The Periodic Table Model of the Gender Transpositions: Part I. A Theory Based on Masculinization and Defeminization of the Brain

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Students of human sexuality have long tried to make sense of atypical masculinity, femininity, sexual object choice, gender identity, or clothing choice. In Part I of this paper, we propose a theory to organize and to make sensible most of the major facts about these gender transpositions—a periodic table model of the gender transpositions. People have neural substrates that have been subjected to particular combinations of two distinct biobehavioral processes: masculinization and defeminization. In our theory, we hypothesize that individuals exhibit behaviors reflecting particular degrees of masculinization and/or defeminization, at least probabilistically. Therefore, each sexological group is characterized by a distinct distribution of its members centered about one particular combination of the two. Many other facts about the gender transpositions, as well as about aspects of gender roles in typical men and women, then flow from the theory. We also consider the possible mechanisms of brain masculinization and defeminization—noting genetic, hormonal, and environmental influences.

The gender transpositions (see definitions, below) have long challenged sexological investigators. Bisexuality, homosexuality, transsexualism, transvestism, and heterosexuality itself appeal to sexologists as examples of traits that ought to fit into a coherent whole yet stubbornly resist simplistic classifications. They appeal to sexologists not only on the basis of natural history, in posing questions about the basic facts gathered about them, but also on the basis of taxonomy—about whether the traits are coherent wholes or are merely arbitrary names applied to a collection of ungeneralizable individuals.

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We have constructed a theory that makes sense of many observations about the gender transpositions. The theory, presented here in its most general form, proposes a model or "periodic table" onto which the various gender transpositions can be fitted. (We found the term in Melicow & Uson, 1964, but were more inspired by Pinkava, 1971.) Many details concerning the origin of the gender transpositions can be understood, we believe, as reflections of variation in two fundamental developmental processes: biobehavioral masculinization and defeminization (defined below). Finally, we propose that masculinization and defeminization are controlled in two ways: by sex hormones acting on the brain during the prenatal or early postnatal period and by certain aspects of childhood socialization and childhood experiences.

We have chosen the term "periodic table" with care. The chemists' periodic table does not directly explain the properties of the elements. Rather, it reflects the more fundamental physical laws that do explain those properties. It served as a guide for research at a time when much less was known about the elements than is known now. Likewise, we do not understand all of the regularities in our table of gender transpositions. But if these regularities are confirmed, they can guide research in the gender transpositions for a long time to come.

The first and most important tenet of the theory is that mammalian species have the potential to undergo particular combinations of masculinization and defeminization. In humans, typical heterosexual men are hypothetically likely to exhibit behaviors that reflect one particular combination of masculinizaton and defeminization, typical heterosexual women are hypothetically likely to have another, homosexuals likely to have another, transsexuals yet another, and so on. We believe that masculinizing and/or defeminizing agents could be genetic, hormonal, psychological, or social.

The next step is to place the groups (or, more precisely, to place the distributions of the groups) in each sex on a two-dimensional graph; possibilities then suggest themselves for filling the blank areas on the graph. In particular, it will make sense to center the distributions for fetishistic transvestites and homosexual cross-dressers on certain areas of the graph, in between the other transpositions.

Third, the model accounts for certain other sex- and gender-related aspects of the lives of people with birth defects of the sex organs or other sex-chromosome-related anomalies. In particular, the especially unmasculinized status of androgen-insensitive "XY women" (Money, 1980, p. 20), the bisexual identity of many women with the
adrenogenital syndrome (Money, Schwartz, & Lewis, 1984), and the apparent increased bisexuality and lesbianism among DES daughters (Ehrhardt et al., 1985) are accounted for by the theory.

Finally, many other features of human sexuality are explained by an additional, developmental hypothesis: In humans, defeminization may take place in childhood, not always in infancy or in utero. This hypothesis, in combination with those mentioned above, makes the theory one which explicitly considers genetic, hormonal, and environmental and social factors in sex- and gender-role development.

Definitions

We offer the following definitions of basic terms. They are cumulative, with the most important ones at the end.

*Sexual orientation:* a preference, in behavior or fantasy, for erotosexual pairing with a partner of the same (homosexual) or the other (heterosexual) genital morphology, including the possibility that one can experience a sequential or simultaneous pairing with partners of either morphology (bisexual). There is usually an underlying assumption that an individual’s sexual orientation lies somewhere on a continuum for hetero- through bi- to homosexuality (but see below). Sexual orientation is therefore commonly expressed by a rating on the linear (one-dimensional) Kinsey scale (Kinsey, Pomeroy, & Martin, 1948).

