Does Biology Limit Equality?

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Shannon N. Davis and Alysia Blake

Abstract

This chapter provides a brief overview of theory and research that has investigated the relationship between physiology and gender difference with an eye toward understanding the role that biology may play in facilitating or inhibiting social equality. We present one extended example that simultaneously examined biological and social theories as structuring individual-level variation in women's personality traits to document the complicated interplay of the biological and the social across the life course. We extend our analysis to discuss implications for the study of race and acknowledge the benefical contributions that intersex and transgender individuals' experiences bring to bear on the study of the relationship between physiology and gender difference. We conlude by noting that though the road to equality is hard and paved with setbacks, it is not bound by biology.

S. N. Davis (✉)
George Mason University, Fairfax, USA
e-mail: sdaviso@gmu.edu

A. Blake
U.S. Census Bureau, Prince George's, USA
e-mail: alysia.d.blake@census.gov

For almost 100 years, research has attempted to document not only how and why biological women and men differ physiologically but how those physiological differences are correlated with social differences (see summary in Fine (2010)). The argument goes like this: women and men (girls and boys) are physically different, which leads them to be able to do different tasks with more or less ease and be interested in different things. Therefore any social differences between women and men are a function of their physiological differences, including body type, mass, and shape, and brain structure. This "just so" story roots gender inequality in biology, and if believed, suggests that biology limits our ability to create gender equality in the social realm.

This chapter provides a brief overview of theory and research that has investigated the relationship between physiology and gender difference. We then present one extended example that simultaneously examined biological and social theories as structuring individual-level variation in personalities (at least among women) to document the complicated interplay of the biological and the social across the life course. After an important caveat highlighting the crucial role that transgender individuals play in constructing our understanding of the connection between biology and social difference, we conclude with remarks about the implications of theory and research that connect physiology and

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biology to social outcomes by extending our analysis to the study of race.

One important note to keep in mind while reading this chapter is that we are discussing literature and theoretical arguments that are based on understandings of sex category as a binary where individuals present themselves socially in a manner that is consistent with their sex category. We acknowledge the limitation of this approach given the burgeoning literature on transgender and intersex individuals and experiences. However, in our efforts to provide understanding of the history and logic of the "just so" story connecting biology and gender inequality, we begin with the notion that sex category is comprised of female and male with individuals presenting as female and male in their interactions. We discuss the insights gained in the scholarship documenting transgender experience in the United States later in the chapter as an important caveat to our overall summary of findings.

1 Overview

We frame the study of the intercorrelations between physiology (as a biological phenomenon) and gender difference (as a social phenomenon) through the lens of gender as a social structure (Risman, 1998, 2004). This framework situates gender at the individual, interactional, and institutional levels as something that is constantly shifting and under construction (Connell, 1987; Lorber, 1994; Martin, 2004; Risman, 1998). Rather than a way of classifying individuals (e.g., people having a gender), gender has consequences for the self through the construction of identities, expectations held by others that are accompanied with rewards and sanctions, and macro-level organizational and ideological components.

This multi-level conceptualization of gender is useful for empirical modeling because it allows for consideration of causal relationships within and across levels of analysis. That is to say, the construction of a gendered self, or how one identifies oneself along the multiple continua femininity and masculinity through the interpretation of one's own body, is also shaped by the internalized expectations of others for them as someone housed in a particular body and how that body is regulated directly and indirectly in the contemporary social and legal landscape. Our review of relevant theoretical frameworks and empirical research connecting physiology and gender difference is comprised of work that has focused largely on the individual-level, with some scholarship examining the ways that social expectations shape how people behave and how they come to understand themselves in relation to others.

2 Current State of Understanding

Berenbaum, Blakemore, and Beltz (2011) provide a succinct history of research on the role biology plays in constructing gender difference. They also provide an excellent summary of the current state of knowledge around the role that biology does and does not play in constructing gender difference. Our summary draws heavily upon theirs; we strongly recommend that individuals interested in learning more about this topic review their excellent article.

Gender differences have long been studied by philosophers, scientists, and social scientists alike (Galton, 1883; Quetelet, 1830/1969; Hall, 1905). Hall (1905), like his contemporaries, concluded that women were inferior and this inferiority was attributed to their biology. As psychological research matured, the role that biology played in creating gender differences in behavior began to be the topic of examination. The earliest examination was conducted using laboratory animals. Phoenix, Goy, Gerall, and Young (1959) found that female guinea pigs exposed to prenatal androgens were masculinized in their mating behavior. Much research has extended the paradigm proffered by Phoenix et al. (1959), focusing on androgen exposure and human behavior.

