia, suggest that all three share a common explanation, and the concept of ETIIs is the best candidate. The third row of Table 20.1 lists autopedophilia and its related phenomena as they pertain to the concept of ETIIs.

Consistent with the concept of ETIIs, autopedophilic men in the study by Hsu and Bailey (2017) tended to be sexually aroused by the fantasy of being the same kinds of children to whom they were sexually attracted, with respect to gender and age. For instance, autopedophilic men sexually attracted to girls more commonly found it sexually arousing to imagine themselves as a girl (58%), and autopedophilic men sexually attracted to boys overwhelmingly found it sexually arousing to imagine themselves as a boy (96%). In addition, sexual attraction to children of a particular gender-age category (e.g., girls 4–10 years old) among autopedophilic men was most strongly correlated with sexual arousal by the fantasy of being a child of the same gender-age category.

The following narrative not only exemplifies autopedophilia as an ETII, but also three dimensions of male sexual orientation—gender (attraction to females), sexual maturity (attraction to children), and location (attraction to the fantasy of being another individual):

> Sometimes I fantasize about being with a child myself, but then I end up thinking about it from the child's perspective, being sexually active with an adult. Sometimes I fantasize about spanking a child, and then I would think about being the child getting spanked. Other times, I fantasize about being a little girl being sexually active with another little girl. (Hsu & Bailey, 2017, p. 121).

20.4 Autoanthropomorphozoophilia

Freund and Blanchard (1993) presented a case report of a man who was sexually aroused by imagining himself as an anthropomorphic dog named Puppy Smith. This man also masturbated with plush animals that represented Puppy Smith and other anthropomorphic animals. Thus, this man appeared to have both sexual attraction to anthropomorphic animals (*anthropomorphozoophilia*) and sexual arousal by the thought or image of being an anthropomorphic animal (*autoanthropomorphozoophilia*) (Hsu & Bailey, 2019).

In conceptualizing autoanthropomorphozoophilia as an ETII, men's attraction to anthropomorphic animals has been internalized to some degree, such that they are sexually aroused by the fantasy of being an anthropomorphic animal. Because plush animals are often representations of anthropomorphic animals, Lawrence (2009b) suggested that sexual attraction to plush animals might actually reflect sexual attraction to anthropomorphic animals.

Furries are individuals who are especially interested in anthropomorphic animals (Gerbasi et al., 2008). Although furries have attracted the most media attention from their large conventions where they socialize and share art, they tend to interact with each other online rather than in person. For at least four reasons, furries are an increasingly visible phenomenon relevant to the question of whether autoanthropomorphozoophilia is an

ETII. First, furries have been controversially portrayed as sexually motivated in the media and popular culture (e.g., Gurley, 2001). Although their exact estimates differ, recent surveys of furries have found that some degree of sexual motivation is not uncommon, reported by at least 50% of their samples (Hsu & Bailey, 2019; Plante et al., 2011; Schroy et al., 2016). Second, many furries identify with anthropomorphic animals and create *fursonas*, versions of themselves as anthropomorphic animals (Gerbasi et al., 2008). Third, some furries wear costumes resembling their fursonas, which look similar to the costumes worn by mascots of athletic teams or theme parks. This practice is called *fursuiting*, and it appears analogous to cross-dressing in autogynephilic males and pretending in apotemnophilic men (Lawrence, 2009b). Finally, some furries report *species dysphoria*, or distress over being a human (Gerbasi et al., 2008). In their sample of 217 furries, Gerbasi et al. found that 24% indicated a persistent feeling of discomfort with their human body, and 29% indicated a feeling that they are a "non-human species trapped in a human body." The species dysphoria reported by some furries seems to parallel gender dysphoria in autogynephilic males, and body integrity dysphoria in apotemnophilic men. Because furries tend to be sexually motivated and change their appearance and behavior to become more like anthropomorphic animals, they may be especially likely to have ETIIs. The fourth row of Table 20.1 lists autoanthropomorphozoophilia and its related phenomena as they pertain to the concept of ETIIs.

A recent study examined the extent to which 334 male furries were sexually motivated, and if so, whether they were motivated by the ETII of autoanthropomorphozoophilia (Hsu & Bailey, 2019). The vast majority (99%) of the sample endorsed some degree of sexual motivation for being furries. As predicted by the concept of ETIIs, more furry participants reported some degree of sexual attraction to anthropomorphic animals (99%) than to real animals (47%) or women (73%). Furry participants were also more likely to report some degree of sexual arousal by the fantasy of being an anthropomorphic animal (93%) than by the fantasy of being a real animal (44%) or a woman (37%), $ds > 1.23$. Furthermore, autoanthropomorphozoophilic participants tended to be sexually aroused by the fantasy of being the same kinds of anthropomorphic animals to whom they were sexually attracted, with respect to gender and species. For instance, sexual attraction to anthropomorphic animals of a particular species (e.g., wolves) was most strongly correlated with sexual arousal by the fantasy of being an anthropomorphic animal of the same species.

The following narrative exemplifies autoanthropomorphozoophilia as an ETII and also suggests its confluence with another ETII involving sexual arousal by the fantasy of being fat:

> It was the early nineties. Garfield was still cool, and I was very interested in both fat people and the idea of being fat. I imagined that I was Garfield, a tubby cat, and I became aroused. I liked the idea of being a cartoon cat that was fat and fluffy. Later in my teenage years, I would seek out other overweight cartoon animals and become aroused imagining that I was them. (Hsu & Bailey, 2019, p. 1365).

20.5 Autozoophilia

There has been limited evidence for an ETII specific to men with *zoophilia*, or sexual attraction to real animals as opposed to anthropomorphic animals. If there were such an ETII, it would involve sexual arousal by the thought or image of being a real animal, or *autozoophilia* (Lawrence, 2009b). In this case, zoophilic men's attraction to real animals would be internalized to some degree, such that they are sexually aroused by the fantasy of being a real animal.

In a study of 82 zoophilic men, Miletski (2002) found that 40% reported at least some identification with animals of their own gender. Similarly, Williams and Weinberg (2003) reported that some zoophilic men in their study believed that they had animal characteristics or felt like animals. Beetz (2004) also described zoophilic men with species dysphoria and the desire to become an animal, usually of the same species to which they were sexually attracted. As previously mentioned with autoanthropomorphozoophilia, species dysphoria and the desire to become an animal appear analogous to gender dysphoria and the desire to become a woman in autogynephilic males (Lawrence, 2009b). However, like the desire to become a child among autopedophilic men, the desire to become an animal cannot be actualized. Casavant (2005) reported the case of a man who identified as a tiger and had extensive body modifications in an attempt to achieve the physical appearance of one. The fifth row of Table 20.1 lists autozoophilia and its related phenomena as they pertain to the concept of ETIIs.

It is not clear whether zoophilic men are manifesting autozoophilia when they identify with animals or experience species dysphoria, because the relevant studies have not asked about sexual arousal by the fantasy of being an animal. Although these studies have been unable to shed light on whether autozoophilia can be conceptualized as an ETII, they have provided some important groundwork for future inquiry. In Hsu and Bailey's (2019) recent study of male furries, for example, participants who were sexually aroused by the fantasy of being a real animal tended to also be sexually attracted to animals, consistent with autozoophilia as an ETII. In addition, Brown et al. (2020) collected data on 286 participants who reported sexual arousal by the fantasy of being an animal, which was erroneously called autoanthropomorphozoophilia instead of autozoophilia. In this sample, autozoophilia was associated with dressing or behaving as an animal, feeling that life would be better as an animal, and considering body modifications to look more like an animal. Because participants were not asked about their sexual attraction to animals, it could not be determined the extent to which this autozoophilic sample fit with the concept of ETIIs.

20.6 Autoandrophilia

Freund and Blanchard (1993) speculated that there could be an ETII specific to men sexually attracted to other men. If this ETII exists, it would involve sexual arousal by the thought or image of being another man, which has been called *autoandrophilia* (Dickey & Stephens, 1995; Lawrence, 2006, 2009b). In this case, men's attraction to other men would be internalized to some degree, such that they are sexually aroused by the fantasy of being another man.

No systematic research has examined the extent to which autoandrophilia exists in men sexually attracted to other men, and whether autoandrophilia can be conceptualized as an ETII. A few case studies, however, support the idea that autoandrophilia is an ETII. For instance, Zavitzianos (1972) described a gay man who appeared to be sexually attracted to male athletes with large penises, and who masturbated wearing a jockstrap to help him imagine that he had a large penis himself. Zavitzianos (1977) later summarized two other cases of gay men with possible autoandrophilia. In the first case, a gay man reported sexual attraction to men who wear boots and gabardine clothes, and he also reported masturbating in front of a mirror while wearing boots and gabardine clothes himself. In the second case, a gay man reported masturbating to the fantasy of being with an army man, as well as masturbating to the fantasy of being an army man himself while wearing a military uniform. Zavitzianos (1972) referred to the sexual interest in wearing specific kinds of same-gender clothing (e.g., jockstrap, military uniform) as *homeovestism*, and it seems analogous to transvestic fetishism in autogynephilic males and pedovestism in autopedophilic men (Lawrence, 2006, 2009b). Indeed, for the men in these cases, their homeovestism was consistent with autoandrophilia. Because these men masturbated wearing the same kinds of clothing worn by the men they find attractive, their autoandrophilia was consistent with the concept of ETIIs. They have internalized their sexual attraction to these other men, resulting in the sexual desire to become more like them.

