Chapter 3
Gender Identity Development: A Biopsychosocial Perspective

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Abstract From the first time individuals described a felt incongruence between their assigned and their experienced gender, people have been interested in the origins of gender dysphoria and transsexualism. This chapter focuses on the various theories and research evidence about gender identity development, which have often pointed to a biological, a psychological, or a social factor as determining one's gender identity. Over time, differing views prevailed, although the multiple perspectives also developed parallel to one another. Two distinct lines of research on gender identity development emerged: those focused on "normative" development and those focused on nonnormative or gender-variant development. The chapter first describes the multiple factors (biological, psychological, and social) that were studied in both lines of research. After that, current studies are presented that give evidence for a complex interaction of biological, psychological, and social factors in gender identity development. Recent findings from neuroimaging and genetic studies of individuals with gender dysphoria provide evidence that nature is of importance. Its exact role however remains largely enigmatic.

Regarding future studies of gender identity development, we conclude that they should seek to understand not only the potential genetic and environmental (from both nature and nurture) factors, but also when these factors emerge in life and how

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those factors may be of influence on the full spectrum from gender-normative to gender-variant development in all its expressions.

3.1 Introduction: The Past, the Present, and the Future

Over the last century, theories and views about gender identity development have been formulated and changed substantially. The focus of theorizing and empirical studies has been to examine which factors determined *gender identity* (one's identification as male, female, or another gender), the malleability of gender identity, and the age at which gender identity was established. Another important concept in the study of gendered behavior and identity includes *gender role*: behaviors, attitudes, and personality traits that are typically attributed to, expected from, or preferred in a boy or a girl. Gender role behavior, masculine or feminine behavior, can to a certain extent also be studied in animals, whereas gender identity involves the labeling of a person's sense of self and, as a typically human characteristic, obviously cannot be studied in animals. Two distinct lines of research have emerged with a focus on gender identity: those focused on "normative" development and those focused on specific subpopulations such as individuals with gender dysphoria (discomfort with the assigned gender identity) or those who have a disorder of sex development (DSD). Studies of "gender variance," gender role behaviors, interests, and preferences that may be nonconforming to traditional gender roles but may not be associated with desires for sex reassignment, have typically been incorporated into studies of normative development. For example, studies of gender and self-concept in masculine or feminine domains such as math or computers stem from the normative literature (Sáinz & Eccles, 2012), but illuminate concepts associated with gender nonconformity that can inform the study of gender variance.

We are beginning to see a convergence of these lines of research such that inquiry should ultimately identify factors associated with variability of gender identity (studied via the mechanisms of gender variance and gender role behaviors) across the entire spectrum. In this chapter, we examine theoretical concepts and research findings, as well as incorporate terminology from both lines of research. We conclude with proposed concepts and strategies to move the field forward in developing an integrative theoretical framework to better understand variability in gender identity development.

In this chapter, we will use the biopsychosocial perspective of gender identity development. It was Engel (1977) who introduced the "biopsychosocial" model as an alternative to the pure "medical model" that was used in medicine at that time. He felt that Western society had adopted the medical model not only as a scientific model to study the origins of disease but also as a cultural belief system. In his view, the biomedical model is used as an explanatory system for "natural phenomena that are puzzling and disturbing," and it provides "a device for social adaptation." The reductionist biomedical model viewed the body as a machine in which disease simply meant a breakdown that had to be repaired. The more

holistic biopsychosocial approach, however, would incorporate behavioral and psychosocial aspects of health. It would give a more thorough understanding and a fuller acknowledgement of all factors that play a role in health and diseases (Engel, 1977).

Some might consider the biopsychosocial perspective "outdated," as it dates back to the last decades of the former century. However, when reflecting on gender identity and gender dysphoria, we feel that this model still helps us to fully appreciate the different factors that influence gender identity development. Gender identity touches upon a sensitive part of everybody's personality. The extent to which gender identity is determined by biological versus social or psychological factors raises strong emotions in many people, especially those who work with or are affected by gender dysphoria.

Historically, the various authors that conceptualized their theories on gender identity development often adopted a biological, a psychological, or a social view. Certain views prevailed at different times, although the perspectives also developed parallel to each other. Currently, contributions from each of these perspectives allow for a richer understanding of the complex ways in which gender identity develops across a broad spectrum. Attempts to understand gender identity development will likely ultimately require a nuanced understanding of the ways in which biological, psychological, and social factors interact with one another.

Before the 1950s, Freud's personality development theory prevailed, positing that variability in gender identity was due to anomalous, early childhood psychosexual experiences, specifically during the phallic stage between ages 3 and 6 (Freud, 1962). A shift in thinking occurred in the 1950s when Money proposed the idea that core gender identity was malleable and could be formed by raising a child as male or female during a critical period in early childhood (Money, Hampson, & Hampson, 1955). Although Money's perspective has been shown to be wrong, the role of social factors in gender identity development has been of interest to many scholars, and there is evidence of its importance.

In the 1960s, Kohlberg formulated a cognitive theory of gender identity development, proposing that children develop gender identity after they are cognitively able to understand that gender differences exist and understand the lifelong consequences of gender identity (Kohlberg, 1966). Cognitive psychology further influenced theorizing about gender identity by introducing the "gender schema theory" in the early 1980s, which argued that, while growing up, children develop a "gender schema," a network of gender-related information coloring and influencing their behaviors (e.g., Bem, 1981).

Various theories have incorporated the importance of social factors for gender identity development. Early social learning theory emphasized gender role behavior and how it is shaped by reward (of gender-appropriate play). In the 1970s and 1980s, psychosocial theories argued that sex-segregated peer networks reinforced stereotypical gender behaviors (e.g., Maccoby & Jacklin, 1987). Bandura argued for the importance of gender role modeling (Bussey & Bandura, 1999).

However, these theories did not seem to work for atypical gender development. How can one explain a felt incongruence between gender identity and sex of birth?

During the 1990s, the attention shifted again, this time to the role of biological factors in gender differences and also in gender identity development. Modern brain studies not only revealed that there are structural differences between males and females in size and distribution of white and gray matter, but that these differences are correlated with differences in cognitive functioning (e.g., Gur et al., 1999). With regard to gender identity, a specific brain area was identified in transsexuals that was similar in size to that of the identified sex instead of the assigned biological sex (Zhou, Hofman, Gooren, & Swaab, 1995). These studies led to high expectations of what biological factors might clarify in regard to the behavioral differences between males and females.

Until recently, most knowledge about gender development came from studies in general population samples. For a long time, the focus has been on normative gender development, which typically makes no distinction between gender development and gender *identity* development, the latter being of utmost relevance for gender-variant development. In this chapter, we are interested in gender *identity* development, although it is important to realize that most studies of normative gender development focus more on gender differences in overt gender role behaviors, such as toy preferences, than on gender *identity* development.