*Masculine and feminine gender-typical behavior:* those personality or behavioral traits on which the two sexes reliably differ in a particular culture at a particular point in time. Gender-typical trait behavior is an empirical matter and is often measured by psychological questionnaires on which the respondent’s endorsement of items is compared to gender norms for a particular culture (for example, the California Personality Inventory’s [CPI] Femininity scale, or the MMPI’s Mf scale). It can, however, be measured in different ways—for example, by directly observing behavior (Barlow et al., 1979; Barlow, Mills, Agras, & Steinman, 1980).

*Masculine and feminine gender roles:* the expectations, or “roles,” prescribed by a culture differentially for women and for men. Gender role, as we define it here, can currently only be measured for humans and is measured by two widely used instruments: the Bem (1974, 1977) and the Spence and Helmreich (1978) sex-role inventories. These inventories were constructed to measure the extent to which an individual endorses the expected or culturally stereotypic behavior of the two genders. Data from these two gender-role inventories suggests that
masculinity-femininity is not a one-dimensional construct (as implicitly assumed by CPI Femininity), but that masculinity and femininity are separately measurable and, in principle, statistically independent. Gender-typical behaviors and knowledge of gender roles have a typical developmental sequence: Children seem to acquire first the knowledge that the sexes differ, then the knowledge of their own sex, then rules that prescribe certain roles for a given sex without exceptions, then the fact that there can be exceptions, and finally the fact that they themselves could be an exception (Goldman & Goldman, 1982; Mac- coby & Jacklin, 1974). Gender-atypical children begin to manifest interest in the roles of the other sex in the same developmental period during which the corresponding gender-typical behaviors emerge for other children (Zucker, 1985).

Core gender identity: the fundamental, inner perception of oneself as male or female. This is usually binary—male or female—and of course need not correspond conventionally with gender role or gender-typical behavior, or genital morphology. This binary nature is sometimes belied by hermaphrodites, who can have an intermediate core gender identity (Money & Ehrhardt, 1972, pp. 16, 158-160); by classic heterosexual male transvestites (see below), who often alternate masculine and feminine personas; and by homosexual cross-dressers (“drag queens’) who sometimes place their core gender identity between that of male and female. Hence, it may be necessary to describe core gender identity on a one-dimensional scale.

Autonomous sexual impulses: sexual activity not initiated by cues from a partner (i.e., chiefly masturbation, as well as much sexual dreaming, and perhaps sexual arousal at a distance). This notion has not yet had much prominence in the sex research literature, but there is value in distinguishing sexual activity which comes about largely as the result of internal cues or processes (an “impulse”—see Weinrich, in press) from that which comes about as a response to cues from a partner or from a sexual setting (a “response”).

Proceptive and Receptive: These two terms were introduced by Beach (1977, for example) to describe two components of female sexual behavior. Proceptivity was defined as behavior likely to instigate mounting or copulation by a male. (“Flirting” is a good human equivalent; see Perper, 1985, for a careful ethological description of the behaviors this slang term encompasses.) Receptivity was the willingness by a female to accept the sexual advances of a male; such advances may or may not have been solicited by proceptive behavior. We
adopt these definitions but in gender-neutral versions in which either sex may display proceptivity or receptivity in connection with sexual activity with either sex. The terms thus become applicable to homosexual and bisexual contacts as well as to heterosexual ones not following the stereotypical sequence.

**LH surge response to estrogen challenge:** the response of the pituitary/hypothalamic axis to a rise in estrogen levels, as measured by the subsequent release of luteinizing hormone (LH). At a certain point in a typical menstrual cycle, the ovaries produce estrogen which results in a surge of LH from the pituitary gland, stimulated by the hypothalamus. Some individuals exhibit an LH surge in response to an estrogen challenge and some do not. Obviously, most adult females do this as part of menstrual or estrous cycles. And most adult males do not—for two reasons. First, males have no ovaries to produce the estrogen stimulus. Second, it appears that typical men have been “defeminized” (see below) and would not produce the LH surge even if estrogen were administered exogenously (Aono, Miyake, Kinugasa, Kurachi, & Matsumoto, 1978; Oshima & Troen, 1981; Van Look, Hunter, Corker, & Baird, 1977).