It may be difficult to detect autoandrophilia in men, because autoandrophilic men are sexually aroused by the fantasy of being another man but are already men themselves. The cases of autoandrophilic men reported by Zavitzianos (1972, 1977) might have been easier to detect because those men were attracted to the more salient or stereotypical features of masculinity in other men (e.g., being in the army), which they then found arousing to fantasize about having themselves. Thus, if an autoandrophilic man became (or was already) as masculine as the men to whom he is attracted, it would mean that he has actualized his desire to become another man, much like autogynephilic males and apotemnophilic men have actualized their desires to become a woman or an amputee through gender confirmation surgery or limb amputation, respectively. Lawrence (2006) suggested that some gay men who engage in bodybuilding might be attempting to make their bodies more like those of the more muscular and thus more masculine men to whom they are attracted.

However, in gay men, it would be difficult to differentiate between bodybuilding that is motivated by an ETII such as autoandrophilia and bodybuilding that is motivated by the desire to look more attractive to potential sexual partners.

Lawrence (2009a) described a man who was both extremely dissatisfied with his own male body and desired to have a more muscular, masculine body like those of the men he found sexually attractive. This man's most arousing sexual fantasy involved having a muscular and attractive male body, being part of a group of masculine heterosexual men who accept him as one of them, and masturbating together with these other men. Consistent with conceptualizing his autoandrophilia as an ETII, this man reported frequent sexual arousal by the fantasy of wearing the bodies of other men and being masculine like them. In the absence of a term to describe the distress that some autoandrophilic men experience from not being muscular or masculine enough, we propose *masculinity dysphoria*, which would be analogous to gender dysphoria in autogynephilic males. The sixth row of Table 20.1 lists autoandrophilia and its related phenomena as they pertain to the concept of ETIIs.

20.7 Autonecrophilia

Autonecrophilia refers to sexual arousal by the thought or image of being a corpse (Aggrawal, 2009), and it might be conceptualized as the ETII that occurs in men sexually attracted to corpses. In this case, their sexual attraction to corpses would be internalized to some degree, such that they are sexually aroused by the fantasy of being a corpse. Because it is likely to be extremely rare, autonecrophilia has not been the subject of empirical research.

The infamous case of Dennis Rader ("BTK") might be a vivid example of a sexually sadistic serial killer with autonecrophilia. A large amount of evidence was recovered after his arrest, including photographs that he took of his dead victims placed in specific positions with their hands bound and with a cloth or mask covering their faces (Knoll & Hazelwood, 2009). Photographs were also included that Rader took of himself placed in specific positions with his hands bound and with a cloth or mask covering his face, exactly as his dead victims were. He was cross-dressed in his victims' clothing, and one photograph shows Rader lying on his back in a grave that was meant for one of his victims. Based on this evidence, it seems that Rader experienced necrophilia and autonecrophilia, and the similarity between the photographs of his victims and himself suggests that his autonecrophilia was an ETII. The seventh row of Table 20.1 lists autonecrophilia and its related phenomena as they pertain to the concept of ETIIs.

20.8 ETIIs as Paraphilias

Freund and Blanchard (1993) suggested that ETIIs may be considered *paraphilias*, an ill-defined set of unusual sexual interests that include pedohebephilia, acrotomophilia, zoophilia, exhibitionism, voyeurism, masochism, and sadism, among others. Although paraphilias are not pathological by nature, they may cause significant distress or impairment in an individual, or they may cause an individual to harm others. Such instances of paraphilias have been called *paraphilic disorders* in the most recent edition of the *Diagnostic and Statistical Manual of Mental Disorders* (fifth ed. [*DSM-5*]; American Psychiatric Association, 2013).

Because they have not been clearly defined or understood, paraphilias have been criticized as a scientifically vacuous concept that is based on value judgments regarding which sexual interests are more or less socially desirable (e.g., Moser & Kleinplatz, 2006). Two important observations, however, support the scientific validity of paraphilias as a concept with limited but promising support: Paraphilias are much more commonly found in natal males than in natal females, and paraphilias tend to co-occur within the same individual (Abel & Osborn, 1992; Baur et al., 2016; Dawson et al., 2016; Joyal & Carpentier, 2017; Långström & Seto, 2006; Långström & Zucker, 2005). Both of these general findings suggest that classifying a sexual interest as a paraphilia is more scientifically meaningful than a mere value judgment.

Paraphilias have typically been classified as sexual interests in either non-normative erotic targets (e.g., pedohebephilia, zoophilia) or non-normative sexual activities (e.g., masochism, sadism) (Freund et al., 1996). ETIIs may represent another class of paraphilias that consist of sexual interests in an erotic target's non-normative location within one's own body (e.g., autogynephilia), resulting in sexual arousal by the fantasy of being the erotic target (Freund & Blanchard, 1993). Consistent with their conceptualization as paraphilias, ETIIs have thus far been observed almost exclusively in natal males rather than in natal females. For instance, First's (2005) study included only four women out of 52 participants who desired limb amputation. We defer further discussion about the existence of ETIIs in natal females to the next section. Also consistent with their conceptualization as paraphilias, ETIIs tend to co-occur, such as autogynephilia most notably with apotemnophilia (29%; First, 2005; Lawrence, 2006), autopedophilia ($r = 0.48$; Hsu & Bailey, 2017), and autoanthropomorphozoophilia ($r = 0.20$; Hsu & Bailey, 2019). A recent study found that men who endorsed any degree of autogynephilia were approximately three times more likely to have endorsed any degree of autopedophilia and autozoophilia, compared with men who did not endorse any degree of autogynephilia (Brown et al., 2020). In addition, at least two other unusual sexual interests that might be classified as paraphilias but not ETIIs have been shown to co-occur with autogynephilia: masochism (Blanchard & Hucker, 1991; Hsu et al., 2015; Långström & Zucker, 2005; Lawrence, 2006, 2013) and gynandromorphophilia (sexual interest in transgender women with a penis; Blanchard & Collins, 1993; Hsu et al., 2016; Rosenthal et al., 2017).

20.9 ETIIs in Natal Females

Conditions resembling ETIIs have been rarely observed in natal females, compared with natal males. Indeed, female paraphilias are not well studied, and it is unclear whether paraphilias occur in natal females at all. Although superficial similarities seem to exist between some female sexual interests and male paraphilias, especially masochism, no evidence has convincingly shown that the same phenomena in natal females reflect paraphilias as in natal males. Evidence for female paraphilias would require, at the very least, that they tend to co-occur in the same individual.

Because men are the preferred erotic targets of most women, autoandrophilia is the most likely candidate for an ETII in natal females. In contrast to autogynephilia in men, however, fewer cases of autoandrophilia in women have been reported. Stoller (1982) reported on three women with transvestic fetishism, and several population studies of paraphilias have found small numbers of women reporting transvestic fetishism (Baur et al., 2016; Dawson et al., 2016; Joyal & Carpentier, 2017; Långström & Zucker, 2005). Despite these reports, it remains unclear whether transvestic fetishism in women reflects autoandrophilia and a paraphilia, much less an ETII. Some women and female-to-male transgender men have reported both sexual attraction to men and autoandrophilia (Coleman et al., 1993; Dickey & Stephens, 1995; O'Keefe, 2007; Stoller, 1982), consistent with the concept of ETIIs. Notably, one recent study by Brown et al. (2020) reported on 328 women who indicated sexual arousal by the fantasy of being a man, with a majority identifying as heterosexual or bisexual (82%) and reporting sexual attraction to men (84%). Although this pattern of sexual interests might appear to be consistent with the concept of ETIIs, the authors also showed that women reported autoandrophilia at a lower prevalence and intensity than men reported autogynephilia.

More research is needed to clarify whether autoandrophilia in natal females is an ETII. Autoandrophilia in natal females might instead be sexual arousal by the specific fantasy of being a gay man and participating in gay male sex, rather than internalization of sexual attraction to men. Bailey and Blanchard (2017) argued that this kind of sexual arousal is responsible for a rare type of gender dysphoria in natal females, called *autohomoerotic gender dysphoria*. In one of Stoller's (1982) case reports, a woman with transvestic fetishism described her autoandrophilia in this manner:

> Today my sex life is mostly satisfied by masturbation, with transvestite episodes occasionally providing a pleasant stimulus to masturbation. I've dressed as a man, replete with moustache, and had my partner call me by a man's name. I take pleasure in being called by a man's name. Dressed as a man, I've sucked my partner's penis. I felt myself, during the experience, to be a gay male. (p. 103).

Besides autoandrophilia, no other putative ETII in natal females has received much scientific or clinical attention. First's (2005) study included only four women with the desire for limb amputation, and Blom et al.'s (2012, 2017) more recent surveys included a total of 20 such women. Information about apotemnophilia

specific to these women was not presented, however. Money (1991) described a woman who reported sexual attraction to amputees, pretending, and the desire for limb amputation, suggesting an ETII presentation of apotemnophilia. In a study attempting to examine autogynephilia in natal females, 93% of 29 women appeared to report autogynephilia (Moser, 2009). Lawrence (2010b), however, raised serious criticisms about its methodology and interpretation, especially the fact that many items measured not autogynephilia but instead sexual arousal from the anticipation of a romantic evening or sexual encounter.