3.2 Normative or Typical Gender Identity Development

Boys and girls grow up differently. As soon as they are born, behavioral differences can be observed. When newborns, quietly lying in their mothers' laps, are confronted with a friendly face and a mobile made of the same colors and sizes as the face; girls spend more time looking at the face whereas boys take more time looking at the physical-mechanical object (Connellan, Baron-Cohen, Wheelwright, Batki, & Ahluwalia, 2000). As infancy progresses, additional gender differences have been observed. Six-month-old boys have greater difficulty than girls in maintaining affective regulation (they are, e.g., more likely than girls to fuss, to gesture to be picked up, and to try to escape or get away by turning and twisting) (Weinberg, Tronick, Cohn, & Olson, 1999). Sex-typed toy preferences exist as early as age 12–24 months (Jadva, Hines, & Golombok, 2010), with boys showing more interest in a car compared to a doll and vice versa. Interestingly, it was not the color or the shape of the toy that mediated the preference; for example, girls preferred a blue doll over a pink car. In general, both boys and girls preferred reddish colors over blue and rounded over angular shapes (Jadva et al., 2010). So at this young age, no color preferences were found, yet in older children, girls tend to prefer stereotypically feminine colors (pink/purple and warm colors), and boys generally choose the masculine colors (blue, brown, and darker colors).

During the preschool years, more behavioral gender differences emerge. Five-year-old girls are better able to give socially desirable solutions for stories of children with a conflict, like proposing to play together or get a teacher or a parent to mediate. Boys more frequently come up with verbally or physically aggressive

solutions (Walker, Irving, & Berthelsen, 2002). In primary school, most children have begun to control their emotions and physical aggressiveness is displayed less frequently. However, boys still show more verbal and behavioral negativity than girls when they are observed while losing a computer game (Underwood, Hurley, Johanson, & Mosley, 1999). For the individual boy or girl, one should be cognizant of the fact that these observed behavioral gender differences show large overlap, and the variability within the sexes is often greater than between sexes.

Variability in sex-typed behavior exists from a young age. Masculine girls and feminine boys can be recognized, as well as feminine girls and masculine boys. Interestingly, the degree of sex-typed behavior observed as a toddler predicts the degree of sex-typed behavior in adolescence (Golombok, Rust, Zervoulis, Golding, & Hines, 2012), suggesting that degree of sex-typed behavior may be very consistent over time. Also, between late childhood (11 years of age) and early adolescence (15 years of age), sex-typed behaviors increase, and again, sex-typed behavior at age 11 predicts individual differences 2 years later (McHale, Shanahan, Updegraff, Crouter, & Booth, 2004).

Hill and Lynch (1983) proposed that in adolescence, *gender intensification* occurs. This means that an increased pressure to conform to culturally sanctioned gender roles results in a further differentiation in gender role identification in boys and girls. Studies testing this idea have shown mixed results. For example, Galambos, Almeida, and Petersen (1990) indicated that sex differences in masculine personality qualities (instrumental qualities such as independence and leadership) increased in early adolescence, but sex differences in feminine personality qualities (expressive qualities such as sensitivity and kindness) did not. A longitudinal study by Priess, Lindberg, and Hyde (2009) showed that adolescents did not become more stereotypical in their gender role identity across adolescence. The authors attributed the lack of support for the gender intensification hypothesis to changed patterns of socialization in present-day adolescents. In present-day society, boys are free to be expressive and girls are supported in being more independent than they were in the past.

The affective component of gender identity (gender contentedness) is also an important factor during development influencing well-being. Feeling gender typical and content with one's gender generally positively influences well-being, whereas feeling pressure to conform to gender stereotypes is generally a negative influence (Carver, Yunger, & Perry, 2003). Developmentally, older children seem to feel more gender typical compared to younger children, while at the same time, they experience less pressure to conform to the gender stereotypes (Carver et al., 2003).

3.2.1 Biological Factors

In a key paper by Phoenix, Goy, Gerall, and Young (1959), effects from sex hormones during prenatal development on the differentiation of the brain towards a male or female direction were first called organizing effects. Since then, numerous animal studies have revealed that sex hormones, testosterone in particular, not only

guide the development of the genitals but also affect sexual differentiation of the brain and behavior (McCarthy, De Vries, & Forger, 2009; see also Chap. 1). In humans, the effects of prenatal sex hormones are more difficult to study, but it is not unlikely that sex hormones influence the development of gender role behaviors, as well as gender identity (the conviction of being a man or a woman) (Hines, 2009; Steensma, Kreukels, De Vries, & Cohen-Kettenis, in press). In this section, we consider the studies examining biological links to gender identity development in humans. Later, we focus specifically on studies examining biological factors in gender-variant populations. For studies of the prenatal effects of sex hormones on gender development, it is important to make a distinction between gender role behavior and gender identity.

The case of an identical twin from Winnipeg was one of the first to show that biological factors in gender identity development could not be ruled out (Diamond & Sigmundson, 1997). This same-sex twin was raised as an opposite-sex twin after a disastrous accident, in which one of them lost his penis during circumcision. After consultation with John Money, the parents decided to raise their boy as a girl and not to mention to the twin what had happened. Although Dr. Money initially claimed otherwise, the boy raised as a girl was very unhappy in this assigned role. Studying the specifics of this case, we would say he/she was certainly gender dysphoric (i.e., the experienced gender identity was discordant from the assigned role). Immediately after the child was told the truth, he decided to reassume the male role. This boy who had a normal masculine prenatal development could obviously not be *turned* into a girl, so his gender identity was not as malleable as John Money had thought. Although this case strongly indicated that biological factors do matter in gender identity development, they do not appear to be the sole factor. There are cases of people with ablatio penis who were raised as girls combined with early childhood gonadectomies, who do not appear to have gender dysphoria in the assigned role (Meyer-Bahlburg, 2005).

3.2.2 Psychological Factors

In their first year, infants as young as 3 or 4 months of age are capable of distinguishing between male and female faces (Quinn, Yahr, Kuhn, Slater, & Pascalils, 2002). Most research of these phenomena is done by habituation or preferential looking approaches. In a habituation approach, infants lose their attention when looking repeatedly to one of two categories, women or men. When the other category is presented, they show attention again. Earlier research indicated an ability to distinguish categories (sexes) in 75 % of infants at 12 months, 50 % at 9 months, and 35 % at 5 months (Fagot & Leinbach, 1993).