The universality of LH-surge defeminization in men is in doubt. Most researchers suspect that men do defeminize in this way (e.g., Meyer-Bahlburg, 1984). But some (e.g., Kulin & Reiter, 1976) find that ordinary men do respond with an LH surge after estrogen injection (although challenged on methodological grounds by Van Look et al., 1977, p. 363). Perhaps the LH surge can be elicited in all humans, but the dose required to elicit it is far higher in men than in women. It is also possible that the LH surge is mediated not in the brain but in the testes (Baum, Carroll, Erskine, & Tobet, 1985). This possibility, if true, would change the mechanism but not the predictions of our theory.

**Gender transpositions:** the categories of gender identity, gender role, and sexual orientation in which “masculine and feminine expectancies and stereotypes are interchanged” (Money, 1980, p. 84). For some students of behavioral science, homosexuality, bisexuality, transsexualism, and transvestism form a poorly differentiated welter of “sexual deviations.” However, sex researchers in the past 2 decades have written careful clinical (sometimes too “clinical”!) descriptions of these sexual atypicalities which suggest that they are distinct, at least in their prototypic form. In particular, the gender transpositions comprise the following:
Homosexuality: the gender transposition in which sexual orientation is transposed, but not necessarily gender role nor core gender identity.

Bisexuality: the gender transposition in which sexual orientation is partially or episodically transposed; neither gender role nor core gender identity need be. Bisexuality is a complex phenomenon deserving its own detailed treatment, which it receives in Part II of this paper (Weinrich, in press). Hence it will not be further mentioned in Part I.

Transvestism: the gender transposition in which gender role is transposed—and not necessarily sexual orientation nor core gender identity. The transvestite male (Pomeroy, 1975) episodically dresses in female clothing, usually with an erotic component to the act of cross-dressing. The core gender identity of the so-called “classic” transvestite male is usually masculine (although there is often an alteration of masculine and feminine identities: Money, 1974), and sexual partner preference is often heterosexual (that is, directed toward women, even during cross-dressing—Buhrich & McConaghy, 1977b, 1977c; Bullough, Bullough, & Smith, 1982; Prince & Bentler, 1972). Cross-dressers who are homosexual, in contrast, typically display a mid-gender or androgynous appearance, and fetishism is usually lacking or less salient. Fetishistic transvestite behavior in women is reported in only three cases (Stoller, 1982).

Transsexualism: the gender transposition in which core gender identity is transposed, but not necessarily gender role nor sexual orientation (although usually at least gender role is). The partner preference of male-to-female (M-F) transsexuals may be homosexual or heterosexual—or sexual desire may be greatly reduced and not strongly directed at either gender (asexual). Female-to-male (F-M) transsexuals are more uniformly likely to be sexually attracted only to females (Blanchard, 1985).

Heterosexuality: the “null transposition”—that is, the gender transposition in which nothing is transposed. This definition does not follow Money (1980). We have included heterosexuality as a transposition because it puts heterosexuality on an equal footing with the transposed transpositions and simplifies terminology (see below). The advantages of including a “zero” in one’s measuring system will be obvious to anyone familiar with the Arabic numbering system or the Kinsey scale.

Masculinization and Defeminization: Although many (perhaps most) gender-typical behaviors are time- and culture-specific, some have a certain abstract similarity across cultures and even across mammalian species. These similarities include for males:

1. Sexual mounting and pelvic thrusting.
2. Aggressive behavior toward male peers with competition for access to females (Trivers, 1972).
3. Tendency toward multiple female partner seeking (Symons, 1979).

4. Sexual arousal at a distance.

And, for females:

1. Sexual receptivity: willingness to assume the posture necessary for sexual intercourse (lordosis in rodents, the "present" in nonhuman primates).

2. Sexual proceptivity: willingness to seek out a sex partner and to indicate to that chosen partner that she may be sexually receptive ("flirting" in humans; see Perper, 1985).

3. "Choosiness" of a mate (Trivers, 1972) and relative monogamy (Symons, 1979), although the latter has important limits (Hrdy, 1981).

