COMMENTS AND REPLIES*

Comment on Udry, ASR, June, 2000

THE LIMITS OF BIOLOGICAL DETERMINISM

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Udry (2000, henceforward Udry), claims to have established that sex dimorphic behavior is produced by prenatal exposure to varying levels of testosterone. He concludes that if societies "depart too far from the underlying sex-dimorphism of biological predispositions, they will generate social malaise and social pressures to drift back toward closer alignment with biology" (p. 454). Udry's work is part of a long scientific tradition—that of biological determinism, which seeks to anchor patterns of gendered behavior to immutable biological roots. These roots have changed over time, but the conclusion—"that shared behavioral norms, and the social and economic differences between [women and men] arise from inherited, inborn distinctions" (Gould 1981: 20)—remains unchanged.

A brief overview of the determinist tradition in Western science is instructive. In the late seventeenth century, anatomists who compared male and female skeletons advanced the idea that sex differences involved "every muscle, vein and organ attached to and molded by the skeleton" (Schiebinger 1992:114). In the nineteenth century, craniometrics (the science of skull size) was in vogue. Durkheim ([1893] 1964), an adherent of craniometrics, claimed that functional differentiation between men and women was revealed in differentiation in skull capacity—and hence intelligence: "[W]ith the advance of civilization the brain of the two sexes has increasingly developed differently. . . . [T]his progressive gap between the two may be due both to the considerable development of the male skull and to a cessation and even a regression in the growth of the female skull" (p. 21). Even before hormones were discovered in the 1920s, scientists had replaced craniometry with the proposal that sex differences arose from physiologically active substances. Weininger (1903) claimed that both the agitation of feminists and the talents of remarkable women were based on unusually high levels of masculine "plasm" (p. 2). Similarly, Heape (1913) theorized that men and women had different "physiological organizations" that destined women for childrearing, emotionality, and domesticity, and men for competition, politics, and commerce (p. 38).

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NEUROENDOCRINOLOGICAL DETERMINISM

Udry's presentation of neuroendocrinology is evocative of these earlier framings of the

A brief chronology will help situate the following comments and replies. The paper by J. Richard Udry that is the focus of the following exchange was originally submitted to ASR *in August 1998. In June 1999, after three revisions, the paper was accepted for publication by then* ASR *Editor Glenn Firebaugh, and it passed into the queue of manuscripts left to be published during our own editorial term (which began in July 1999). The Udry article appeared in June 2000, and reaction to it was swift. The three comments that appear here were all submitted for review in the Fall of 2000. Following their final acceptance in May 2001, Professor Udry was invited to reply. Because his reply and one of the comments both deal with the original decision to publish the article, we also invited Professor Firebaugh to reply. —EDS.*

subject. While Udry focuses solely on the effects of testosterone rather than estrogen, his assertions are similar to those in the following naive text, written in endocrinology's youth:

> A woman who has delicate skin, lovely complexion, well-formed breasts, and menstruates freely will be found to have a typical feminine outlook on life, aspirations, and reactions to stimuli which, in spite of the protests of our feminists, do constitute the biological feminine mind. Large, vascular, balanced ovaries are the wellsprings of her life and personality. On the other hand, the woman who menstruates poorly or not at all is coarse-featured, flat-chested, heavily built, angular in her outlines, will also be often aggressive, dominating, even enterprising and pioneering, in short, masculinoid. She is what she is because she possesses small, shriveled, poorly functioning ovaries. (Berman 1928:208)

While scientists of various schools of determinism have shared the assumption that gendered differences in behavior result from immutable biological forces, the behaviors they have deemed unfeminine and hence pathological have varied widely, including the use of wet-nurses, masturbation, advocating women's suffrage, wearing pants, and in Udry's scheme, making too high an income (e.g., Fausto-Sterling 2000; Schiebinger 1992). Yet each of these determinist camps has claimed that its version of femininity is natural and universal, and each "refuse[s] to take seriously the historical and geographical differences between women" (Grosz 1990:335). Udry's measures of femininity suffer from similar spurious universality, as evident, for example, in his selection of the wearing of cosmetics as one of his multiple criteria for "natural" femininity. In fact, the use of makeup provides an excellent example of the extent of cultural influence on gendered practice, because there has been a total reversal in cosmetic practices for the population in Udry's sample, middle-class white American women. A century ago, such women did not use any makeup and considered "painting" with cosmetics to be a debased practice, indulged in only by "savage races" and prostitutes (Peiss 1996:316). The contemporary use of makeup can hardly be "caused" by hormones, which have not seen a similar reversal of polarity. Udry also seems to ignore variation in male gender roles across time and place when he states that males "can be thought of as highly immunized against feminine socialization by prenatal androgenation" (p. 452). Again, a simple look at historical variation in Western masculine practices demonstrates that wide fluctuation does occur; for example, 300 years ago European men of power and means sought to appear gorgeous by wearing wigs, facial powder and beauty marks, leg-accentuating stockings, high heels, velvet robes, and furs (Kuchta 1996).