Whether children this young are able to categorize or *label* gender is still a matter of debate, however. Reaching the cognitive ability to label their own and others' gender is the first stage of what Kohlberg (1966) defined as *gender constancy*, the proposed notion that children must understand that they will always stay the same sex and that identification should be based on genitals. Gender constancy was

proposed to develop in three stages between the ages of two and seven, although some studies suggest these stages are reached earlier (Slaby & Frey, 1975). These three proposed stages include *gender labeling*, the ability to label one's own and others' gender; *gender stability*, the recognition that gender does not change over time; and *gender consistency*, the recognition that gender does not change if someone's appearance or activities change but is generally ascribed to one's genitalia (for a review, see Ruble, Martin, & Berenbaum, 2006). Along with reaching the stage of gender constancy, most children develop a core sense of self as male or female and a gender identity congruent with their natal sex.

Holding these cognitive perceptions has consequences. Knowing basic gender information is related to increased play with the two most strongly stereotyped toys (trucks and dolls) (e.g., Zosuls et al., 2009). When toddler girls who responded to a test for gender labeling consistent with societal gender norms were compared to girls who responded inconsistently with gender norms, the former group showed less aggressive behavior than the latter. For boys this was not the case, suggesting that their overt aggression does not violate society's expectations for males (Fagot & Leinbach, 1985). Children also consciously choose which toy to play with. Girls who were told that a toy was typically female chose to play with it more frequently than when the same toy was presented to be typically male (Martin, Wood, & Little, 1990).

In a study asking 2–7-year-olds gender constancy questions, children gave more gender constant answers when they were older (Levy, 1998). When asked to attribute gender-specific activities to pictures of either a boy or a girl engaged in different behaviors, building blocks, playing a ball, and using a tool were considered masculine, while taking care of a baby, playing a doll house, and doing makeup were considered feminine. Children thus construct cognitive gender schemas during development; these are organized networks of mental associations representing information about themselves and the sexes that influence information processing and behavior (for a review, see Martin, Ruble, & Szkrybalo, 2002). Before children reach gender constancy, most have acquired knowledge about gender stereotypes (girls have long hair and boys short hair) and gender-stereotyped behavior (boys are aggressive, girls take care of others). Most children have an active role in their gender schema development as they, for example, remember gender-consistent information better than gender-inconsistent information. In their thinking about sex-typed traits and behavior, young children are fairly rigid; only after age 7 do they become more flexible (Signorella, Bigler, & Liben, 1993).

3.2.3 Social Factors

Social roles and expectations vary for girls and boys. Even before birth, gendered characteristics are ascribed to expected infants (Montgomery, 2010). For example, pregnant women experiencing much fetal movement may expect that their baby will be a boy. In the study of infants' behavioral gender differences (boys having greater difficulty than girls in maintaining affective regulation), mothers used different

parenting strategies for boys versus girls. However, these differences were insufficient to account for the gender differences in infants' behavior (Weinberg et al., 1999). Another study described more favorable ratings of less nasal (male) vocalizations, even when the sex of the infant was unknown, suggesting both differences in sex and differential adult responses to sex differences (Bloom, Moore-Shoenmakers, & Masataka, 1999). The extent to which socialization factors contribute to the development of gender identity is not fully understood.

Social cognitive psychology emphasizes the role of environment in gender development: Modeling is one of the most pervasive means of transmitting values, attitudes, and patterns of thought and behavior, and children tend to choose, attend to, and associate with same-gender models (Bussey & Bandura, 1999). Evidence suggests that boys tend to do this more so than girls, for whom gender-atypical behavior is accepted more easily. As gender-stereotyped activities and interests are observed before children reach complete gender constancy, it is argued that modeling influences are important even in children's early gender development (Bussey & Bandura, 1999).

The most important consequence of a child's developing gender schema is probably that children increasingly choose to play with same-gender playmates. In the years between preschool and puberty, children consistently report spending more time with same-sex peers and siblings (Maccoby, 1998). Although many gender differences are quite small, gender accounts for a very large proportion of the variance in children's play partners (Maccoby, 1998). Children thus spend a major part of their time in all-male or all-female groups and grow up in different subcultures. Consequently, gender segregation influences children's social development and friendships. Boys tend to play in larger groups and show more physical and rough and tumble play, and their social interaction is more dominance related. Girls play in less hierarchically organized groups and show more close friendships.

In their thinking about sex-typed traits and behavior, the gendered context of one's family may influence gender attitudes. Although most youth report declines in stereotypical gender beliefs, firstborn boys with both brothers and traditional parents become more traditional across middle childhood and adolescence (Crouter, Whiteman, McHale, & Osgood, 2007). Children growing up in less traditional families, on the contrary, show more nontraditional gender role attitudes. For example, children growing up in Dutch lesbian families showed less traditional gender stereotypical thinking compared to children in heterosexual families (Bos & Sandfort, 2010). Cultural differences play a role as well. Italian children, for example, were more likely to favor stereotypical toys and activities than were Dutch children (Zammuner, 1987).

3.3 Gender-Variant Development

At the same time as gender-typical behavior emerges, some children will show what is also called gender-atypical or gender-variant development in early toddlerhood. These preschool children are boys displaying female interests and behavior and

girls who strongly prefer male toys and playmates. They may even express an explicit desire to be the other gender as soon as they can talk (Cohen-Kettenis, 2005; Cohen-Kettenis & Pfäfflin, 2003). A recent long-term follow-up study found that gender-dysphoric children who insist they "are" the other gender are more likely to seek gender reassignment during adolescence than other gender-dysphoric children who state they "want to be" the other gender (Steensma, McGuire, Kreukels, Beekman, & Cohen-Kettenis, 2013).

Studies using the Child Behavior Checklist (CBCL), a parent-report behavioral problem questionnaire, show that cross-gender behavior in children is more common than the stated wish to be of the other gender (Achenbach & Rescorla, 2001; Cohen-Kettenis & Pfäfflin, 2003; Verhulst, Van der Ende, & Koot, 1996; Zucker & Bradley, 1995). For example, in a large Dutch twin study, 3.4 % of the 7-year-old boys and 5.2 % of the 7-year-old girls were reported to behave sometimes or often like the opposite gender, while only 1.0 % and 1.7 %, respectively, had stated the wish to be of the opposite gender (Van Beijsterveldt, Hudziak, & Boomsma, 2006). At age 10, these percentages had decreased, although less so for the stated wish. This shows that for many, cross-gender behavior diminishes when children reach their teenage years.