Brown et al. (2020) recently studied ETIIs in natal female participants and found that they were about half as likely as natal male participants to endorse more than one of the four ETIIs assessed: autogynephilia (natal males), autoandrophilia (natal females), autopedophilia, and autozoophilia. However, natal female participants who endorsed one ETII were more than twice as likely to have endorsed another. Both of these findings further support the conceptualization of ETIIs as paraphilias, which are much less common in natal females than in natal males and also tend to co-occur within the same individual. We previously summarized two recent studies that examined whether autopedophilia and autoanthropomorphozoophilia can be conceptualized as ETIIs among men (Hsu & Bailey, 2017, 2019). These studies also included a very small minority of natal female participants, whose results will be detailed in a future article and compared with those from Brown et al.'s (2020) study.

20.10 Sexual Masochism as an Alternative to ETIIs

One plausible alternative to conceptualizing some phenomena as ETIIs is sexual masochism (Freund & Blanchard, 1993). In particular, autogynephilic, autopedophilic, and autozoophilic fantasies and behaviors can sometimes be viewed as masochistic. Specifically, the idea of becoming a woman, a child, or an animal may be humiliating or submissive to some men, as may cross-dressing, dressing in children's clothing, or pretending to be an animal. Thus, sexual arousal in these types of fantasies and behaviors may be related to masochism instead of an ETII or the internalization of sexual attraction to women, children, or animals. In support of this alternative, autogynephilia tends to co-occur with masochism (Blanchard & Hucker, 1991; Hsu et al., 2015; Långström & Zucker, 2005; Lawrence, 2006, 2013), and some forms of animal role-play (e.g., pony play, pup play) have been associated with masochism (Aggrawal, 2011; Wignall & McCormack, 2017). Fantasies and behaviors motivated by sexual masochism exaggerate differences between men and their preferred erotic targets (e.g., women), increasing their feelings of submissiveness. In contrast, fantasies and behaviors motivated by an ETII increase similarity between men and their preferred erotic targets.

Freund and Blanchard (1993) presented three cases of men who superficially appeared to be motivated by ETIIs based on their fantasies and behaviors, which included fantasizing about being either a baby or a young boy and wearing diapers. One man described his sexual fantasy of being a baby put into the washing machine

by his mother, and he also reported a history of cross-dressing in order to feel powerless or degraded. The men in all three cases reported that they were most sexually attracted to adult women and fantasized about adult women spanking or degrading them. Their fantasies thus exaggerated differences between them and their preferred erotic targets (i.e., adult women) and did not increase similarity. As a result, Freund and Blanchard concluded that these men were motivated by masochistic fantasies of being a baby or child and wearing diapers, rather than by an ETII.

Among autopedophilic and autoanthropomorphozoophilic men, the correspondence between their external and internal erotic targets with respect to gender and either age or species suggests that they are more likely motivated by ETIIs than by sexual masochism (Hsu & Bailey, 2017, 2019). The finding that these men tended to be sexually aroused by the fantasy of being the same kinds of children or anthropomorphic animals to whom they were sexually attracted is more consistent with the concept of ETIIs, because there was increased similarity rather than differences between the men and their preferred erotic targets. Future work to distinguish ETIIs and sexual masochism may continue to benefit from examining the specificity of a potential ETII at multiple levels, or whether sexual attraction to other individuals matches sexual arousal by the fantasy of being one of those individuals in more than one dimension of sexual attraction (e.g., gender and age). Lawrence (2013) presented an especially compelling example of this specificity in an autogynephilic individual: "In adolescence, I had a strong attraction to certain actresses (e.g., Dianna Rigg from *The Avengers* and Mary Tyler Moore). I would get aroused by fantasies involving having my appearance changed to match that of these actresses" (p. 113).

Further complicating the distinction between them, ETIIs and sexual masochism are both paraphilias, and paraphilias tend to co-occur (Abel & Osborn, 1992; Baur et al., 2016; Dawson et al., 2016; Joyal & Carpentier, 2017; Långström & Seto, 2006; Långström & Zucker, 2005). Thus, it is likely that the same individual might fantasize or behave in ways that reflect an ETII, sexual masochism, or perhaps even both simultaneously. Autogynephilic males, for example, are especially likely to be masochistic (Blanchard & Hucker, 1991; Hsu et al., 2015; Långström & Zucker, 2005; Lawrence, 2006, 2013). In theory, this might mean that autogynephilia is an ETII that tends to co-occur with sexual masochism, that it is a form of sexual masochism, or that it reflects both an ETII and sexual masochism. It seems possible that these three interpretations of autogynephilia can be true to different degrees, depending on the autogynephilic male.

20.11 Causes and Development of ETIIs

Little is known about the causes and development of ETIIs. Because paraphilias are poorly understood in general, it is not surprising that most ETIIs are even less so. Family co-occurrence of transvestic fetishism and gender dysphoria, both closely related to autogynephilia, has been reported in several natal males, including a pair of monozygotic twins (Green, 2000). Although this finding tentatively suggests a

familial contribution to autogynephilia, it is not clear the extent to which the contribution is due to shared genes or shared environment. If there is a role for environment in the causes and development of ETIIs, we suspect that it is a minor one. Without knowledge of anthropomorphic animals and exposure to them, someone is unlikely to become a furry or to develop autoanthropomorphozoophilia. Indeed, some furries recall that they became furries after discovering online pornography of anthropomorphic animals, and others recall that they developed autoanthropomorphozoophilia after watching cartoons featuring anthropomorphic animals (Hsu & Bailey, 2019). Most people encounter anthropomorphic animals at some point in their lives, however, and do not become furries or develop autoanthropomorphozoophilia. Thus, environmental or learning factors may be relevant to the causes and development of ETIIs, but they cannot explain why some individuals develop ETIIs and others do not. Individual factors are more likely to be relevant, especially in explaining the development within the same individual of seemingly different but co-occurring ETIIs, such as autogynephilia and apotemnophilia (First, 2005; Lawrence, 2006), or autogynephilia and autopedophilia (Hsu & Bailey, 2017).

An underlying predisposition, perhaps genetic or inborn, could be one such individual factor that leads some individuals and not others to develop ETIIs. Two case reports have described boys younger than 3 years old who expressed a desire to cross-dress and displayed penile erections when they did (Stoller, 1985; Zucker & Blanchard, 1997). These cases suggest that individual factors relevant to the development of autogynephilia and other ETIIs, if not genetic or inborn, have an early onset. Given the overlap between autogynephilia and paraphilias that are not considered ETIIs, including masochism (Blanchard & Hucker, 1991; Hsu et al., 2015; Långström & Zucker, 2005; Lawrence, 2006, 2013) and gynandromorphophilia (Blanchard & Collins, 1993; Hsu et al., 2016; Rosenthal et al., 2017), ETIIs might even share the same causes as other paraphilias, which would suggest an underlying predisposition to develop paraphilias in general and not ETIIs specifically.

A tendency to gravitate toward male-typical and "nerdy" occupations and hobbies, especially those involving computers and technology, has been observed in those with ETIIs, including autogynephilic individuals (Bailey, 2003; Lawrence, 2007, 2013) and furries (Gerbasi et al., 2008). Consistent with this observation, a former phone sex operator remarked that many who called her to role-play their autogynephilic fantasies were "nerdy" and worked in Silicon Valley, a high-tech sector in San Francisco (Culturally Bound Gender, 2013). According to Lawrence and Bailey (2009), a study by Veale et al. (2008) showed that transgender women who are active on the Internet are overwhelmingly autogynephilic. Furthermore, two studies have found that autogynephilic transgender women score higher than non-autogynephilic transgender women do on a measure of autistic traits (Jones et al., 2012; Pasterski et al., 2014), which are closely associated with male-typical and "nerdy" interests (Baron-Cohen, 2002). Consistent with autogynephilia being correlated with both increased "nerdy" interests and autistic traits, an autogynephilic individual who experienced gender dysphoria in one case study was described as having strong interests in model building and anime, as well as Asperger's syndrome

(Gallucci et al., 2005). Another study showed that furries are more likely to report having been diagnosed with an autism spectrum disorder, compared with the general population (Reysen et al., 2018). Finally, a recent study examined whether autistic traits were related to four putative ETIIs (autogynephilia in men, autoandrophilia in women, autopedophilia, and autozoophilia), finding limited evidence in this regard (Brown et al., 2020).

Future research is necessary to clarify the ways in which autogynephilia, autoanthropomorphozoophilia, and other ETIIs are related to "nerdy" interests and autistic traits, which have the potential to reveal more about the causes and development of ETIIs. For instance, if ETIIs are correlated with increased autistic traits, it might be that individuals with ETIIs have difficulty with distinguishing their own mental states and experiences from those of others, which tends to show in the cognitive representations and neural systems of individuals with autistic traits (Gallese et al., 2013; Lombardo & Baron-Cohen, 2010). ETIIs might then reflect the specific difficulty with distinguishing oneself from other individuals as an erotic target, resulting in sexual arousal by the fantasy of being another individual. Several neuroimaging studies have examined differences in brain structure and activity between men who desire limb amputation and men who do not (see Brugger et al., 2016, for a review). The results have implicated brain regions relevant to body representation and the sensorimotor system in the desire for limb amputation.