4. Attention to nest building, parenting, and protection of young. Note that these definitions are nonexclusive: The fact that mounting and pelvic thrusting (1.) are claimed to be typical of males does not imply that they do not occur in females. Likewise, proceptivity among females does not preclude its occurrence in males. These points are of utmost importance to our theory. It is easier to keep them in mind if one imagines not a line with "masculine" at one end and "feminine" at the other but rather a plane with a "masculine" axis perpendicular to a "feminine" axis.

We will draw a parallel between the somatic differences between the sexes—such as the shape of the genitalia—and the biobehavioral differences just listed. Two processes—masculinization and defeminization—operate on both body and mind in producing the distribution of masculine and feminine traits observed in human societies.

Masculinization and defeminization are the two processes by which mammalian fetal genitals and nervous systems are switched from the female developmental pathway to the male developmental pathway. When we refer to these processes operating on the genitals (or visually perceptible secondary sexual characteristics such as body hair or breasts), we will use the term somatic masculinization and defeminization. Usually, however, we will discuss the nervous system, which we believe reflects biobehavioral masculinization and defeminization. When brevity is useful, we will drop the term biobehavioral.

Aliens from outer space, with PET-scan eyesight, would see that human brains are about as sexually dimorphic as human bodies are when viewed with normal vision. That is, the differences between women and men are quite small in comparison, say, to differences between species, but the male-female differences are easy to spot when you know where to look (in gross anatomy: de Lacoste-Utamsing &

Whether these differences are measured one-dimensionally or multidimensionally varies and must be addressed by evidence. For the most part, the external genitalia vary one-dimensionally (see, e.g., Money & Ehrhardt, 1972). So one is born with a clitoris, with a penis, or with something in between—never with both at once. The internal genitalia, however, vary two-dimensionally. In fetal life, antecedents are laid down for both masculine and feminine structures—the Wolffian ducts and the Mullerian ducts, respectively. The Wolffian ducts develop under the action of androgen and degenerate in its absence. But the Mullerian ducts degenerate in the presence of a different substance and develop in its absence (Taguchi, Cunha, Lawrence, & Robboy, 1984). (This hormone is called Mullerian-inhibiting substance, or MIS, a high molecular weight glycoprotein; Wilson, George, & Griffin, 1981, p. 1,280.) So it is entirely possible (though of course uncommon) for an individual to be born with both male and female internal reproductive structures.

Research in the last few decades has shown that brain sexual dimorphism resembles the internal-genital dimorphisms just mentioned. That is, a prenatal hormone treatment that increases the adult expression of a part of the typical male coital sequence (e.g., mounting) does not necessarily decrease the expression of a part of the typical female coital sequence (e.g., lordosis). Something that increases a typically masculine sexually dimorphic trait (mounting, say, or autonomous sexual impulses) we term a masculinizing agent. Something that decreases a typically feminine sexually dimorphic trait (receptivity, say, or hormonal cyclicity associated with the estrus or menstrual cycle) we term a defeminizing agent. Because typical masculine and typical feminine traits are not mutually exclusive, defeminizing agents are not always the same as masculinizing ones (Baum, 1979; Goy, 1970; Money & Ehrhardt, 1972, p. 7; Oshima & Troen, 1981).

This point is extremely important. In mammals, somatic development is female in the absence of hormonal stimulation; a fetus has a so-called “passive” or “natural” inclination to follow feminine paths of development, both in genital morphology and in behavior. In order to divert development from this path in the direction of typical masculinity, both morphology and behavior have to be masculinized and defeminized. Sometimes (e.g., for the external genitals), these two agents are the same or very similar (testosterone and/or dihydro-
testosterone). But other times (e.g., for the internal genitals), these two kinds of agents are very different substances (e.g., MIS and testosterone).

Masculinization and defeminization typically can only occur at certain critical periods in development (MacLusky & Naftolin, 1981; Taguchi et al., 1984). For sexually dimorphic differentiation of the brain, they can be different for different hormones and are not identical with the critical periods for differentiation of the genitalia. The most likely sensitive period for the differentiation of the hypothalamus is at 4-5 months gestation—firmly in the second trimester (Dörner, 1976)—but nearly all genitalia differentiate during the first trimester. (An exception: Growth of the male external genitals and descent of the testes both begin in the first trimester and continue throughout gestation and thus overlap the probable period for hypothalamic differentiation: Wilson et al., 1981, Fig. 1.) These facts suggest that people with atypical brain development are not necessarily likely to have atypical genitalia.