Presumably, only a small percentage of these children with gender-variant behavior fulfill the criteria for the diagnosis of gender identity disorder (GID). Although prevalence rates of GID in childhood are lacking, prevalence estimates in adults (male-to-female (MtF) transsexuals 1:10,000, female-to-male (FtM) transsexuals 1:30,000) indicate that this will probably be low (Zucker & Lawrence, 2009). The extent of gender-variant behavior and associated distress sufficient to qualify for a psychiatric disorder is a matter of serious debate, especially reconsidering the GID criteria for the upcoming DSM-5 and ICD-11 (Cohen-Kettenis & Pfafflin, 2010; Meyer-Bahlburg, 2010; Zucker, 2010). One important reason for this debate is that only a minority of GD children will be future gender reassignment candidates. Their gender-variant behavior may be pathologized considering that prospective studies of boys and girls with GD show that, at follow-up, the proportion of participants with a same-sex or bisexual sexual orientation is substantially higher than the base rates in the general population (Drummond, Bradley, Peterson-Badali, & Zucker, 2008; Green, 1985; Wallien & Cohen-Kettenis, 2008; Zucker & Bradley, 1995). In one unique longitudinal general population study of 879 Dutch boys and girls, gender-variant behavior was measured during childhood with the CBCL, while sexual orientation was assessed 24 years later, when participants were 27–36 years of age. The prevalence rates of same-sex orientation were, depending on the sexual orientation domain, 8.4–15.8 times higher in the childhood gender-variant subgroup, as compared to the childhood non-gender-variant subgroup (Steensma, Van der Ende, Verhulst, & Cohen-Kettenis, 2012). No one of the gender-variant subgroup in the general population was transsexual in adulthood, indicating that gender-variant behavior in childhood is indeed more predictive of same-sex sexual orientation in adulthood than later GD.

3.3.1 Biological Factors

Two lines of research are of particular interest to study the effects of sex hormones on gender identity development among gender-variant populations. First, by studying gender identity outcome in individuals whose sexual differentiation followed an atypical route, studies that have examined individuals with disorders of sex development (DSD). DSD are congenital conditions in which the development of chromosomal, gonadal, or anatomical sex is atypical (Hughes, Houk, Ahmed, & Lee, 2006). Second, studies that have examined sex-typical brain and behavior in individuals with a gender identity that is not in line with their assigned sex at birth.

3.3.1.1 Disorders of Sex Development

In individuals with DSD, both gender role behavior and gender identity have been studied. Many studies have found evidence for a role of prenatal testosterone in later masculine behavior (Hines, 2009). However, because the focus of this chapter is on gender identity development, we will confine ourselves here to studies focused on gender identity.

A recent study into psychosexual outcome in adolescents with various DSD found no signs for gender dysphoria or uncertainty about their gender identity (Jürgensen et al., 2012). Earlier studies did, however, report gender identity problems in certain DSD.

Congenital adrenal hyperplasia is an enzyme deficiency that exposes female fetuses to elevated testosterone levels. In general, women with CAH develop a female gender identity, but gender dysphoria occurs more often in this group than in women without CAH (De Vries, Doreleijers, & Cohen-Kettenis, 2007; Dessens, Slijper, & Drop, 2005). According to Jordan-Young (2012), the higher prevalence of masculine gender identity in women with CAH could arise from a slightly more masculine appearance caused by the physiological effects of CAH. The prevalence of gender identity problems did not, however, appear to be associated with the severity of genital masculinization, which can be seen as an indicator of the degree of prenatal androgenization (Dessens et al., 2005).

Children with 46 chromosomes and XY sex chromosomes (46, XY) who have 5α-reductase-2 deficiency (5α-RD-2) or 17β-hydroxysteroid dehydrogenase-3 deficiency (17 β-HSD-3) are usually born with female-appearing or ambiguous genitalia due to androgen biosynthesis problems. They are generally raised as girls, but at puberty when their genitals start to masculinize, transitions to the male role are not uncommon (De Vries et al., 2007). Children with 5α-RD-2 whose gonads are removed before puberty are more likely to maintain a female gender identity (Hines, 2009). The rise in testosterone levels after puberty therefore seems to be an important factor in gender identity formation and consolidation in individuals with this condition (Steensma et al., in press). We must, however, also consider cultural factors, because "gender role change occurs at different rates in different societies" (Hughes et al., 2006, p. 155).

Complete androgen insensitivity (CAIS) is a condition in which 46, XY individuals have testes and produce androgens but are insensitive to these androgens, causing their external genitals to develop in the female direction. Because of their complete female appearance, the diagnosis is often missed at birth and they are thus generally raised as girls and assigned to the female sex. Usually these women have a female gender identity and do not show signs of gender dysphoria (De Vries et al., 2007). Their brains could be hypothesized to have developed in the female direction because of the complete absence of androgen effects. But we should not forget that their physical appearance is also entirely feminine and they are nurtured in the female role. The combination of all these factors might have been necessary to develop a solid female gender identity in these individuals. However, T'Sjoen et al. (2011) have recently reported a female-to-male gender transition in a case with CAIS. Gender dysphoria and gender transitions occur more often in individuals with partial androgen insensitivity syndrome (PAIS) (Mazur, 2005). Regardless of the sex in which they are reared, around 25 % of individuals with PAIS seem to develop gender dysphoria (Warne, 2008). The partial susceptibility of their brains to the effects of prenatal androgens may have led to this more varied representation of gender identity and dysphoria (Steensma et al., in press).

Together, studies in individuals with DSD show that prenatal testosterone exposure of the brain may affect a male gender identity development. However, exposure to high levels of testosterone does not always lead to a male gender identity (e.g., in CAH). Therefore, it is still unclear from these studies how and to what extent prenatal androgens affect gender identity development. It is also not known how prenatal androgens interact with other factors to influence gender identity. In a letter to the editor, Cadet (a woman with AIS) nicely describes the deliberate evaluation of gender identity in a person with DSD (Cadet, 2011; Meyer-Bahlburg, 2011). It is not unlikely that the cognitive processes behind gender identity development in persons with DSD are rather different from those of non-DSD individuals.

3.3.1.2 Gender Dysphoria

Several postmortem studies have found that the brains of MtF transsexuals have some sex-specific characteristics that are more similar to females than males. In postmortem brain material of MtF transsexuals, the central portion of the bed nucleus of the stria terminalis (BSTc) and the interstitial nucleus of the anterior hypothalamus 3 (INAH3), sex-dimorphic nuclei in the human hypothalamus, appear to be similar in volume and number of neurons to that of women and smaller compared to that of men (Garcia-Falgueras & Swaab, 2008; Kruijver et al., 2000; Zhou et al., 1995). A more recent study of the same group shows that the volume and neuron number of another hypothalamic nucleus, the intermediate nucleus, of MtF transsexuals have intermediate values compared to those of men and women (Garcia-Falgueras, Ligtenberg, Kruijver, & Swaab, 2011).