We speculate that ETIIs and autistic traits might be related because both are caused by difficulty with understanding mental representations of oneself versus others, and ETIIs specifically represent this difficulty as it pertains to understanding an erotic target as oneself versus others. But there is at least one other developmental pathway through which ETIIs might be related to autistic traits, and it involves the dysphoria that sometimes accompanies ETIIs. It is possible that increased autistic traits cause some individuals with ETIIs to develop an intense and obsessional focus on becoming more like their preferred erotic targets (e.g., women, anthropomorphic animals), resulting in dysphoria related to their current identity (e.g., man, human). In this scenario, ETIIs are related to autistic traits not because there is a direct association between them, but rather because autistic traits cause dysphoria in those with ETIIs.

Consistent with this explanation, the link between autogynephilia and "nerdy" interests or autistic traits has mainly been observed in autogynephilic individuals who were either experiencing gender dysphoria or transgender with a presumed history of gender dysphoria (Bailey, 2003; Culturally Bound Gender, 2013; Gallucci et al., 2005; Jones et al., 2012; Lawrence, 2007, 2013; Pasterski et al., 2014). No study has yet reported such a link controlling for gender dysphoria or in a sample of autogynephilic males without gender dysphoria. Instead, recent studies have indicated that prepubescent children with gender dysphoria are also elevated in autistic traits (VanderLaan et al., 2015a, 2015b; Zucker et al., 2017). Natal males who experienced gender dysphoria as prepubescent children tend overwhelmingly to become gay rather than autogynephilic men in adulthood (Zucker, 2014). Because the evidence suggests increased autistic traits in both autogynephilic individuals and prepubescent children with gender dysphoria, autistic traits might be related to the

dysphoria that these two different groups share and not autogynephilia or ETIIs more generally. This developmental pathway might implicate autistic traits as causally related to dysphoria in those with ETIIs, in contrast to a developmental pathway in which ETIIs and autistic traits are both caused by difficulty with distinguishing between mental representations of oneself and others.

20.12 Future Directions

It is unlikely that ETIIs are limited to those that were reviewed in this chapter. Two promising approaches to studying ETIIs have been employed sparingly so far. The first, used by Hsu and Bailey (2017) in their study of autopedophilia, is to recruit participants sexually attracted to specific kinds of individuals (e.g., pedohebephilic men) and examine whether a subset of them report sexual arousal by the fantasy of being one of those individuals, consistent with the concept of ETIIs. The second, used by Lawrence (2006) in her work on apotemnophilia and Hsu and Bailey (2019) in their study of autoanthropomorphozoophilia, is to recruit participants who desire to change their appearance or behavior to become more like a specific kind of individual (e.g., men who desire limb amputation, furries), and to examine the extent to which they are motivated by ETIIs. Individuals who might be sexually motivated to change their appearance or behavior are especially promising candidates for this second approach.

Regarding the first approach to studying ETIIs, there exist men sexually attracted to overweight or obese individuals (Swami & Furnham, 2009) and to individuals of a particular race/ethnicity that is different than their own (Phua & Kaufman, 2003). Future research could investigate the putative ETIIs specific to these two populations of men, which would involve sexual arousal by the fantasy of being overweight or obese and by the fantasy of being a different race/ethnicity, respectively. Regarding the second approach to studying ETIIs, there exist individuals known as adult baby/diaper lovers, who are predominantly male and enjoy role-playing as babies and wearing diapers (Hawkinson & Zamboni, 2014). It is possible that adult baby/diaper lovers are motivated by an ETII involving sexual arousal by the fantasy of being a baby, because they change their appearance and behavior to become more like babies and appear to do so for sexual reasons. However, this interpretation would require that they tend to experience both sexual attraction to babies and sexual arousal by the fantasy of being a baby. Two recent studies found little evidence that adult baby/diaper lovers tend to be sexually attracted to babies and thus motivated by an ETII (Fuss et al., 2019; Hsu, 2019). Not all individuals who change their appearance or behavior to become more like another kind of individual are motivated by ETIIs, but we must study that possibility in order to know.

The concept of ETIIs has been controversial and difficult for many people to appreciate and accept, despite its increasing empirical support and potential for explaining otherwise puzzling phenomena, such as cross-dressing among heterosexual men, desire for limb amputation, and the furry phenomenon. Some individuals

who might be characterized by ETIIs dislike and reject the notion that their changes in appearance and behavior are sexually motivated by a paraphilia. For example, some transgender women have been especially hostile to the idea that autogynephilia can be a fundamental motivation for gender confirmation surgery in natal males (Dreger, 2008). We hope this chapter helps researchers, clinicians, and other interested readers to better understand ETIIs. We also hope this chapter stimulates much needed research on ETIIs, which may reflect an understudied but important dimension of sexual orientation.

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Chapter 21
Consensual Non-monogamy from a Developmental Perspective

Lisa Dawn Hamilton and Seth B. Winward

Abstract Consensual non-monogamy (CNM) is an umbrella term for sexual, romantic, and/or intimate relationships involving more than two people, in which the non-monogamous aspect of these relationships is consented to by all people involved. Public awareness and incidence of CNM is growing, and there are many opportunities for research in this domain. This chapter addresses developmental factors in CNM relationships with a focus on swinging, polyamory, open relationships, and multipartner sex. There is very limited research on developmental components of CNM relationships, so we use existing relationship development theories to discuss where CNM may fit (or not) into the existing models. We also review the existing research on parenting and being raised in CNM families, specifically in polyamorous families. CNM relationships are commonly stigmatized and participating in these stigmatized relationship styles carries with it the risks associated with minority stress, but CNM relationships can also be a source of resilience. Recommendations are made for how to move research on the developmental aspects of CNM relationships forward.

Keywords Consensual non-monogamy · Polyamory · Swinging · Non-monogamy · Relationships · Adult attachment · Human sexuality

Consensual non-monogamy (CNM) is an umbrella term that encompasses any relationship where there are more than two people involved in sexual, romantic, and/or intimate relationships and where the non-monogamous aspect is consented to by all involved. This contrasts with monogamous relationships in which two people commit to only being sexually and romantically involved with one another for a period of time. CNM is also different from infidelity, which is when a person in a monogamous relationship engages in extradyadic sexual or romantic activity without the consent of their partner. CNM has existed in various forms across many

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cultures throughout history, either as part of the mainstream culture or as subcultures (Conley et al., 2012; Smith, 2016).

Interest in CNM has been increasing in the general population, as evidenced by Google searches between 2006 and 2015 (Moors, 2017), and the increase in popular books and websites on the topic. One of the original guidebooks for engaging in CNM, *The Ethical Slut,* first published in 1997, is now in its third edition (Hardy & Easton, 2017). Research on the topic of CNM has also increased, but there has been very limited research attention on developmental factors in CNM.

Monogamy is the dominant relationship model in most Western cultures at the present time. However, research shows that many people engage in infidelity (Atkins et al., 2001). Whether humans are meant to be monogamous or not is debated in the academic literature, often with reference to the fact that only 3% of species are monogamous (c.f. Kleiman, 1977). Even within those supposedly monogamous species, many are only socially monogamous, meaning they pair-bond primarily with one mate, but engage in extrapair sexual behavior (Gowaty, 1996). Cross-cultural research has shown many variations from the monogamous model that is predominant in current Western cultures (Schmitt, 2005; Zeitzen, 2008), but psychological theories on the development of relationships focus mainly on the Western concept of romantic love and monogamy (Conley et al., 2012). Within this monogamous cultural paradigm, many non-monogamous subcultures have formed. In the United States, research has documented CNM subcultures beginning in the 1950s (Walshok, 1971). Even for those who are mostly monogamous, there may be deviations from strict monogamy, such as multipartner sex. Dan Savage, a popular writer and podcaster, coined the term *monogamish* to describe couples who are socially monogamous, but who may engage in non-monogamous activities in specific circumstances (Savage, 2013).

CNM can take many forms, but the commonly studied variations within the social sciences literature include swinging, polyamory, open relationships, and multipartner sex. This chapter will primarily focus on these styles of CNM. Although we do not have conclusive data on how many people engage in CNM relationships, there have been several large studies that have provided estimates of prevalence.

In two convenience samples recruited online by American researchers for a study of relationships, they found that 5.3% of the combined sample reported being currently in a CNM relationship (Rubin et al., 2014). The 2012 National Survey of Sexual Health and Behavior, a random, representative sample of Americans found that 4% of participants reported currently being in an open relationship, which was slightly higher than the number of participants who reported being lesbian or gay (3%) (Levine et al., 2018).

For lifetime prevalence of ever participating in some form of CNM relationship, an MTurk study of Americans that was weighted for the U.S. Census came to an estimate of 12.8% for having ever participated in a CNM relationship (Rubel & Burleigh, 2020). Additionally, two large nationally representative samples of currently unmarried and/or single people drawn from the Singles in America study by Match.com found in both samples that approximately 21% of participants reported

ever having been involved in some sort of consensual sexually non-exclusive relationship at some point in their life (Haupert et al., 2017). Current incidence of CNM relationships seems to hover in the range of estimates of lesbian and gay individuals for the U.S., while the prevalence of having ever engaged in a CNM relationship is much higher.

21.1 Categories of CNM

The definitions of the different types of CNM relationships are continuously evolving and are not mutually exclusive. Below is an amalgamation of the traits most commonly associated with each subtype of CNM drawn from our general knowledge as well as both academic and popular sources (e.g., Rubin et al., 2014; Veaux & Rickert, 2014).