No one knows for sure what substance is responsible for human biobehavioral defeminization. It may be MIS itself (Hutson & Donahoe, 1983), although this is speculation and goes against conventional wisdom that MIS is a locally acting agent. In contrast, in rats, masculinizing and defeminizing agents are more or less the same, but the critical periods for the two processes may differ (Baum, 1979), perhaps substantially (Goy, 1970). According to some definitions, defeminization does not take place in primates, humans included (Baum; Goy & Goldfoot, 1975), but we are dissatisfied with the narrowness of such definitions. Some workers (e.g., Baum) treat species in which normal males are capable of lordosis (or of presenting) as species in which biobehavioral defeminization by definition does not occur. We prefer a broader definition (such as that of Oshima & Troen, 1981), in which a lowered readiness to lordose indicates a degree of defeminization, or in which raising the threshold required to elicit the LH-surge response is the primary element of the definition. Our uncertainty about these matters is reflected in an uncertainty in some of our predictions. Most hold if human biobehavioral masculinizing and defeminizing agents are the same but operate at different critical periods.

This dispute might be illuminated by broadening another aspect of the definition of defeminization. Perper (1985) has precisely laid out the body language of courtship: A series of body-language "statements" which courting men and women make to each other. In par-
ticular, he found that courtship is initiated when a woman makes pro-
ceptive gestures—such as moving close—to a man she is interested in
meeting. Perper, in collaboration with Weis and Crosbie, asked college
men and women to write accounts of the way they pursue courtship
and made some striking discoveries (see also Perper & Weis in this
issue). They found that college women know the first stages very well
and are aware (in less detail) of the later stages, for which men typically
take the initiative (such physical contact and explicitly sexual
touching). Men, in contrast, seem to know nothing of the woman’s first
proceptive steps and almost inevitably begin their description of
courtship with their first overtly sexual physical contact. It is as if
men are blind—or have been blinded by defeminization—to these
initial proceptive steps. Loss or lack of knowledge of these steps might
serve as a bioassay for defeminization in humans.

There is one final qualification to our presentation. After the critical
periods pass, for the typical adult expression of sexually dimorphic
behavior the brain must be stimulated by androgens or estrogens: The
organized brain and somatic tissues must be activated by circulating
sex hormones (McEwen, 1981; Reinisch, 1974). We will gloss over this
important point, but ultimately it will have to be faced to complete the
periodic table.

The Theory Described

The periodic table model proposes a two-dimensional graph or
“periodic table” upon which the biobehavioral masculinization and
defeminization of brains can be roughly plotted and onto which
distributions of the various gender transpositions can be approximate-
ly placed. Moreover, we propose that biobehavioral masculinization
and defeminization could be controlled in two ways: by hormones act-
ing on the brain during the prenatal or early postnatal period and by
certain aspects of childhood socialization.

For the sake of simplicity, let us take the primary characteristic of
masculinization to be mounting behavior, with secondary character-
istics being autonomous sexual impulses (as measured by masturba-
tion), and sexual arousal taking place at a distance, directed at a varie-
ty of sexual partners but based on arousal to an (ethologically) im-
printed “type” (Weinrich, in press). Correspondingly, lower degrees of
masculinization involve less mounting, low masturbation, lack of sex-
ual arousal at a distance, and lack of interest in a variety of sexual
partners.

Similarly, let us take the primary characteristic of defeminization to
be decreased proceptivity and/or receptivity (e.g., decreased likelihood of lordosis, "presenting," "flirtation," or otherwise presenting oneself as a sexually receptive partner), with secondary characteristics being an acyclic pattern of gonadotropin secretion, and an increased tendency to eroticize femininity. Correspondingly, less defeminization is hypothesized to involve a higher willingness to be proceptive or receptive, LH-surge responsivity to estrogen challenge, and a reluctance to eroticize femininity in oneself or in others. (For sources, see Baum, 1979; Money, 1980; Money & Ehrhardt, 1972; Oshima & Troen, 1981; Reinisch, 1974; and references cited in each.)

Figure 1 presents these hypotheses graphically. Each masculinization item appears (twice) on the right, opposites on the left. Each defeminization item appears (twice) on the top, opposites on the bottom. The four corners thus represent four different combinations of biobehavioral masculinization and defeminization.