Contemporary neuroendocrinologists are aware of the dangers of biological determinism. While Udry speaks of "female hormones" and defines testosterone as "the androgen that masculinizes behavior" (p. 444), contemporary neuroendocrinologists point out that the term "sex hormones" is misleading, since, in addition to sex organs, these hormones affect the growth and development of the "brain, lungs, bones, blood vessels, intestine and liver" (Fausto-Sterling 2000:118). Their own claims for the effects of hormones are much more modest: "It would be unwise to [assert] that our culturally grounded assumptions as to what constitutes 'masculine' or 'feminine' behaviors [in humans] are necessarily reflections of biological processes" (Adler 1981:150, citing Bermant and Davidson 1974). To the extent that influences of early endocrine conditions on later gendered behavior are claimed, such influences are stated to be, not clear as they are in animals, but "subtle," due to the strong effects of culture and socialization (Nelson 2000:172). Even Reinisch, Ziemba-Davis, and Sanders (1991), whom Udry cites and upon whose study his research is partly based, claim only that prenatal hormone exposures lead to "slightly different" behaviors in males and females (p. 214).

While the claims of Reinisch et al. (1991) are more modest than Udry's, their study is undermined by a flaw shared by his. Neither study specifies the mechanism by which hormonal exposures in utero are supposed to produce gendered preferences and behaviors. As Roberts (2000) has pointed

out, "Reinisch et al. end up claiming either that there is some sort of biological force that produces 'playing with dolls' and 'interest in watching sports on TV,' which is nonsensical, or that there is some [unspecified] intermediary" between hormones and behavior that produces these effects (p. 6). The problem with studies such as these is that "[t]he human brain is treated largely as a black box with prenatal hormonal input and later behavioral output" (Doell and Longino 1988:59).

Although Udry does not specify a mechanism by which maternal testosterone produces low wages and high jewelry use, in another article he and his colleagues state that "the mechanism through which fetal androgens most probably work involves influencing the structure of the brain and/or the subsequent sensitivity of key parts of the brain to adult androgens. At the present time there is much discussion of putative male-female differences in several areas of the brain, and there is some general agreement, focused primarily on a few but potentially important nuclei in the hypothalamus, and possibly the size and/or shape of the corpus callosum [citations omitted]" (Udry, Morris, and Kovenock 1995:365). This is a rather vague reference to a controversial area of research and is, in any case, inadequate. Small variations in brain morphology cannot explain phenomena such as wage level, who drives on a date, or division of labor in the home, since each of these phenomena is mediated by social factors.

BODY FRAMES AND SOCIAL MEANINGS

At the beginning of the twentieth century, as at its end, groups of scientists were interested in measuring small differences in the size of the corpus callosum. Instead of looking for a neurological source for gender difference, however, the early groups were searching for a biological seat for presumed racial differences in intelligence (Fausto-Sterling 2000). Geneticists today have shown that racial differences are literally only skin deep (Templeton 1998); sociologists have demonstrated that due to social framings of race, small physical differences have deep social consequences. In a study of skin tone differences and the socioeconomic status of African Americans, for example, Keith and Herring (1991) found that "[n]et of education, parental socioeconomic status, sex, region, urbanicity, age and marital status, the fairer one's pigmentation, the higher his or her occupational standing ($P < .01$)" (p. 772).

When Udry states of his study, "nonwhites were omitted because pilot work with another sample indicated that female adult hormone levels and their correlations with behavior differ by race" (2000:447), we may interpret this in one of two ways. Either Udry is unaware of current scholarship on the biology of race, which makes clear this exclusion is unjustified, or he acknowledges cultural mediation of the relationship between physiology and gender, and his results are tainted by bias. We are inclined toward the former interpretation—that Udry, like other biological determinists, presumes physiological causation for "commonsensical" ideas of race and gender that prevail at his time (Benderley 1987:102). This pattern is particularly evident in the research on girls with CAH (congenital adrenal hyperplasia) upon which Udry relies as evidence that prenatal hormone variations cause variations in gender behavior (pp. 445–46).