Transsexuals thus show similarities in these nuclei with their experienced gender identity and differ from their sex of birth. The INAH3 is, however, also associated

with sexual orientation and smaller in homosexual than in heterosexual men (Levay, 1991). For the BSTc, volume and neuron number in MtF transsexuals have been found to be smaller compared to both hetero- and homosexual men (Kruijver et al., 2000; Zhou et al., 1995). These findings show that, at least, these sex-dimorphic nuclei have developed in the direction of the experienced gender rather than in line with the birth sex. The extent to which these nuclei play a role in gender identity development remains to be determined.

One should keep in mind that these postmortem studies were all conducted by the same group in rather small samples. We are not aware of attempts to replicate these findings. And although the authors examined possible factors that might have influenced the results (by including material from castrated men, pre- and postmenopausal women, and MtF transsexuals that stopped taking cross-sex hormones before death), the influence of cross-sex hormone treatment on the results cannot be completely ruled out.

The relationship between prenatal androgens and sexual differentiation of the brain may also be studied in sex-typical cognitive abilities. Do individuals with GD show similarities in sex-typical cognitive functioning with their experienced gender or rather with their sex of birth? Preferably, sexual differentiation of cognitive functions should be studied in individuals with GD before the start of any treatment to ensure that findings cannot be explained by treatment effects (Kreukels & Cohen-Kettenis, 2012).

Cohen-Kettenis, van Goozen, Doorn, and Gooren (1998) found less functional cerebral asymmetry during processing of auditory verbal stimuli and better performance on a verbal memory task in MtF transsexuals compared to control men. FtMs also performed in a male-typical way on the verbal memory task. On sex-typical tasks, untreated MtFs and FtMs scored between male and female controls (Van Goozen, Slabbekoorn, Gooren, Sanders, & Cohen-Kettenis, 2002). A Norwegian study by Haraldsen, Opjordsmoen, Egeland, and Finset (2003) did, however, find a cognitive pattern consistent with birth sex in untreated individuals with GD before the start of treatment. Govier, Diamond, Wolowiec, and Slade (2010) suggest that there may be separate underlying etiological mechanisms in MtF and FtM conditions, based on results of a dichotic listening study. Overall, the neuropsychological findings provide some evidence for cross-sex indicators prior to gender reassignment.

In recent years, there has been a flurry of neuroimaging studies searching for biological mechanisms behind gender dysphoria. Some imaging studies do not find any evidence for a biological component in gender identity development and show that brain measures in individuals with GD do not differ from their sex of birth (Emory, Williams, Cole, Amparo, & Meyer, 1991; Savic & Arver, 2011). However, the study by Emory and colleagues was performed in treated transsexuals, and other studies before the start of treatment find greater similarities with the experienced gender for individuals with GD. Brain studies have focused on the size of the putamen, white matter microstructure, gray matter, cortical thickness, and functional activation patterns in response to various stimuli.

Several studies support the hypothesis for a sex-atypical differentiation of the brains of individuals with GD. First, FtMs differed from control women before the

start of treatment in regional cerebral blood flow in the left anterior cingulate cortex and right insula (Nawata et al., 2010), and during mental rotation, untreated MtFs differed from control men in brain activation (Schöning et al., 2010). Second, similarities have been found between the brains of individuals with GD and their experienced gender in structure (white matter microstructure) in FtM transsexuals (Rametti, Carrillo, Gomez-Gil, Junque, Segovia et al., 2011) and function (hypothalamic activation) in response to odorous steroids in MtFs (Berglund, Lindstrom, Dhejne-Helmy, & Savic, 2008) and brain activation in response to erotic material in MtFs (Gizewski et al., 2009).

Brain measures may also show patterns that fall between those of men and women. Untreated androphilic MtFs show white matter microstructure patterns that differ from male *as well as* from female controls (Rametti, Carrillo, Gomez-Gil, Junque, Zubiarre-Elorza et al., 2011). In another study, untreated MtFs had similar volumes of gray matter compared to control men, but their putamen showed greater similarity with the female volume (Luders et al., 2009). Zubiaurre-Elorza et al. (2012) found a larger volume of the right putamen in FtMs compared to female controls, but no difference with male controls. This could be evidence for subcortical gray matter masculinization in FtMs. In MtFs, they showed that cortical thickness did not differ from female controls, but did from male controls, suggesting cortical thickness feminization in MtFs. These latter findings do indicate that different biological mechanisms may play a role in the etiology for FtM and MtF transsexualism.

Apart from etiological differences between MtF and FtM transsexualism, one might also discuss the findings of these neuroimaging studies in light of different typologies. Especially for MtF transsexualism, it is thought that there might be different developmental principles for subtypes with regard to sexual orientation (homosexual versus nonhomosexual) and onset age (early versus late onset of gender dysphoria). Although some of the abovementioned studies give information on onset age and sexual orientation and discuss their findings in light of these characteristics, others do not. The studies by the Spanish group (Rametti, Carrillo, Gomez-Gil, Junque, Segovia et al., 2011; Rametti, Carrillo, Gomez-Gil, Junque, Zubiarre-Elorza et al., 2011; Zubiaurre-Elorza et al., 2012) include only early-onset homosexual transsexuals, whereas the Swedish group (Berglund et al., 2008; Savic & Arver, 2011) only studies nonhomosexual transsexuals. The Spanish studies support the hypothesis for atypical sexual dimorphism of the brain in early-onset homosexual transsexuals. On the other hand, Savic and Arver (2011) found smaller volumes of the putamen and thalamus and greater volumes of gray matter in the temporoparietal junction and the insular and inferofrontal cortex in non-androphilic (nonhomosexual) MtFs compared to controls (men and women). These findings might also indicate a biological mechanism for gender dysphoria, although it certainly is a different mechanism than a sex-atypical dimorphism which is thought to underlie gender-dysphoric feelings. Together, the results of both groups are in line with Blanchard's idea that only the brains of homosexual transsexuals have developed in the direction of their experienced gender (Cantor, 2011).

All aforementioned studies were performed in adults with GD. In studies that did report onset age of the participants, it was retrospectively assessed. Our own group

recently studied brain activation during verbal fluency in a group of adolescent, and thus early onset, individuals with GD (Soleman et al., 2013). We found a sex difference in activation in the right Rolandic operculum, an area adjacent to Broca's area during verbal fluency, and a trendwise linear increase in brain activation from control girls to FtMs to MtFs to control boys. Although these latter findings only approached significance, they again demonstrate brain activation patterns that fall between the sexes (Soleman et al., 2013).