Contemporary research has moved beyond this limited focus. Contemporary work has improved methodologically, incorporated

alternative explanations, as well as situated biology within a social context.

2.1 Evolution

The focus of evolutionary psychology is that behavior results from historical adaptive pressures (Berenbaum et al., 2011). Behavior, as influenced by the brain, is believed to have developed to solve problems over time, thus enabling survival. So, gender differences in adaptive pressures are believed to underpin present-day differences in behavior. Trivers' (1972) theory of sexual selection is the basis for most approaches in evolutionary psychology. In Trivers' (1972) paternal investment theory, differences in paternal investment influences sexual behaviors. Sexual selection is then used to explain gendered behaviors.

Other scholars have since taken a broader evolutionary approach to gendered behavior, as sexual selection is more complex than as implicated by Trivers (1972). Many studies have not been able to support his predictions (Gowaty, 2003; Hrdy, 1997; Parish & De Waal, 2000).

2.2 Genetics

Genes on sex chromosomes have also been examined as a source influencing gendered behavior (Berenbaum et al., 2011). Early on, there was interest in the effect of spatial ability of genes on the X-chromosome (Wittig, 1976). However, there were subsequent failures in attempts to replicate that finding. Therefore, the attribution of gender differences in spatial ability to X-chromosomes lost traction. However, work with those who have sex-chromosome abnormalities has provided new support for that genes on the X-chromosome may affect aspects of cognition, which includes spatial ability (Ross, Roeltgen, & Zinn, 2006). There has also been a renewed interest in the sex chromosome genes and behavior, but the focus has shifted to the Y-chromosome rather than the X-chromosome (Arnold, 2009; Arnold & Chen, 2009).

2.3 Hormones and Animal Models

Sex hormones have been at the heart of most of the research on biological mechanisms underlying gendered behavior. Most of this work has built on research by Phoenix and Goy (Gibber & Goy, 1985; Phoenix et al., 1959, 1973), which utilized rodents and primates. Research with nonhuman animals has demonstrated that hormones affect behavior in two ways (Becker et al., 2008; Goy & McEwen, 1980): (1) sex hormones make permanent changes to the brain and subsequently impacts the behaviors associated the brain structures (organizational effects), and (2) sex hormones temporarily alter the brain and behavior as they circulate through the body during adulthood and adolescence (activational effects). The primary difference between the two are permanence and timing (Arnold & Breedlove, 1985).

2.4 Prenatal Sex Hormones in Humans

Jordan-Young (2010), especially chapter two, provides a detailed discussion of the application of brain organization theory to humans; we strongly recommend her work for individuals interested in learning more about this topic. One important historical development in this area has focused on individuals with hormone related disorders. Individuals with congenital adrenal hyperplasia (CAH) have provided a natural experiment for examining the influence of hormones on gendered behavior (Berenbaum et al., 2011). First studied by Money and his colleagues (see Money & Ehrhardt, 1972), CAH is a genetic disease that results in exposure to large amounts of androgens. So, females with CAH should behave more male-typed than those without CAH if gendered behaviors are influenced by the presence of androgens during important developmental periods. Prenatal androgen exposure is associated with a preference for male-typed activity in females (Meyer-Bahlburg, Dolezal, Baker, Ehrhardt, & New, 2006; Nordenström, Servin, Bohlin, Larsson, & Wedell, 2002;

Pasterski et al., 2005). Females with CAH also have other male-typed behaviors and characteristics, such as: higher spatial abilities, more aggressive behavior, and less interest in babies.

2.5 Adolescent Hormones in Humans

There have been three approaches to biological based work in adolescence. The first of these approaches has centered around the effect of increased sex hormone levels on characteristics that become more gender-typed in adolescence, such as cognition (Galambos, Berenbaum, & McHale, 2009). The second approach looks at the how the timing of pubertal development, such as the onset of puberty (Susman & Dorn, 2009), impact behavior. The third approach, which is recent in its development, is based on rodent studies that demonstrate how sex hormones at puberty permanently change the brain. However, the association between hormones to adolescent behavior is less established as that linking prenatal exposure and gender typing (Berenbaum et al., 2011).