Swinging usually involves couples engaging in sexual activity together or with other couples. The slang term emerged in the 1960s in a context of "swap clubs" and was formerly known as *wife swapping* or *mate swapping* (Denfeld & Gordon, 1970; Swinging, n.d.). Modern swingers often identify as being in *the lifestyle* (Serina et al., 2013). The most common form of swinging involves couples going to swinger clubs or parties to meet up with other couples to engage in multipartner sex, or to "swap" sexual partners with another couple. An early study of swinging also noted that swinging activities rarely happen spontaneously and the sexual activity is highly intentional, planned, and specific (Walshok, 1971).

Swinging can also happen outside of formal parties and events, involving couples meeting up to engage in sexual activity. Within swinger events, women are encouraged to engage in sexual activity with one another, but for male participants, same-sex sexual activity is rare and often discouraged (Vaillancourt & Few-Demo, 2014). The primary defining characteristic of swinging versus other forms of CNM is that it primarily includes male-female couples engaging in sexual activity with other male-female couples.

The term *polyamory* is believed to be coined independently by Morning Glory Zell in 1990 (Zell-Ravenheart, 1990) and by Jennifer Wesp in 1992 (Polyamory, n.d.). It means many (poly) loves (amory). As the name indicates, polyamory is a relationship style that involves ongoing, loving relationships. However, polyamory itself is still a contested term and the centrality of love, and of what polyamory means, is not consistent across relationships or individuals (Klesse, 2006).

There are many forms that polyamory can take. Some polyamorous relationships include multiple people in a closed relationship (polyfidelity), some include a couple or triad as the center of the relationship, with individuals in the relationship free to also pursue other relationships. Some people in polyamorous relationships have one person they identify as a primary partner, with other partners seen as secondary or tertiary, while other people in polyamorous relationships eschew the idea of relationship hierarchies. The term *nesting partner* can be used to describe the relationship partner(s) a polyamorous person lives with. Some people identify as *solo-poly*,

which means they are polyamorous and engage in relationships with multiple people, but do not have primary or nesting partner(s). Polyamorous relationships can reproduce traditional relationship structures and gender dynamics or can redefine traditional understandings of kinship (Haritaworn et al., 2006). Like all CNM options, polyamory can take many forms, but the primary defining characteristic is usually long-term caring/loving relationships with multiple people.

Open relationship can be used as an umbrella term for CNM relationships that fall outside of the definitions of polyamory and swinging. Open relationships often involve a couple who engage in sexual activity with people outside of their relationship. Sometimes this form of relationship is completely open and transparent, sometimes there are restrictions about who the outside partners can be, or when and where the outside sex can take place (e.g., when one partner is out of town), and some people have a "don't ask don't tell" policy in their open relationship. In a don't-ask-don't-tell style of open relationship, participants are allowed to engage in extradyadic sexual activity as long as they are discreet and the other partner does not know the details of what is happening.

Most of the research on open relationships has been done in samples of gay men (e.g., LaSala, 2005; Parsons et al., 2013). There has been very little research done on heterosexual or lesbian open relationships. In general, it is harder to study open relationships, perhaps because their amorphous qualities making them hard to define and quantify for scientific study. Additionally, those in open relationships are often socially monogamous, and if they do not explicitly disclose their open status, it would not be known to outsiders.

Multipartner sex is another form of CNM, which usually refers to single incidences of sexual activity of sex between more than two people. The most common occurrence of multipartner sex is a couple involving a third person in their sexual activity, also known as a threesome. However, multipartner sex can also involve attending orgies or sex clubs to engage in sexual activities with others. Couples who practice multipartner sex may not consider themselves to be non-monogamous given the sex happens as part of the relationship (Fisher & Hamilton, 2016), or may categorize themselves as monogamish (Parsons et al., 2013). In terms of sexual fantasies, threesomes and other multipartner sex are the most common fantasies reported by Americans (Lehmiller, 2018). Regardless of how many people engage in multipartner sex, it is clearly a desire for many.

Polygamy refers to marriage, specifically, and is defined in the Oxford English Dictionary as "The practice or custom of having more than one spouse at the same time" (Polygamy, n.d.). In practice, polygamy often refers to polygyny, a relationship style where a man has multiple wives, and is often related to specific religions (Sheff, 2014). Polygamy can also refer to polyandry, where one woman has multiple husbands. Polygyny is much more common than polyandry. This chapter will mostly focus on consensual non-monogamies other than polygamy because the bulk of recent research has been done on other forms of non-monogamy, and also CNM relationships seem to be qualitatively different than polygamous relationships, which are often mandated through prevailing cultural norms or religion (Zeitzen,

2008). People who are unfamiliar with CNM often conflate polygamy with polyamory or other forms of CNM, so it is important to make the distinction clear.

21.2 Conducting Research with Members of Marginalized Groups

Historically, mainstream Western social science researchers and clinicians have pathologized marginalized groups. In terms of sexuality research, this phenomenon is most apparent for lesbian and gay people, whose sexual orientation was deemed a mental illness until 1973. Given this history (and, some would argue, the present state) of social science research, people from marginalized groups may be understandably hesitant to participate in research. Additionally, CNM, outside of swinging, was mostly ignored by researchers until the early 2000s. Both the reticence of CNM individuals to participate and the lack of awareness of CNM by researchers has contributed to there being limited data on developmental factors related to CNM.

Fortunately, since 2000, there has been some research performed by individuals who are members of the communities they study, or ethnographers who were able to gain the trust of participants. This research has provided insight into non-monogamous subcultures, such as how individuals in non-monogamous relationships navigate their relationships (e.g., Barker, 2005; LaSala, 2005) and about parenting in polyamorous families (Sheff, 2010). These early studies alerted other researchers to the existence of CNM. Additionally, the rise of online research, which can give participants a sense of anonymity and safety when disclosing their non-monogamy, coupled with the growing attention to and understanding of non-monogamous relationships, has led to an increase in online studies that can access people practicing CNM (Haupert et al., 2017; Moors et al., 2015).

21.3 Developmental Relationship Models

Developmental theories usually focus on typical or average developmental trajectories. In Western countries, where the bulk of English-language psychological research is conducted, the developmental models for relationships focus exclusively on couples. When variations from a couple-based model are included in developmental research, it is usually through the lens of infidelity (a.k.a. non-consensual non-monogamy).

21.3.1 Stage-Based Developmental Theories

21.3.1.1 Theories of Romantic Relationships

Most contemporary research on the development of relationships across adolescence and early adulthood incorporates both behavioral systems and attachment theories. In Furman and Wehner's (1994) approach to relationship development, they argue that *affiliative* and *sexual/reproductive* motivations develop first in relationships followed by *attachment* and *caregiving* later. Thus, early relationships and early phases of relationships tend to be more casual in nature, but there is an expectation of progression of shifting attachment needs from parents and siblings to a long-term partner (Furman & Wehner, 1994).

No developmental relationship models include CNM as the end point in a developmental trajectory and most explicitly focus on a "progression" from casual dating to a two person committed relationship. Meier and Allen (2009) summarize the systems approach of Furman and Wehner (1994) and the more stage-based approach of Brown (1999) into a model that proposed 4 stages of relationship development from early adolescence to early adulthood. The first stage is interacting with other-sex peers in groups, followed by casual dating, then stable relationships, and the final stage is committed monogamous relationships. Subsequent research in the development of romantic relationships has used this or similar models as their focus (Connolly et al., 2013). The theories outline a normative model of progression along a continuum to monogamous marriage (Furman & Collibee, 2014). Some explicitly state that a failure or delay to develop a committed monogamous relationship is evidence of a problem (Cohen et al., 2003; Connolly et al., 2013).

As would be expected, empirical work stemming from these theoretical models provide support for the models (Seiffge-Krenke, 2003). A longitudinal study using the Add Health data that collected responses from teenagers over 8 years explicitly reported on the adolescents' "progression" toward a committed relationship or "regression" toward more casual relationships (Meier & Allen, 2009). Most of the stage-based models allow for some variability in the age at which adolescents and young adults move through the different stages, but all have monogamous relationships as the ultimate goal. Theoretical frameworks that do not include the possibility of CNM relationships hinder the study of the development of CNM.

21.3.1.2 Erikson's Theory of Psychosocial Development

Erikson's theory of psychosocial development, developed with his spouse Joan Erikson (who was not formally credited with the work), covers a wide range of developmental milestones. In Erikson's stages, the most relevant stage would be Stage 6, Intimacy vs. Isolation, which follows the adolescent psychosocial crisis of Ego Identity vs. Identity Diffusion (Erikson, 1985). If adolescents emerge from Stage 5 with a strong sense of identity, they are then ready to form affiliations and

intimacy with others. Erikson addressed the importance of relationships broadly without a singular focus on committed, monogamous relationships. In this stage, Erikson's theory does not specify the types of relationships that are important and allows for a wide array of intimate relationships. He defines intimacy as "the capacity to commit [oneself] to concrete affiliations and partnerships" (Erikson, 1985, p. 263), using plurals to denote there would be multiple meaningful relationships.