In Chap. 2 of this volume, we have seen that heritability studies indicate that genetic factors probably play a role in gender development. A few studies found polymorphisms in sex steroid-related genes in transsexual groups (Bentz et al., 2008; Hare et al., 2009; Henningsson et al., 2005), but two other studies failed to find evidence for such polymorphisms (Bentz et al., 2007; Ujike et al., 2009). To further elucidate if and how genes influence gender identity, future studies should focus on direct effects of genes on the sex chromosomes on sexual differentiation and gender identity development, investigate epigenetic mechanisms, and apply genome-wide studies starting with the study of the sex chromosomes (see Chap. 2).

3.3.2 Psychological Factors

Psychological factors that play a role in the gender identity development of gender-variant children have always been a focus of investigation and hypothesizing. Zucker et al. (1999) administered the gender constancy interview (Slaby & Frey, 1975) in 206 clinically referred gender-dysphoric children (184 girls, 22 girls) and 95 controls (siblings, clinical referrals, and normal controls). This interview assesses the child's ability to identify the gender of dolls or photographs (gender discrimination), the child's own gender (gender identity), the child's own gender over time (gender stability), and the child's own gender with changes in clothing or behavior (gender consistency). Results showed that, in gender-dysphoric children, there was no qualitative difference in gender constancy development. Gender-referred children thus showed the same sequence when reaching the stages of gender labeling, gender stability, and gender constancy as found in normative samples (Slaby & Frey, 1975). However, the gender-referred children reached three stages of gender development, gender identity, gender stability, and gender consistency, later than controls. Additionally, in a free-play task, gender-referred children who had reported sex-normative gender consistency showed more same-sex play compared to the gender referrals who reported nonnormative gender consistency (Zucker et al., 1999). This finding is consistent with the literature on normative gender development, arguing that the acquisition of the ability to label gender is a prerequisite for developing gender-typed behavior (Ruble et al., 2006). Similar to the studies in normative gender development, the study in gender-referred children had a cross-sectional design and, therefore, does not provide evidence for the direction of the effect between gender constancy development and sex-typed behavior. This might

be different in normative gender development compared to gender-variant development. As Zucker et al. (1999) suggests in discussing his findings, it might be that in gender-dysphoric children, the different patterns of gender self-labeling have a different meaning and are not randomly made. It might be that there is not an underlying cognitive developmental lag, but rather the incongruence between natal and experienced gender. Also, it may be that cross-gender behavior promotes or encourages self-labeling. Indeed, in clinical practice many (not all) parents have early narratives of their gender-dysphoric child expressing strong cross-gender behavior as early as age two or three and insisting to be the other gender at one time. By the time they go to the gender identity clinic, most gender-dysphoric children are perfectly able to label their own gender according to their natal gender, which they strongly dislike while expressing that they want to be the other gender. They may even express anatomic dysphoria ("I do not want to have a penis" or "I do not want to have breasts") (Cohen-Kettenis, 2005).

In terms of gender-variant development, older studies suggested that GD is part of a more pervasive psychological disturbance (Coates & Person, 1985). It has been postulated that an anxious temperament of the child interacting with certain parental factors and a child's predisposition to cross-gender behavior might lead to the development of gender dysphoria (Zucker & Bradley, 1995). There are indeed studies that show high prevalence rates of separation anxiety traits (Zucker, Bradley, & Lowry Sullivan, 1996) and other internalizing problem behavior in referred gender-dysphoric children (Cohen-Kettenis, Owen, Kaijser, Bradley, & Zucker, 2003; Wallien, Swaab, & Cohen-Kettenis, 2007). In these studies, however, a putative temporal direction between anxiety or internalizing problem behavior and gender dysphoria cannot be determined. It might be that clinic-referred gender-dysphoric children will be anxious in later childhood because they are at risk for developing self-esteem problems. A recent study in 147 referred gender-dysphoric children on self-perception showed that, compared to the Dutch norms, they had low scores on various dimensions of self-concept (global self-worth and physical appearance among others) (Rijn, Steensma, Kreukels, & Cohen-Kettenis, 2012). This finding correlates with the aforementioned findings from general population samples indicating that a combination of low gender typicality and high felt pressure to conform to gender stereotypes is predictive of internalizing problems (Yunger, Carver, & Perry, 2004).

In most prepubertal children, gender dysphoria will remit, while in a minority it will persist after puberty (e.g., Drummond et al. 2008; Singh, 2012; Steensma et al., 2013; Wallien & Cohen-Kettenis, 2008) and only be resolved by gender reassignment (e.g., Cohen-Kettenis & van Goozen, 1997; Smith, Van Goozen, Kuiper, & Cohen-Kettenis, 2005). One recent qualitative study compared three factors that emerge between the ages of 10 and 13 that seem crucial in whether gender dysphoria persists or remits. These were changing social environment (the social pressure to conform to gender stereotypes increased), the anticipated or experienced bodily changes of puberty, and first experiences with falling in love and sexual attraction (Steensma, Biemond, Boer, & Cohen-Kettenis, 2011).

3.3.3 Social Factors

In the 1950s, Money and his colleagues, who were the first to conduct follow-up studies among patients with DSD, concluded that gender identity largely followed the gender of rearing and that nurture overruled nature in establishing gender identity (Blizzard, 2002; Meyer-Bahlburg, 1998; Money et al., 1955). Although Money always acknowledged the importance of biological factors (hormones and genes) in gender identity development (Money, Ehrhardt, & Masica, 1968), he assumed that early (preferably not later than 24 months) gender reassignment and accompanying surgery creating sex-compatible external genitalia would enable the child to label himself/herself cognitively as a boy or a girl and develop a male or female self-image (Blizzard, 2002; Money et al., 1955). Later research, however, has provided evidence that biological factors are in many cases of larger importance and children with DSD who were raised according to Money's "optimal gender policy" sometimes developed gender identity problems. Despite this, in a review of gender identity outcomes in various DSD, gender change after a chromosomally opposite gender assignment occurred in only 42 % of cases, with considerable variability across DSD (0–80 % range). In most cases, the best predictor of gender identity outcome in adulthood remained the initial gender assignment. This suggests that gender assignment (which may include early childhood medical intervention such as gonadectomy), together with concomitant social and psychological factors, has influence on gender identity outcome (De Vries et al., 2007). Because many factors, including cultural and historical-sociological ones, are involved in gender assignment at birth in individuals with DSD, assumed contributions of environmental factors versus early medical interventions when DSD individuals persist with a chromosomally opposite gender assignment can only be interpreted cautiously.