2.6 Circulating Hormones in Humans

There is an established body of literature investigating the link between circulating hormones and gendered characteristics, such as cognition and aggression (see Buchanan, Eccles, & Becker, 1992; Hampson, 2007; Maki & Sundermann, 2009; Puts et al., 2010). Most of these studies have been done on adults and adolescents, using observational studies to examine the bidirectional effects of hormones and behavior. The findings have been complex, as hormones do not have simple causal effects. The studies that are most beneficial are those that examine the indirect impact of hormones and situate the results within a social context (Berenbaum et al., 2011).

2.7 The Brain

The early study of gender differences in the brain primarily focused on cerebral hemispheric specialization (lateralization) (Berenbaum et al., 2011). While it still is a topic of study, the differences are small and it is not known how they impact the differentiation of gendered behavior (see Blakemore et al., 2009). However, technological innovations, such as magnetic resonance imaging (MRI) and fMRI, that allow for brain imaging has increased research on brain gender differences in the size of specific brain regions and the activity of those regions while doing a particular emotional or cognitive task (see Goldstein et al., 2001; Hamann & Canli, 2004; Lenroot et al., 2007; Resnick, 2006). For example, gender differences have been found in brain activation relating to spatial ability (Grön, Wunderlich, Spitzer, Tomczak, & Riepe, 2000), as well as in brain responses to sexual stimuli (Hamann, Herman, Nolan, & Wallen, 2004). However, because the brain is dynamic and changes in response to its environment, it is hard to know the which came first, gender differences in the brain or gender differences in behavior (Berenbaum et al., 2011).

2.8 Gene-Environment (GE) Interaction

There is evidence to support that the interplay between genes and the environment can impact non-gendered components of behavior (Rutter, Moffitt, & Caspi, 2006). Behaviors may be impacted by genes in the same way the presentation of genes may depend on an individual's environment. While the behavioral work surrounding GE interactions are nestled in psychopathology, gender differences can be seen (Berenbaum et al., 2011). The integration of genes and the environment can potentially lend insight into gendered psychological processes. The environment can impact the genome without changing DNA (Berenbaum et al., 2011). Instead, it can alter the way the genes are expressed. This process is called epigenetics. In this process, genes can be turned on or turn off by the environment, which impedes or allows making of a protein. Most of this research has been with rodents. However, Champagne (2008)

provides an example of epigenetics via the transgenerational effects of maternal care in her research with rodents.

The field of epigenetics has opened up substantial lines of inquiry, especially with the deeper understanding of how genes are activated or deactivated in certain social and physical environments, leading to genetic changes in biological inheritance across one or two generations (see Wade (2013) for a detailed description of this burgeoning area of scholarship among humans). Thus the impact of social circumstances on biological predispositions resulting from activated genes is a key new area of research, especially among scholars interested in the connection between biology and gendered behavior.

2.9 Effects of Both Physiology and the Social Environment

Both physiology and the social environment impact gendered characteristics. In sex hormones, this can be seen in hormone-environment interaction and hormone-environment correlation (Berenbaum et al., 2011). The former refers to a statistical interaction between the environment and hormones. An example is the masculinization of behavior in females by the presence of male siblings and the demasculinization of behavior of males by the presence of female siblings. This was also found in nonhuman animals. For example, males rats reared in a primarily female litter were found to demasculinize sexual behavior even though it is influenced by testosterone (de Medeiros, Rees, Llinas, Fleming, & Crews, 2010).

Meanwhile, hormone-environment correlation refers a correlation between the individual's social environment and their hormones, with hormones influencing selection of responses from the environment (Berenbaum et al., 2011). An example of this is those with early exposure to sex-atypical hormones being less attracted to animals of the opposite sex. Consequently, they exhibit less sexual behavior (Clark & Galef, 1998; Pomerantz, Roy, Thornton, & Goy, 1985). This early exposure also seems to influence the social interactions of humans.

Physiology related to self-regulation also appears to have gendered differences. Research has shown that girls have more emotional self-regulation and better effortful control than boys (Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Matthews, Ponitz, & Morrison, 2009). Children's social interactions, particularly with their peers, further amplifies these differences (Fabes, Shepard, Guthrie, & Martin, 1997; Fabes, Martin, Hanish, Anders, & MaddenDerdich, 2003).