<table>
<thead>
<tr>
<th>Masculinized and defeminized</th>
<th>Masculinized and undeeminized</th>
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<tbody>
<tr>
<td>High mounting</td>
<td>High mounting</td>
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<td>High masturbation</td>
<td>High masturbation</td>
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<tr>
<td>High visual arousability</td>
<td>High visual arousability</td>
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<tr>
<td>High partner variety</td>
<td>High partner variety</td>
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<tr>
<td>No LH surge (acyclic)</td>
<td>No LH surge (acyclic)</td>
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<tr>
<td>Low receptivity</td>
<td>Low receptivity</td>
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<td>Low proceptivity</td>
<td>Low proceptivity</td>
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<td>Femininity and eroticism</td>
<td>Femininity and eroticism</td>
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<tr>
<th>Unmasculinized and defeminized</th>
<th>Unmasculinized and undeeminized</th>
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<tr>
<td>Low mounting</td>
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<td>Low masturbation</td>
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<td>Low visual arousability</td>
<td>Low visual arousability</td>
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<tr>
<td>Low partner variety</td>
<td>Low partner variety</td>
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<tr>
<td>LH surge (cyclic)</td>
<td>LH surge (cyclic)</td>
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<td>High receptivity</td>
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<td>High proceptivity</td>
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<td>Femininity and eroticism</td>
<td>Femininity and eroticism</td>
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<td>unconnected</td>
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**Figure 1.** The theory behind the periodic-table model. Brain masculinization and defeminization usually go together (upper-right and lower-left corners), but in some cases they can occur independently (upper-left and lower-right). Each typical sex difference is hypothesized to be controlled by a masculinizing process or a defeminizing one. Each of the quadrants thus has a different combination of sex-typical traits.
Next, we ask what kind of person might be found in each of the four corners. We already have candidates for the upper-right-hand and lower-left-hand corners—male and female heterosexuals, respectively—but their placement is tautological and of no empirical significance. That leaves two remaining corners to explore.

The Upper-Left-Hand Corner

What kind of person would be found in the upper left? A glance at the characteristics of this combination—not masculinized, but de-feminized—suggests that such people would be fairly asexual. They wouldn’t be much interested in mounting, and they wouldn’t be much interested in being sexually receptive. They would have a brain relatively unresponsive to estrogen challenge. This description fits three kinds of people: male-to-female transsexuals, androgen-insensitive XY women, and perhaps certain lesbians.

Male-to-female transsexuals. M-F transsexuals usually do not have an interest in sexual variety, masturbation, and so on (Money & Primrose, 1969) and have very low rates of masturbation and nocturnal emissions (Pomeroy, 1967, 1969; Sörenson & Hertoft, 1982). M-F transsexuals seem unconcerned that their estrogen therapy will decrease the size of their testicles and the apparent size of their penis and make masturbation more of a chore than a pleasure (Money & Primrose, p. 122). Some M-F transsexuals have been known to castrate themselves in order to rid themselves of their masculinity (van Kamm en & Money, 1977). It seems that some transsexuals are not as much interested in gaining femininity as they are in losing their masculinity—exactly the asexual combination that would be expected in this corner of the graph. Note the difference between this outlook and the (we believe mistaken) view that male-to-female transsexuals are simply homosexuals who have internalized society’s view that one cannot love men unless one is a woman (e.g., Ross, Rogers, & McCulloch, 1978).

Now consider the following report (Pomeroy, 1969, pp. 185-186):

[M-F transsexuals’ sexual] fantasies were almost always of themselves as females having intercourse with a male. . . . In some cases they reported their dreams as being devoid of overt sexual behavior; orgasm occurred merely as a result of dreams of themselves being females.

Such reports suggest that M-F transsexuals eroticize femininity, but this eroticization takes an interesting form. Most heterosexual men, of course, eroticize femininity: They have a sexual attraction to the stereotypically feminine clothing, behavior, and accessories of their girlfriends or women in general. M-F transsexuals also seem to
connect femininity with eroticism but displace this interest onto themselves. There are even M-F transsexuals who remain sexually and/or emotionally attracted to women after their operation, thus identifying as lesbian male-to-female transsexuals (Blanchard, 1985; Feinbloom, Fleming, Kijewski, & Schulter, 1976; Gottlieb, 1978)—which can also be viewed as a way to displace an eroticization of femininity onto oneself. The sex attractive to M-F transsexuals varies (Barr, Raphael, & Hennessey, 1974; Hoenig & Kenna, 1974, Table VIII), and the variation seen so far may be an underestimate, since the sex asserted to be attractive can fail to gibe with direct measures of erection to sexual stimuli (e.g., Buhrich & McConaghy, 1977a, Table 1). This pattern became clear to us only after we arranged the groups in the XY graph for reasons unrelated to this pattern; therefore, ex post facto, we consider the tendency to connect eroticism with femininity as a correlate of defeminization.