In the older literature on the development of gender dysphoria in non-DSD children, social factors such as a maternal wish for a daughter, paternal absence, parental reinforcement patterns, or a symbiotic relationship between mother and son were considered of significant importance (e.g., Green, 1974; Stoller, 1968). More recent theories suggesting that parental psychopathology might partly influence gender-variant development have received only minimal empirical evidence. In these theories, parents' emotional unavailability might hamper healthy limit setting and cross-genderedness might be encouraged (Zucker & Bradley, 1995). However, a study investigating the presence of psychological problems in parents of gender-dysphoric children revealed only mild depressive symptoms in the mothers, but no other indications of serious parental psychopathology (Wallien, 2008).

3.4 An Integrative Biopsychosocial Perspective on Gender-Variant Behavior

In their review on transsexualism, published more than a decade ago, Cohen-Kettenis and Gooren (1999) wrote: *"Adult gender identity and gender role behavior develop gradually over a long period of time and are influenced by multiple, interacting factors, active at different developmental periods… Our understanding of this process has increased considerably, but a large part of it still remains enigmatic."* How far have we come since then? From the previous sections in this chapter as well as from Chaps. 1 and 2, we can conclude that there is evidence that biological, psychological, and social factors are all influential in determining not only how one's gender identity is resolved but also the degree of gender-typical or gender-atypical behavior that is displayed.

The role of nature versus nurture has always been debated in studies of psychological characteristics in humans, and this is to an even larger extent true for their respective roles in gender (identity) development and gender dysphoria. At present time, the generally accepted view is that a complex interplay between genetic (nature) and environmental (nurture; social and biological) factors leads to individual behavioral differences (e.g., Lenroot & Giedd, 2011). The various family (mostly twin) studies that are presented in Chap. 2 show a considerable heritability of gender-related traits within sexes (heritability estimates for gender dysphoria varied from 0.22 to 0.77, although in population studies, it is probably not gender dysphoria that is measured, but gender variance). These studies demonstrate the fact that with regard to gender dysphoria, the same complex interaction between nature and nurture exists.

3.4.1 Interacting Biological, Psychological, and Social Factors

The studies described above have begun to identify how some characteristics of development such as brain functioning and cognitive representations differ for gender-variant individuals, as well as possible links to these factors. What is not known is how these factors work together to influence gender identity development. For instance, how might the experience of being reared in a more or less stereotypical household interact with levels of prenatal androgen exposure to influence variability in identity as well as gender role beliefs?

One such study using sex hormone binding globulin levels measured during the first trimester of pregnancy as a measure for prenatal testosterone exposure found an association between these levels, parental encouragement of feminine behavior in

childhood and gendered behavior in adult women. Adult women with the highest prenatal testosterone exposure were least susceptible to their mothers' encouraged femininity in childhood (and displayed the least feminine behavior), whereas women of mothers with the lowest testosterone levels were most feminine and only then did parental encouragement affect feminine behavior (Udry, 2000).

In more traditional cultures that still value the male over the female role, transitions to the male role in individuals with 5α-RD-2 deficiency after the rise of testosterone levels in puberty and its virilizing effects are more common (Hughes et al., 2006). This implies that both biological factors and cultural ones are important.

An interaction between psychological and social aspects of gender identity has long been found in population-based studies of gender conformity; gender nonconformity is more distressing for children who experience high pressure to conform to gender norms (Carver et al., 2003). A current study has expanded this concept to examine the role of contentedness with assigned gender, gender-atypical friendship styles, and adjustment (Menon, 2011). For girls in particular, gender contentedness was associated with better adjustment, even in the context of gender-atypical peer relationship styles which were associated with less adjustment. For boys, the role of contentedness was less clear (Menon, 2011). Studies such as these reveal the importance of combining multiple indicators of well-being and examining the role of gender identity in multifaceted ways. Children who feel more comfortable with their gender identity may have better resilience to cope with their own gender-atypical behaviors.

3.4.2 Gender-Normative Versus Gender-Variant Development

Prior research efforts have been largely divergent in studying either gender-typical-normative or gender-variant nonconforming development. The merging of these two lines of inquiry may help to reveal processes and interactions among developmental forces that influence gender identity development across the entire range. The final section of this chapter is focused on what we have come to learn about the various interacting developmental influences, considering the ways in which each line of study (i.e., gender-normative versus gender-variant development) can inform the other and identifying future areas of research.

Most studies on normative gender (identity) development to date have focused on "universal" and "average" developmental trends and average times when "gendered" milestones occur as well as average differences between groups, instead of delineating the range of experiences within a population. This approach has gone as far as to suggest that children who do not develop a particular concept have "failed" a developmental task. For instance, part of the theory on gender identity development is that all children will develop a belief that gender cannot be changed (gender constancy) (Kohlberg, 1966). A child who holds an alternative perspective would be considered incorrect or delayed in development, although it is recognized that the empirical support for this concept has been weak (Ruble et al., 2006).

Research evidence, clinical experience, and research with children, adolescents, and adults with GD have shown that variability exists around the ways in which people define and label their own gender identity and experience gender as permanent or changeable over time. There may be children who believe they are a gender other than the one typically assigned based on genital appearance. There may also be children who believe they will grow up to be a gender different than the one they currently are. Children who report that gender can change over time might not understand that changing gender is a lengthy and uncommon process (i.e., they might not yet have the cognitive skills to understand this), or they may represent one small part of the population that experiences gender as something changeable.

According to cognitive theories of gender, these gender-dysphoric children would be classified as having a "developmental lag" in achieving the phase of "gender constancy" (Zucker et al., 1999). However, it can also be that these children refer to the possibility of gender reassignment, a possibility that some children are aware of at a very young age (Cohen-Kettenis & Pfäfflin, 2003). At this point in time, we do not know the underlying motivation that drives a gender-dysphoric child to this belief of being the other gender (Zucker et al., 1999), but initial research has discovered that children with this belief are far more likely to request gender reassignment as adolescents. That is, although gender dysphoria will remit in most prepubertal children, Steensma et al. (2013) found in their prospective follow-up study that, among children who were interviewed with the Gender Identity Interview for children (Wallien et al., 2009; Zucker et al., 1993) and asked with what sex they identified as "I am a boy" or "I am a girl," the children who expressed a cross-gender identification had a greater chance of persisting gender dysphoria.