Girls with CAH are born with masculinized genitalia and are also reported in some studies to behave in a masculinized manner. The assumption of Udry and others whom he cites is that the prenatal testosterone exposure that causes the girls' genital difference also causes behaviors such as increased interest in sports and decreased interest in having children. But, as in the case of race, these differences in behavior may result from the great disparity in treatment people receive due to differences in their appearance. Consider how the parents of these girls are likely to treat them. According to a generally dry medical text, "One can only attempt to imagine the anguish of the parents. That a newborn should have a deformity . . . [affecting] so fundamental an issue as the very sex of the child . . . is a tragic event which immediately conjures up visions of a hopeless psychological misfit

doomed to live always as a sexual freak in loneliness and frustration" (Dewhurst and Gordon 1969:1405) To avoid this presumed result, CAH girls must endure repeated genital surgery. In one study cited by Udry, of the 34 patients studied, 27 had had "clitoral reductions" at a mean age of 5.3 years, and 16 had had vaginal operations, at a mean age of 10.0 years (Dittmann et al. 1990:416). In addition, girls with CAH must submit to numerous genital examinations, "often with photographs and a parade of medical students and interns" (Fausto-Sterling 2000:86). As a result, these girls are very aware that their status as females is suspect, which is very likely to affect their behavior. Moreover, in a study of CAH girls of whom less than 30 percent had had genital surgery, no significant differences were found between the sample group and control group (McGuire, Ryan, and Omenn 1975).

While we do not agree that the behavior of girls with CAH proves a hormonal causation of gendered behavior, we do find the experiences of these girls instructive. These girls' bodies are very visibly different at birth, and this difference has deep social consequences. Yet we all vary in our phenotypes—having, for example, a darker or lighter skin tone, more robust or gracile bone structure, more delicate or broad facial features. Though environmental and social factors influence our bodily form and physiognomy, these differences show largely biological causation. If in fact Udry's findings have some validity, we suggest that this is because variations in prenatal hormonal exposures affect physical development in small ways, and that these small variations in bodily form are given great social significance in our deeply gendered society. Thus we agree with Udry that biology and social forces interact in producing variations in gendered behaviors, but unlike Udry, we grant the social a much greater role in that interaction and hence predict that these gendered behaviors will change over time. And, in fact, while earlier research on CAH girls claimed that they were more likely to wear pants as a result of their hormonal exposures (Ehrhardt, Epstein, and Money 1968), more recent research does not find this result (or even look for it).

ANIMAL COMPARATORS

Udry claims that the "generic model" of what he terms "sex-dimorphic and reproductive behavior" is "broadly applicable to all vertebrates" (2000:444). This framing of comparisons between humans and animals is much broader and less cautious than most biologists claim, including those Udry cites. Collaer and Hines (1995), for example, warn that "caution is required in extrapolating findings from experimental animals to humans because of the enormous differences in behavioral and social complexity as well as the lack of precise correspondence between most behaviors of laboratory animals and humans. In addition, even among various rodent species, effects seen in one species are not always duplicated in others" (pp. 60–61). One difference between animals and humans that neuroendocrinology textbooks point out is that, unlike animals, humans have cultural gender patterns in addition to sexes (e.g., Nelson 2000:195). Unlike mainstream neuroendocrinologists, Udry (1994:562) does not acknowledge the difference between sex and gender and has claimed that the terms gender and "sex dimorphism" can be used interchangeably. This allows him to speak without irony, if oddly, of the gender of garter snakes (p. 444). Other neuroendocrinologists do not speak of the gender of garter snakes because they understand that snakes do not have culture.

Udry's research design is based on studies of sexual dimorphism, largely in rodents and primates. Basing research on humans on these studies is problematic in many ways. Studies of sexual dimorphism in female rodents, for example, examine lordosis, "a reflexive dorsoflexion of the caudal vertebral column" that enables male penetration (Malven 1993:224). Lordosis can hardly be considered analogous to career choice or use of jewelry in women. In addition, primatologists note that there is wide variation on the closeness of the tie between hormones and behavior in primates; these ties "appear closely correlated in gorilla reproductive behavior, somewhat less so in chimps, and least of all in orangutans" (Sperling 1997:254).