2.10 Summary

Previous research has examined the connection between biology and social difference through many possible pathways. Theoretical perspectives largely are derived from an evolutionary framework, highlighting the notion that gender differences are responses to evolutionary needs, fueling the "just so" story of gender difference today. However, from the expression of genes and how they interact with the environment to construction of the brain and how it is formed in utero, researchers have found inconclusive evidence for how individuals' behavior (largely women's behavior) is shaped by biological mechanisms. Other research on humans has documented the complicated nature of the relationship between hormones and behavior. In sum, then, previous research focusing on the construction of gender at the individual level has incorporated biological mechanisms with mixed results.

3 Extended Case Study

Research documenting the connection between biological variation and gender at the individual level has focused at times on comparing across sex category, that is comparing women and men (or girls and boys). However, research has also documented that comparing variation in

outcomes within sex category (that is, looking at how biological variation is correlated with differences in women's experiences) also provides a key insight into the extent to which biology can and has shaped social outcomes. Here is the logic. There are average differences in biological components, such as hormone levels, that are tied to sex category. Individuals who are male have higher levels of testosterone and sex hormone binding globulin (SHBG) than do individuals who are female, and individuals who are female have higher levels of estrogen and progesterone than do individuals who are male. Almost all individuals have all of those hormones; the average amount in the circulating bloodstream varies across sex category (as noted above, studies on unique individuals missing hormones has been the basis of many studies on biological connections to social gender differences—see Money & Ehrhardt, 1972). When comparing within sex category on characteristics that may vary, such as levels of circulating hormones, researchers can more clearly make claims about how potential biological mechanisms shape social outcomes. Comparing women to women on social outcomes at least controls for the fact that others likely perceive them as women and treat them accordingly in social interaction (West & Zimmerman, 1987).

As summarized above, brain organization theory argues that hormones wash over the fetal brain during the second trimester of pregnancy, organizing it in particular ways that manifest themselves as gendered predispositions and/or behaviors later in life (Phoenix et al., 1959). One sociological study building on brain organization theory (Udry, 2000) drew heavy criticism from other sociologists (Kennelly, Merz, & Lorber, 2001; Miller & Costello, 2001; Risman, 2001), in part because of the author's direct claims about biology potentially limiting women's desires for gender equality.

The first author and a colleague (Davis & Risman, 2015) decided to approach the implication that biology can limit women's potential for equality by reanalyzing the data originally used to make such a claim (Udry, 2000). We asked whether and how biology (measured by prenatal maternal circulating testosterone and SHBG and adult testosterone and SGBG), parental socialization, and adult situational expectations shaped adult women's reported personality traits. Specifically we examined whether adult personality traits were responsive to social outcomes that are typically used as measures of (or related to) gender equality, such as occupational status, motherhood status, division of household labor, and attitudes toward gender equality. Our findings were complicated, and supported the idea that social outcomes and experiences are constructed through complicated interconnections of biology, socialization, and responses to current circumstances across the life course (Davis & Risman, 2015). Childhood socialization was unequivocally the most important predictor of adult women's reported personality traits. Prenatal maternal circulating hormones shaped adult women's reported personality traits, but shaped their reported masculine personality traits more than their reported feminine personality traits. And our expectations of a situationally flexible self that was responsive to adult expectations was supported for reported feminine personality traits but not reported masculine personality traits.

We determined through our research that biology does not directly limit gender equality. But we did find that prenatal maternal circulating hormones did contribute in a small way to the extent to which women in the contemporary United States later identified themselves as more or less masculine or feminine. We hypothesize that there are potentially a few mechanisms at work here, connected to biology, but residing largely in the social sphere. First, maternal circulating hormones are measures of mother's biology. It is likely that mothers with higher levels of testosterone would be more likely to socialize their daughters in ways that are more consistent with identifying oneself as more masculine, as argued by Cohen-Bendahan, van de Beek, and Berenbaum (2005). Certainly we found that maternal socialization and behaviors in childhood were of significantly more importance in constructing personality traits than were prenatal maternal circulating hormones and women's own circulating hormones. Second, if

there are potential biological mechanisms that predispose women to have certain personality traits, their behavior is reinforced and reaffirmed through socialization in childhood and beyond. Interactions with others in childhood and adulthood were significantly more influential in overall influence on adult personality traits than were the combined influences of biology. If biology could limit equality, then, our research suggests it is due to the social responses to biology rather than biology as a primary factor.