Erikson, like many psychodynamic theorists, did assume that heterosexual marriage was the ideal relationship formation, but does make room for multiple intimate relationships as a positive outcome of this stage of development. In fact, he even argues that some romantic relationships could lead to isolation if the individual is not given a chance to form other intimate relationships (Erikson, 1985). In context, he was referring to friendships, but makes the point that intimacy with multiple people is important for healthy development. While the intention of Erikson's work was likely not to make space for CNM relationships, his theoretical framing of the importance of relationships during this stage does allow room for alternatives.

21.3.2 Attachment Theory and CNM

Another key developmental theory, for which there is some research on CNM, is Attachment Theory, a well-supported theory that explains the quality and function of relationships. Stemming from Bowlby and Ainsworth's initial work on attachment between caregivers and infants, researchers developed models of adult attachment (Bartholomew, 1990; Bartholomew & Horowitz, 1991; Hazan & Shaver, 1987).

Similar to infant-caregiver attachment theories, adult attachment theory uses secure attachment as its ideal state. Secure attachment in adult relationships can be defined as feeling comfortable with love and attachment and secure in the relationship (Bartholomew & Horowitz, 1991; Hazan & Shaver, 1987). Insecure attachment can take different forms. Hazan and Shaver's (1987) model included two forms of insecure attachment: avoidant, defined as hesitancy to be close to others and a difficulty trusting others in relationships, and anxious/ambivalent, defined as feeling that partners do not get close enough and fear that a partner will leave. Horowitz and Bartholomew's 2-dimension model allows for 3 forms of insecure attachment: preoccupied, which aligns with the anxious/ambivalent category of Hazan and Shaver, dismissive, defined as people who are dismissive of relationships and do not care to be close to others, and fearful, defined as those who are fearful of becoming close to others.

Although it is not explicitly stated in the models of adult attachment, researchers and therapists often operate on the assumption that healthy, secure attachment leads to monogamous pair-bonded relationships in adulthood. Until recently, there was virtually no attention paid to CNM in the attachment literature (Conley et al., 2013). Popular therapeutic interventions focusing on adult attachment theory devalue anything outside of a monogamous relationship (e.g., Johnson, 2013). Johnson's

Emotion Focused Therapy (EFT) is rooted in the need for secure attachment within a pair bond and does not acknowledge the possibility of CNM being a healthy relationship option (Johnson, 2013).

However, as Bartholomew (1990) points out in her review of the childhood attachment literature, as children grow up, they can form secure attachments with friends and relatives other than their primary caregiver(s). Additionally, a critical difference between infant-caregiver attachment and adult attachment is that adults have a choice about their attachment figures (Bartholomew, 1990). In an applied context, there is existing evidence of positive outcomes using EFT in therapy with people in CNM relationships (Kolmes & Witherspoon, 2017). To our knowledge, there is no evidence that secure attachment can only be to one attachment figure at a time, either in childhood or in adulthood.

There have been empirical studies assessing the links between attachment style and CNM or interest in CNM. In heterosexual, monogamous individuals who had never engaged in CNM relationships, avoidant attachment style was positively correlated with willingness to engage in CNM and more positive attitudes toward CNM, whereas anxious attachment style predicted more negative attitudes toward CNM (Moors et al., 2015). Qualitative results from another study of willingness to engage in CNM found that responses related to anxious attachment were common in those reporting unwillingness to participate in CNM relationships (Sizemore & Olmstead, 2018). A study of people who participated in CNM relationships found that anxious attachment was not related to participating in CNM relationships, but those low in avoidant anxiety (and higher in secure attachment) were more likely to be in a CNM relationship (Moors et al., 2015).

The research on attachment in CNM relationships is only beginning, so a clearer understanding of the links between attachment styles and CNM will hopefully emerge through further study. The link between avoidant attachment style and willingness to engage in CNM makes theoretical sense given people with an avoidant attachment style do not feel comfortable with intimacy and may assume that with multiple partners they would be able to have less intimate relationships. However, those people who were actually engaging in CNM were more secure and less avoidant. Engaging in CNM often requires a lot of intimacy as there are a lot of in-depth conversations about emotions and boundaries to ensure all involved are consenting and comfortable. Thus, CNM may sound ideal to someone who is more avoidantly attached, but it can be challenging in practice. Finally, for people with a more anxious attachment style, the fear of abandonment can preclude any interest in having their partner be involved with other people. Of course, people of any attachment style have the capacity to engage successfully in different types of relationships, but CNM might be more challenging for those who are less securely attached.

21.4 Who Engages in CNM?

There have been a few studies examining demographic and personality factors of people who engage in CNM. Early research found that non-monogamy, in the form of open relationships, was reported to be much more common among gay men than other groups of people (LaSala, 2005; LaSala, 2004; Parsons et al., 2013), and the new wave of research in this domain focused primarily on gay men. This difference between sexual orientations has been demonstrated in new representative samples, such as the National Survey of Sexual Health and Behavior (NSSHB), which found that 32% of gay men in their sample reported being in open relationships compared to 2% of heterosexual participants, 5% of lesbian participants, 22% of bisexual participants, and 14% of those reporting another sexual orientation (Levine et al., 2018). Researchers have theorized that the high prevalence of gay men in CNM relationships might be due to less restrictive gender roles for gay men or because men tend to have higher levels of sexual desire (Parsons et al., 2012).

A study of 111 lesbian, gay, and bisexual individuals found that both men and women who identified as sexual minorities had similar levels of interest in CNM relationships (Moors et al., 2014). Overall, the findings have been relatively consistent. People who identify as sexual minorities are more interested in CNM than heterosexual individuals. It is understandable that for individuals who do not have clearly defined sexual and relationship scripts (as heterosexual people do), those outside of the heterosexual mainstream would be more likely to explore alternative sexual and relationship styles and configurations.

Early research on heterosexual people engaging in CNM focused heavily on swingers. People who identify as swingers, at least those who participate in research in the U.S., are primarily white, heterosexually married couples, and relatively consistently middle- to upper-class (Fernandes, 2009; Jenks, 1998; Walshok, 1971). More recently, research on CNM beyond swingers still finds that participants are mostly white and well educated (Levine et al., 2018; Sheff & Hammers, 2011). Sheff and Hammers highlight that much of the research on CNM is conducted by white academics, and the samples they study tend to mirror their characteristics. They argue that scholars have failed to truly understand CNM and have perpetuated race and class privilege by only focusing on specific groups of individuals. Interestingly, some early research into swingers highlighted that people new to the middle class (emerging from working class or rural backgrounds) were themselves marginalized. The swinging culture may have emerged as a way to bond with other people in similar circumstances. Organized groups such as nudist groups, swinger groups, and other experimental groups or *institutionalized subcultures* that emerged in the 1970s may have been reflective of this phenomenon (Walshok, 1971).

Although the bulk of the research and the most visible communities of CNM individuals tend to be from white, middle- and upper-class communities, it is important to consider that less privileged individuals are even more marginalized and may have qualitatively different experiences than the groups who are the research participants in the majority of studies on CNM. Currently, we do not

have a full and accurate picture of who practices CNM, but Black, Indigenous, and other people of color are working to make CNM research and education more representative of the people who engage in CNM relationships (Johnson, 2019; Patterson, 2018; Tallbear, 2018).

21.5 Developmental Trajectories in CNM

Research on developmental trajectories of CNM relationships is limited. There is debate about whether CNM tendencies should be considered a sexual orientation, whether inclinations toward CNM change over time, or whether CNM is part of a political identity (Klesse, 2014). There is little research to support any of these possibilities. There is also debate about how to define CNM in order to even identify whether it qualifies as an orientation.

Many people engage in informal non-monogamy when they are adolescents and young adults by engaging in casual dating, casual sex, and multipartner sex. Various adolescent, college student, and emerging adult samples reporting on their most recent sexual partner say that it was casual sex 20–36% of the time (e.g., Eisenberg et al., 2009; Fortenberry et al., 2010). In addition, most young adults report having some sexual contact with a casual partner in their lifetime (Weaver & Herold, 2000), and up to 50% have experienced intercourse with a casual partner ever in their lifetime (e.g., Grello et al., 2006; Træen & Lewin, 1992; Weaver & Herold, 2000).

Adolescence and emerging adulthood are times for experimentation, risk taking, and testing out boundaries (Arnett, 2000). These years are a common time for both casual dating of multiple partners at once and multipartner sexual interactions (for example, see the Spotlight Feature in this chapter for research on threesomes in emerging adults). Although threesomes are often associated with younger adults, a large study of Americans found that a threesome was the most commonly reported fantasy across all age ranges (Lehmiller, 2018).

More formalized versions of CNM tend to emerge as people get older. For swingers, many are married couples ranging in age from their 30s to 60s (Fernandes, 2009; Jenks, 1998). In the 2012 NSSHB study, the age range reporting the highest frequency of open relationships was 35–44 year olds, with the age brackets above and below coming in a close second, indicating there is a normal distribution of more formal CNM (as opposed to casual relationships) across the life span (Levine et al., 2018). Studies with swingers indicate that many people begin swinging once their children are school-aged or out of the house. Polyamorous relationships tend to evolve like monogamous relationships, with people having more formalized definitions of their relationships as they get into their late 20s and early 30s. Moors et al. (2015) found that participants in CNM relationships were more likely to be older than participants in monogamous relationships. Likewise, a study of gay men found that younger men were more likely to engage in monogamous relationships than older men; however, it was unclear whether this finding reflected an age effect or a

cohort effect (Adam, 2006). Longitudinal research is lacking in the area of CNM, which is a key area for future study.