Even if we were to accept, for the sake of argument, the problematic analogies between animal and human behavior, Udry's assumptions appear outdated. Animal researchers in the 1960s characterized lordosis as appropriately passive mammalian female behavior, and Udry's research echoes this characterization—he asks women whether they drove, paid, and "decided" on dates and relates passive responses to low testosterone (p. 448). Yet rodent researchers no longer describe female sexual behavior as passive, and, in fact, devote more emphasis to female "proceptivity," in which female rodents initiate mating activity by hopping, wiggling, and often mounting the male (Malven 1993). Similarly, Udry's assumption of natural feminine passivity is no longer accepted by primatologists, who now devote much study to the issue of female dominance. Among chimpanzees, for example, they have found that "given the opportunity, a more dominant female chimp will kill and eat babies born to other females" (Hrdy 1999:52). This finding also underlines the fact that females are not universally inclined toward baby care in the way Udry assumes. This is evident in rodents as well as primates: "In addition to building a nest, licking her pups clean, protecting and suckling them—all pleasantly maternal-seeming pursuits—a mother hamster may also recoup some of her investment in these pups by eating a few, a time-honored maternal tactic for adjusting litter size in line with prevailing conditions. Among mice . . . mothers cull right after birth . . . occasionally abandoning whole litters if the number of pups falls below a certain threshold, something much larger mammals (lions and bears) also do" (Hrdy 1999:46). Finally, Udry's assumption that careers are universally unimportant to feminine creatures is discordant with the fact that female animals spend the bulk of their day, even when suckling infants, seeking food, defending against predators, and so on; as primatologist Altmann (1980) puts it, "baboon mothers, like most primate mothers, including humans, are dual-career mothers" (p. 6).

Another way in which current animal research does not bear out Udry's biologically deterministic framework is in the way that it underlines the importance of environmental factors. Recent research has found that even in a very simple animal, the rat, early hormone exposure does not act directly on the brain to cause sex-dimorphic behaviors: Maternal licking of the anogenital region mediates the development of these behaviors in offspring, and different amounts of licking lead to variations in sexual behavior (Moore and Power 1992).[1] Environment regulates the hormonal enabling of reproduction—for example, male cichlid fish are hormonally incapacitated from reproducing unless they have contact with other males (Fox et al. 1997). Finally, environmental changes can lead to alterations of both hormone levels and sex dimorphic behaviors. For example, nondominant male orangutans have low testosterone and appear adolescent. But if the dominant male is removed, such a "Peter Pan" male's testosterone levels rise markedly, and he acquires the bulk and cheek flanges of a dominant male (Hrdy 1999:76). Hence, one cannot assume that even if a nonspurious correlation is found between femininity and adult testosterone levels that the hormones cause the behavior and not vice versa.

CONCLUSION

Udry's study, like so many biologically deterministic studies prior to it, bases alarming conclusions about gender relations and the fate of society upon weak scientific grounds. As others have noted, "[R]esearch

[1] A similar pattern has been shown in primates, such as the rhesus monkeys studied by Goy (1970) in research that Udry (p. 446) terms the "design template" for his study. Observations of the activities of young rhesus monkeys indicate that the mothers' differential treatment of male and female offspring plays an important role in the degree to which they engage in rough-and-tumble play (Fausto-Sterling 1985). The genetically female offspring that were exposed by Goy to testosterone in utero were born with a male genital form. Thus, Fausto-Sterling calls into question Goy's conclusion that the increased level of rough-and-tumble play was accounted for by the masculinizing effect of prenatal androgen exposure. Instead of testosterone, the mother's differential treatment of the male-appearing females may be the important variable.

on and claims about sex differences, especially those linked to biology are, like Banquo's ghost, impossible to kill . . . [because a] modern society built on sex differences requires continual infusions of supportive science" (Tiefer 1995:36). We believe that it is both possible and desirable to integrate sociological and biological theories. But as sociologists we must insist that the interaction be viewed as a "co-construction or 'interimplication'" (Roberts 2000:17) rather than as a circumscription of social forces by biological ones. Udry states, "It is important that sociologists reconcile their social constructionist models of gender with prevailing [sic] theories emerging in the biological sciences" (p. 445), but it seems equally important that biological determinists familiarize themselves with the sociological research on the cultural construction of gender.

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Comment on Udry, ASR, *June 2000*

WHAT IS GENDER?

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SCIENTISTS HAVE long tried to determine how biology might affect behavior. One particular hotspot of research has fixated on two of the many steroid molecules more commonly referred to as hormones: testosterone and estrogen. These molecules have assumed a place in both scientific and general discourse as determining factors of "gendered behavior." In his article, "Biological Limits of Gender Construction," Udry (2000, henceforward Udry) reports on his study of the adult gendered behaviors that result from women's prenatal exposure to testosterone. In this comment, we critique Udry's guiding theoretical framework, his definition and operationalization of "gendered behavior," and the social and political implications of his findings.

UDRY'S CONCEPT OF "BIOSOCIAL"

Udry's project is centered on 163 white 27-to-30-year-old women from somewhat higher-than-average socioeconomic class backgrounds. When these women were fetuses—during the second trimester of their mothers' pregnancies—researchers measured the amount of testosterone and sex hormone binding globulin (SHBG) present in their mothers' blood. Since SHBG inhib-

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