These findings, focused on hormones as the biological mechanism through which gender differences occur, are not inconsistent with those studies in epigenetics that have found how genetic imprinting through activation/deactivation in response to the social environment can occur over a span of one-to-two generations (Pembrey et al., 2006; Wade, 2013). Modifications to the maternal genome that respond to changing social environments for more women (e.g., more social circumstances marked by competition and self-reliance) could potentially have been transferred to the participants in this study. This theorized alternative explanation of the interaction between genes and the social environment reinforces the primacy of social circumstances in shaping social outcomes, as social circumstances may facilitate or inhibit the expression of genetic predispositions.

4 Important Caveat

Studies that follow the experiences of transgender individuals as they transition across sex categories complicate our understanding of how biological differences as tied to sex category are connected to differences in social outcomes (Connell, 2010; Westbrook & Schilt, 2014). So to does the burgeoning scholarship on intersex individuals (e.g., Davis & Murphy, 2013; Davis, 2015) challenge scholars' understandings of how biology and social outcomes could and have been connected. Our goal in this chapter has been to highlight the direction of scholarship in the past; the future of scholarship in this area has opportunities for greater interrogation of the interrelationships among sex category, gender, and biology.

5 Conclusions and Implications

Scholarship documenting gender difference has historically been used as evidence for how and why gender inequality is maintained (Jordan-Young & Rumiati, 2012). The notion of being hardwired for difference makes for an easy explanation for how and why inequality based on perceived sex categories evolved and continue to exist. Yet, scholarship has documented how hard we as humans work to maintain the connection between the biological and the social. We as humans continue to look for biological differences to explain social inequalities because biological explanations for social inequalities are easier to accept than is our own culpability in constructing those inequalities. This is one explanation for why the just-so stories of brains hardwired for difference (Jordan-Young & Rumiati, 2012) resonate with the public. And this is one reason why working toward greater gender equality is an uphill battle as it is difficult to create greater opportunities at the institutional level when interactions are fraught with beliefs about immutability at the individual level.

However, research has shown how to undermine beliefs about inherent difference: put people who are different from one another together (with equal footing) and ask them to work together. There is voluminous evidence that diversity in work groups undermines beliefs about gender, racial, ethnic, religious, and other "inherent" differences that lead to hierarchical relationships (see review in Ridgeway and Correll (2004)). There is also much to be learned from scholars of race and ethnicity who continue to battle the insidious perceived connection between biology and inequality regarding race and racial differences (e.g., Benjamin, 2015; Morning, 2014).

As our world is complex, so too are the explanations for how to understand the world. Biology matters, if for no other reason that human beings are embodied (Lorber, 1994; Connell, 1987). We respond in interactions to the bodies of the others,

holding them accountable to the categories we perceive they inhabit, be it sex, race, age, or some other biologically related or socially constructed category. Therefore one key way to work toward decoupling the just-so story of biology leads to inequality is to provide evidence through interaction that changes understandings of what it means to inhabit a certain category (see West and Zimmerman (1987) and West and Fenstermaker (1995) for more information). This is hard in a complicated world where fear and distrust of perceived difference permeates the cultural landscape. However, the road to equality is hard and paved with setbacks but as we have documented here, is not bound by biology.

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Shannon N. Davis is Associate Professor of Sociology at George Mason University. Her research focuses on the reproduction of gender inequality in institutions, in particular within families and higher education as well as the construction and maintenance of beliefs about gender (gender ideologies). In addition to numerous publications in scholarly journals such as *Journal of Family Issues*, *Marriage & Family Review*, and *Community, Work, & Family*, she is co-editor (with Sarah Winslow and David J. Maume) of *Gender in the Twenty-First Century, The Stalled Revolution and the Road to Equality* (University of California Press) and co-author (with Theodore N. Greenstein) of *Methods of Family Research* (3rd edition, Sage).

Alysia Blake is a Survey Statistician at the U.S. Census Bureau. She is also a doctoral student of Sociology at George Mason University. Her doctoral research focuses on mental illness and stigma, as well as the intersection of race, gender, and disability.