21.6 Children in CNM Households

A question that often gets raised in relation to CNM and development is the health and well-being of children raised in a household where CNM is being practiced. There are relatively limited data on children in non-monogamous families. A review of the literature found that as of 2017, there were only 5 articles that focused on non-monogamous families (Brewster et al., 2017). Some non-monogamous families consist solely of adults, but many others include one or more children who are collectively raised by the adult members of a non-monogamous family.

21.6.1 Children in Polygamous Households

Although the idea of raising a child outside of a two-parent context may seem strange to those raised within a monogamous society, non-monogamous child-rearing has been practiced for millennia across many cultures and societies all over the world that practice polygyny (Elbedour et al., 2002) and polyandry (Hrdy, 2000). Generations of children across the world were born into and raised within diverse familial structures. The practice of polygyny, in particular, was a staple of many societies and is practiced in many places to this day in regions of the Middle East and in many African countries (Al-krenawi et al., 2002; Cook, 2007; Elbedour et al., 2002; Hamdan et al., 2009). Polyandry is much less common but is still observed among a few societies in Africa, Central Asia and the Indian subcontinent, Oceania, and South America.

Research on non-monogamous families is mostly conducted with polygamous families, which are not the focus of this chapter. Briefly, there are mixed findings as to whether children in polygamous families have more negative educational, developmental, and mental health outcomes compared to children in the same communities who are in monogamous-presenting families. Polygamous families have lower socioeconomic status (SES) on average, and when controlling for SES-related variables (e.g., income, parental education, parental occupation), the differences between children from polygamous and monogamous families disappear (e.g., Al-krenawi et al., 2002; Hamdan et al., 2009). A review by Elbedour et al. (2002) argued that the key difference is the acceptance of polygamy within their community. Children from polygamous families have more positive outcomes when they live in communities that are more welcoming and open to polygamy (e.g., Bedouin Arabs; Elbedour et al., 2002).

21.6.2 Children in Western Polyamorous Households

More recently, polyamorous families in the West have begun to receive scholarly attention from psychologists, sociologists, and queer theorists. The experiences of children born into non-monogamous families vary depending on the type of relationship structure they are raised in, as well as the cultural and social context. The structure of non-monogamous families can be complex and fluid, with different parents and partners playing different roles in the lives of their children. The study of non-monogamous families is further complicated by the sheer variety of non-monogamous relationships and their place within a given cultural and social context.

Due to the more formal structure of polyamorous families (e.g., multiple parents/caregivers consistently involved in the children's lives), compared to other forms of families involving non-monogamous parents, recent research on CNM families is mostly conducted with polyamorous families. In a survey of an online polyamory forum, approximately 26% of the polyamorous respondents reported having children under the age of 18 living with them, and 69% said they would have children or had previously had children in a polyamorous relationship (Pallotta-Chiarolli, 2006). Of this sample, only 30% had told their children about their polyamorous relationship.

In many cases, openly polyamorous families are most structurally similar to the "blended" families of serially monogamous parents that include children from multiple partners living in the same household (Sheff, 2014). Polyamorous families often deal with similar issues as both blended families and sexual minority families (Sheff, 2011). Children in polyamorous families often have many adults in their lives. Parents' partners occupy positions akin to aunts and uncles in a monogamous family, while children of other unions occupy positions analogous to siblings or cousins (Sheff, 2014).

In a longitudinal ethnographic study of multiple polyamorous families, Elisabeth Sheff conducted in-depth interviews and observations of individuals and families in three waves over the course of 15 years. In total, Sheff conducted 131 interviews and observed 500 participants. This research is chronicled in her book, *The Polyamorists Next Door*, and is the most comprehensive study of polyamorous families to date (Sheff, 2014). Sheff's study documented interviews with parents and children and found that overall the children appeared to be well adjusted. Participants emphasized the importance of honesty with their children, and children discussed feeling like they did not have to hide things from the adults in their lives. Other benefits included increased financial resources, more social stimulation due to having large familial structures, and more people involved with childcare such that adults had access to more personal time. Overall, having additional adults in their life to care for them was a benefit for children in terms of having more attention, social support, and role models.

Younger children were generally unaware that anything was different about their families, as is appropriate for their developmental phase. Younger children did not categorize the adults in their lives the way that the adults did, but were more likely to focus on the role of the adult in addressing their needs (e.g., playing games, reader of

bedtime stories). Older children, particularly in the approach and entry to puberty years, were more aware. The *tweens* and teenagers reported being questioned about their family structure at school by peers who noticed additional adults in their lives. Children reported not always wanting to explicitly explain the details of their families because they knew others would be judgmental or not understand. For some of the teens, it was "no big deal" and they did not see their families as different from other families with step-parents, for example. For other teenagers, they felt self-conscious that their families were different (Sheff, 2014).

When asked about their own relationship ideals and preferences, the teenagers in Sheff's study gave a range of responses with some unquestioningly assuming that they would have a monogamous relationship in the future, some more consciously saying they would prefer monogamy, and some being interested in exploring polyamory. Having polyamorous parents does not seem to "make" children polyamorous, but obviously makes them more aware of alternatives to monogamy (Sheff, 2014).

21.7 Living a CNM Life in a Monogamous World

The majority of Western countries structure their laws and institutions around monogamous marriage or two-person cohabitation relationships. As such, these cultures strongly privilege monogamy (Conley et al., 2012). There are both benefits and harms that come from engaging in marginalized relationship styles (Sheff, 2014; Witherspoon, 2018). Both likely influence the trajectories of relationships in ways that are different from monogamous relationships.

21.7.1 Stigma against CNM Individuals and Relationships

There is robust stigma toward people who engage in CNM, although this varies by CNM type. This is well known by those with lived experience of CNM relationships (Sheff, 2014) and the biases against people in CNM relationships have been documented by researchers (Cohen & Wilson, 2017; Conley et al., 2013; Grunt-Mejer & Campbell, 2016; Moors et al., 2013). Many non-monogamous people whose relationship structures allow the choice to be closeted about their non-monogamy, present as monogamous to friends, family, and workplaces. For example, people who engage in swinging at specific times and places can hide their non-monogamy. Others are open about their CNM by choice, and some, such as polyamorous people who have multiple partners living in one home, have relationship structures that require them to be open about their CNM status.

Stigma has been documented in survey studies of overt attitudes, which consistently demonstrate that people report negative attitudes toward people in CNM relationships and more positive attitudes toward monogamous people. Conley

et al. (2013) conducted a series of four studies that illustrated the stigma against CNM, as well as the halo effect on monogamy. Across the studies, participants who read a definition of monogamy or a vignette about a monogamous couple rated monogamous couples and individuals higher on positive relationship and personal characteristics, compared with participants who read a definition or vignette about people in CNM relationships. This was true when the researchers compared participants across gender, ethnicity, and relationship type (CNM vs. monogamous). In addition to relationship characteristics, the researchers also had participants rank people on characteristics unrelated to relationships (e.g., reliable dog walking, law-abiding). Participants also rated monogamous people higher on these traits compared to those in CNM relationships, adding evidence for the halo effect around monogamy.

The findings that monogamy and those who practice it are ranked higher in morality, relationship satisfaction, and other variables compared to CNM have been found in other studies (Cohen & Wilson, 2017; Grunt-Mejer & Campbell, 2016). Additionally, within different types of CNM relationships, there does seem to be a hierarchy of how different types of CNM relationships are judged. Studies suggest that prejudice against people who engage in CNM stems from the violation of norms that hold sexual and romantic monogamy as the ideal relationship style. However, polyamory, which has loving relationships included in its definition, has been shown to be viewed the most favorably of the CNM styles (Grunt-Mejer & Campbell, 2016; Matsick et al., 2014). Participants respond least favorably to relationships in which there is sexual activity in the absence of romantic love. One study found swinging was viewed most negatively (Matsick et al., 2014), and another found swinging and open relationships were similarly negatively ranked (Grunt-Mejer & Campbell, 2016) when judged by a predominantly monogamous sample.

21.7.2 Stigmatized Relationships and Minority Stress

Relationship stigma's negative effects have been demonstrated across numerous studies on sexual minorities (Meyer, 1995, 2003). Minority stress can affect physical and mental health. People in CNM relationships often feel the need to conceal their identities, and this concealment can also affect health outcomes (Quinn & Chaudoir, 2015). Pallotta-Chiarolli (2010) documented how many polyamorous families tried to conceal their status to their communities and their children's schools.

There is emerging evidence that the negative effects of minority stress that have been documented for other sexual minorities also affect those in non-monogamous relationships (Witherspoon & Theodore, in press). The stigma associated with CNM relationships can lead to a number of negative outcomes, including social rejection by peers, rejection by family members, and discrimination in medical and therapy settings (Pallotta-Chiarolli, 2010; Sheff, 2014; Vaughan et al., 2019). Further, there is evidence of discrimination against non-monogamous people in legal settings.

Polyamorous families risk being reported to authorities for their nontraditional relationship structures, where stigma and bias can negatively affect CNM families (Sheff, 2014). Additionally, CNM behavior or relationship structures can be used against people during separation and divorce proceedings. Examples have included people losing custody of children after a separation, being denied property rights after a separation, or not have their role as a child's non-biological parent recognized.