Furthermore, in the gender constancy theory, the labeling of gender is often linked to genitals (e.g., girls have a vagina), which does not allow for cognitive flexibility or account for variability based on the presence, absence, or characteristics of the genitals. Psychosexual outcome studies of individuals with DSD have helped to shift concepts of gender identity away from purely genital definitions, but the general notion remains that gender identity is unalterable. When someone is born with ambiguous genitals, as may be the case in individuals with DSD, a variety of other characteristics are used to interpret the development of a gender identity. According to Money's (1955) optimal sex policy and Kohlberg's (1966) gender constancy theory, children who are taught that someone is a man if he has a penis and understand that this concept is considered fundamental to cognitive development will not have the opportunity to develop a more flexible view of what defines gender. For example, children performing a classical gender constancy task are not asked to consider other indicators of maleness or femaleness, such as clothing, mannerisms, and self-reported identity. More modern theories of gender identity development incorporate aspects such as contentedness with gender and understanding of pressure to conform to stereotypes (Egan & Perry, 2001) but still generally expect that children understand that the gender assigned at birth will not change.

Contrary to this developmental expectation, we know that gender does change over time for some people, i.e., individuals who undergo sex reassignment or who begin to identify with a gender other than the one into which they were born. Such

individuals might require support and medical interventions to develop a body that is consistent with their internal gender identity, or they might experience an internal gender identity that develops and changes over time in a more fluid manner but experience a gender that changes over time. Only when developmental theories account for alternative pathways of development will it be possible to fully understand the biological, psychological, and social factors that contribute to the development of gender identity and how it may change or not over time for different people.

Only recently, research on gender nonconformity and gender dysphoria has begun to examine the extent to which individuals may transition completely from one gender to another or may instead identify as a third gender or gender queer (Bockting & Ehrbar, 2005). Some gender-dysphoric children and adolescents describe discomfort with a binary system of gender that expects people to fall within socially prescribed norms for male or female. This group may not necessarily struggle with a sense of being in the wrong body, but rather struggle with an inability to conform to rigid binary gender expectations (Bockting & Ehrbar, 2005; Kessler & McKenna, 2000; Lombardi, 2009). What is not known about third gender identity is the extent to which it may be influenced by the accessibility and affordability of gender reassignment treatment, the social support for or against gender reassignment, or the societal willingness to accept individuals with an ambiguous gender. To be certain, the concept of third gender identity is represented in queer theories (Kessler & McKenna, 2000) and community-based studies in North America (Bockting & Ehrbar, 2005; Lombardi, 2009; McGuire & Conover-Williams, 2010; Menvielle & Rodnan, 2011) and appears less frequently in the research based on clinical studies. A major unknown factor for understanding third gender identities includes the role of societal acceptance (or not) of nonrigid gender binaries. In a society that expects rigid gender binaries, will individuals be more likely to make complete transitions than those in a society more willing to allow individuals to inhabit a space between male and female? The biological, psychological, and social factors associated with third gender identities represent an area of future research that, if fully explored, should assist us in better understanding the full spectrum of gender identity development.

3.5 Future Directions

Behavioral genetic studies of gender identity have provided us with some information on the relative contribution of genetics to gender identity development. As with most features of development, gender identity is complex and genetic contributions likely exist across multiple genes. As described in Chap. 2, some association studies have been performed that investigated candidate genes for transsexualism. Given the importance that androgens and estrogens play in the sex differentiation of the brain (see above, this chapter), genes that are involved in either sex steroid biosynthesis or action are the focus of investigation. In the small number of studies performed, only two polymorphisms appeared to show an association with transsexualism: in CYP17

in FtM transsexualism (Bentz et al., 2008) and in AR in MtF transsexuals (Hare et al. 2009; Henningsson et al. 2005). Klink and Den Heijer conclude that "… *no strong candidate gene has emerged for the development of gender dysphoria. Because of the complexity of gender identity development it does not seem likely that one single gene will be discovered. Gender identity is such a robust and prominent trait that polymorphisms of genes alone are unlikely to account for the development of gender dysphoria"* (Chap. 2).

Clearly, future studies will focus on genes that are involved in gender identity development. How will these studies help us in understanding determinants of gender identity development? Are psychological and social factors still of relevance, or are biological determinants so important that we do not have to consider psychological and social factors any longer?

Studies of gene × environment interactions have not extended into the gender identity realm yet, but the groundbreaking study of the role of the serotonin transporter gene (5-HTT) suggests that, for some individuals, a genetic predisposition (the short allele variation of the 5-HTT gene) must be coupled with an aversive environmental exposure (child maltreatment) in order to elicit certain characteristics (depression) (Caspi et al., 2003). A decade after the publication of this study, gene environment research has been a hot topic, as indicated by the large number of publications in high-impact journals. However, their original promise has been tempered and criticized, as finding specific gene environment interactions and replicating them turns out to be extremely complex due to the large number of factors that are involved (Duncan & Keller, 2011). Apart from genes and environment, behavioral outcome is also determined by the timing of the interaction, resulting in an age x gene x environment interaction (Lenroot & Giedd, 2011). With regard to gender identity development, it has been suggested, for example, that gender identity is malleable at a certain young age but becomes "fixed" and unalterable after adolescence (Zucker, 2004).

We have come to recognize that no one etiological factor can account for transsexualism. As described before, neuroimaging studies in gender-variant people may also help us in elucidating the mechanisms behind gender identity development. A specific group of interest may be that of people with Alternating Gender Incongruity, a subcategory of *bigenders* who experience alternating gender states (Case & Ramachandran, 2012). Gender-dysphoric feelings may be a result of the difference between the brain's gender and the "sex" of the body. Neuroimaging studies have shown evidence for sex-atypical differentiation of the brain in at least certain subgroups (early-onset "homosexual") of people with GD. A different mechanism may be behind gender dysphoria in transsexuals attracted to the gender other than their natal one. A magnetic resonance study showed differences in the brain between these MtF transsexuals and male and female controls (Savic & Arver, 2011). Future neuroimaging studies should further focus on the mechanisms that underlie these differences in various subgroups of transsexuals.

In order to disentangle the contribution of the different factors involved in gender identity development, we thus have to take into consideration that the gender dysphoria phenomenon by itself is not a homogeneous condition but consists of

different subtypes. For example, as pointed out before, age of onset and sexual orientation might differentiate subtypes, but comorbid conditions, such as autism spectrum disorders, might also reflect that different causal developmental pathways can lead to the final outcome of gender dysphoria (e.g., De Vries, Noens, Cohen-Kettenis, van Berckelaer-Onnes, & Doreleijers, 2010). In addition, it is important to elucidate what the resemblances and differences are of individuals exhibiting gender nonconforming behavior and those with an explicit desire for gender reassignment treatment. Are these distinct groups or are they both part of a more or less continuous gender dysphoria phenomenon?

Future studies of gender identity development should not only seek to understand the potential genetic and environmental (both from nature and nurture) factors in the development of gender identity but also when these factors emerge in life and how those factors may have differential influence at different points along the spectrum of gender dysphoria.

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