People in CNM relationships often need to navigate uncharted relationship territory with little support. Referring specifically to polyamorous relationships, Ritchie and Barker (2006) documented how there are also often not words to describe things that occur within polyamorous relationships that do not exist in monogamous relationships. As such, polyamorous people need to develop new language to describe their arrangements (such as the word polyamory itself!). Other examples include terms such as *metamour*, "relationship with a partner's partners or significant other's other significant others" (Ritchie & Barker, 2006, p. 593) or *compersion*, a term that describes the happiness and joy one experiences when their partner is happy about another partner. It is essentially the opposite of jealousy. Neither of these terms have made it into any major dictionaries as of this writing, but are well known in the communities that use them. The defining of such terms can lead to social identity, development of community, and other positive benefits, as was seen in the gay rights movement (Ritchie & Barker, 2006). In the past decade, interest in CNM has increased dramatically (Moors, 2017), likely due in part to the development of language and communities. Although CNM relationships are stigmatized, the community and connection derived from being part of this sexual minority also confers benefits. Research on the benefits is just beginning to emerge.

21.8 Directions for Future Research

As shown by the lack of studies on the development of CNM, there are clear gaps in this area of research that can be filled by future researchers. The assumption that a monogamous pair-bonded relationship is the normative trajectory is challenged by the overwhelming evidence that many people have had more than one sexual relationship in their lifetime, and so do not meet the criteria of monogamy (Conley et al., 2012). This assumption is also challenged by high rates of infidelity in supposedly monogamous relationships.

One very basic recommendation to drive research on CNM forward, broadly, would be to include questions about CNM relationships in research studies on relationships and sexuality. The APA Division 44 Task Force on CNM provides resources regarding how to ask these questions (https://www.div44cnm.org/resources). Additionally, in studies including questions about extradyadic sex, there should be an option to indicate whether the sex happened with or without the consent of the partner. Most large, representative sample studies have not

differentiated between CNM and infidelity when they ask about extradyadic or extramarital sexual activity.

As noted previously, the study of development often entails studying typical and normative changes, with the assumption there is forward progression over time. This approach is standard within many social science fields including sociology and psychology, but the focus on those at the center to the exclusion of those at the margins has been criticized by feminist scholars who advocate for standpoint epistemologies (e.g., Collins, 2000; Haraway, 1988). Developing new theories and models of relationship development that can account for and recognize non-monogamous trajectories would allow for more empirical work to follow. Sexual Configurations Theory is a psychological theory of sexuality and relationships that begins from a place of not assuming one normative form of relationship (monogamous, heterosexual, cisgender) and defining everything else in comparison to the norm. The Sexual Configurations Theory framework allows people to define their sexuality in terms of the gender(s) they are attracted to (including genders outside the male-female binary), the number of partners they wish to have, and additional factors of their sexual configuration/orientation, such as dominance and submission (van Anders, 2015).

Although research in the field of CNM is expanding, there is very little research from a developmental perspective. There is a need for longitudinal research and theorizing about developmental trajectories of CNM relationships, both over the life span and within the relationships themselves. Are there different life span trajectories for the different of the types of CNM relationships, as suggested by cross-sectional research? Once relationships are established, are there developmental trajectories that take place within swinging, polyamorous, or open relationships? Anecdotal evidence says there may be some identifiable phases of opening up previously monogamous relationships, but there has been no formal research in this area.

We also do not know factors that predispose individuals to enter CNM-style relationships, and understanding in this area would be an important addition to the literature. Developmental influences likely play a role in whether individuals choose to pursue CNM relationships vs. monogamous relationships. There are likely multiple pathways that lead to the decision to engage in CNM, and this would need to be accounted for in developmental models.

Life history theory states that environmental influences and constraints shape how species and individuals engage in sexual strategies (Kleiman, 1977). Although it does not differentiate between types of non-monogamy, it theorizes about the importance of the interaction between the environment and genetics. Studying environmental factors, broadly defined, across the life span would contribute to our understanding of CNM. Future research can examine social factors, such as family background, cultural and countercultural influences, and cultural and personal traumas. Genetic influences may also play a role as has been shown in other species, such as voles, where the specific genes that differentiate monogamous and non-monogamous species have been identified (Young et al., 2011). There has also been some debate about whether non-monogamy and monogamy are sexual

orientations, so further research is needed in this area to assess whether non-monogamous samples share similarities with other sexual minority samples.

21.9 Conclusions

Research on CNM relationships is a burgeoning field of study. People in CNM relationships make up a similar percentage of the population as other sexual minority groups, but much less is known about them. Understanding the development and maintenance of CNM relationships can help reduce stigma and enhance the lives and increase the safety of those who are in CNM relationships. Understanding diverse relationship structures can enhance relationship science broadly, and developmental researchers can play an important role in this exciting new area of study.

Spotlight Feature: Current Developments in Research Assessing Mixed-Gender Threesomes

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Research indicates that a substantial proportion of adults are interested in or have fantasized about mixed-gender threesomes (MGTs; Armstrong & Reissing, 2014; Joyal et al., 2015; Lehmiller, 2018; Morris et al., 2016; Thompson & Byers, 2017; Thompson et al., 2021). MGTs can be defined as the sexual behavior of three people at the same time in which persons of more than one gender are present. For example, in a recent study conducted by Thompson and colleagues (2021), it was discovered that 81% of adults reported some level of interest in engaging in an MGT. It is also apparent that interest varies according to the gender composition of the MGT and the gender of the respondent. For example, in an online survey of 4,175 American adults, one-third of participants reported that being in a threesome was part of their favorite sexual fantasy of all time, while 93% of men and 84% of women reported that they had fantasized about a threesome at least once before (Lehmiller, 2018).

Despite the large proportion of adults indicating interest in MGTs, research reveals that a relatively small proportion of adults report experience with this sexual activity (Armstrong & Reissing, 2014; Thompson & Byers, 2017; Thompson et al., 2021). In fact, among a sample of 1573 English-speaking adults, only 433 (30%) indicated having participated in an MGT (Thompson et al., 2021). Among those 433 adults, 104 (24%) reported only experiencing MGTs involving two men and one woman, 168 (39%) reported only experiencing MGTs involving two women and one man, and 137 (32%) reported experience with both these types of MGTs.

Given that so many people report interest in MGTs, why is it that relatively few ever act on this interest and participate in MGTs? The discrepancy between adults' interest in and experience with MGTs may relate to how society responds to non-traditional/unconventional sexual behaviors. According to proponents of Sexual Script Theory (SST; Gagnon & Simon, 1973), people acquire information about appropriate sexual behavior via the observation of others and media consumption, most of which is mononormative and heteronormative. Mononormativity refers to the assumption that sexual behaviors/relationships can only occur, or are only normal, between two (and only two) partners (Hooper, 2014). Heteronormativity is the assumption that everyone is either male or female, and that sexual activity only occurs, or is only normal, between other-sex members (Herz, & Johansson, 2015). Behaviors that violate this "normative sexual script" are often met with judgment and strong societal stigma (e.g., Conley et al., 2019; Pistella et al., 2016), and this is no different for MGTs. Indeed, research indicates that hypothetical men and women described as initiating MGTs were perceived as possessing inferior cognitive abilities, behaving less morally, and as having lower quality relationships as compared with those initiating dyadic sexual behaviors (Thompson & Byers, 2021). Thus, it is likely that many adults are willing to engage in MGTs but have chosen not to

because their interest was countered by inhibition about engaging in an unconventional sexual activity due to fears of being negatively evaluated or stigmatized.

Although society has traditionally disapproved of unconventional behaviors such as MGTs, Coon (2006) suggests that sexual norms and opinions in Western cultures are shifting and becoming increasingly permissive. Consequently, opportunities to engage in behaviors that were once highly stigmatized may now be more accessible. This is also likely true for MGT participation, in which adults may be more likely to participate due to societal shifts promoting sexual freedom. In fact, research indicates that these shifts in societal norms have impacted conceptualizations of heterosexuality, particularly for males. In fact, in a qualitative study conducted by Scoats and colleagues (2018), 29 of their 30 heterosexual male participants indicated that they did not view an individual instance of an MGT involving two males as a threat to one's heterosexual identity.

Additionally, shifts in societal norms have also been argued to influence conceptualizations of monogamy. In fact, although monogamy has traditionally been defined as sexual and romantic exclusivity to one's romantic partner (Klesse, 2006), recent research indicates that a substantial proportion of US adults in self-defined monogamous relationships are interested in MGTs involving a romantic partner (Thompson & Byers, 2017). Furthermore, another qualitative study conducted by Scoats and Anderson (2019) indicates that participation in an MGT often does not threaten one's monogamous relationship orientation in ways that many other forms of multi-person sexual behavior (e.g., consensual nonmonogamy) might. In fact, the researchers argue that participation in MGTs may actually support monogamy and enhance relationship quality.

With all of this in mind, research indicates that a substantial proportion of individuals report some degree of interest in MGTs, yet they may be reluctant to act on those interests due to fears stemming from societal stigma. That said, because sexual norms and opinions are becoming increasingly permissive in Western cultures, MGTs may start to emerge as a "golden opportunity" to explore consensual nonmonogamy and same-sex sexual behavior in a more "socially acceptable" way (Scoats, 2019).

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