Androgen-insensitive XY women. Androgen insensitives have target tissues throughout their bodies which are insensitive to the androgens produced by their gonads. So their external genitalia are entirely feminine, and at puberty their (testicular) estrogen causes a feminizing puberty and the growth of breasts (but little pubic and underarm hair, which apparently requires androgen sensitivity). As no single criterion suffices to decree sex of assignment, these people can be termed "XY women" (Money, 1980).

There is little written about the sexuality of these women (Masica, Money, & Ehrhardt, 1971; Money et al., 1984); our model suggests that they will be relatively asexual, but it does not decree the direction of their sexual impulses, if any. More to the point, it also suggests that their LH response will be like the typical, defeminized men’s LH response—there should not be an LH surge—and there is increasing evidence that this is the case (Oshima & Troen, 1981; Van Look et al., 1977).

This finding has confounded one of the major students of this LH effect (Dörner, 1979), whose theories suggest, by extrapolation from rat experiments, that prenatal androgen treatment would turn off the LH surge (Ricketts, 1984). If this were true in humans, then presumably people entirely insensitive to androgens would retain the ability to respond to estrogen challenge with an LH surge. But apparently they do not do so (references cited above). This contradiction is resolved if masculinization and defeminization in humans are (a) caused by two different substances, (b) have different critical periods with responsivity to androgen lacking only during the masculinization critical period,
or (c) are mediated by two different biochemical pathways. Our theory thus does away with this contradiction, showing where Dörner is mostly wrong but partly right.

Certain lesbians. There may be certain lesbians who partially resemble, in their masculinization/defeminization status (and not necessarily in any other way), the “lesbian” M-F transsexuals mentioned above. These lesbians would not experience a strong desire for taking the sexual initiative or for acting proceptively (although they might experience such sexual responses—see Weinrich, in press). However, like M-F transsexuals, they would admire or be attracted to an idealized femininity. A “woman-identified woman,” for example, is one who esteems and models herself upon feminine norms and values, not patriarchal or man-centered ones. That the woman-identified ideal bears an abstract similarity to the idealization of femininity seen in M-F transsexuals at first struck us as unlikely, but the analogy is strongly suggested by the theory and should be carefully thought out.

If this placement is correct, then perhaps these women’s hypothalamic-pituitary axes would not respond to estrogen with an LH surge. They might thus be expected to have some menstrual irregularities, unless their estrogen levels are as high as may be needed to elicit an LH surge in ordinary men. Alas, evidence on menstrual cyclicity in lesbians seems entirely lacking.

The Lower-Right-Hand Corner

What kinds of people might be found in the lower right, where we hypothesize biobehavioral masculinization, but not defeminization? These people could notice in themselves an impulse to mount. They could also notice an impulse to be mounted. If such people were asked which of the two they “really” liked, they might have a personal preference, but it would be easy for them to imagine people with a different preference. Or they might have a weak preference but be flexible and willing to do different acts with different people. Or they might be puzzled, having no preference at all; these people would engage in such acts one after the other with the same person, or even at the same time with two different people.

This description, we believe, fits most homosexual men and many lesbian women. An understanding of (if not desire for) both sides of the classic coital act is unremarkable to gay people themselves. Moreover, they typically find it puzzling or silly when other people wonder whether a gay person plays the role of “husband” or “wife” in a relationship with a lover. This flexibility can occur even in the face of
strong pressures from the larger society to declare oneself male or female, which can in turn cause strong subcultural pressure to declare oneself as “butch” or “fem.” For example, in Mexico gay men clearly declare themselves “butch” or “fem,” but their actual behaviors in bed are more flexible than the overt cultural norms would suggest (Carrier, 1976, pp. 120-121).

In contrast, there are heterosexuals who don’t (can’t?) take these things nonchalantly. As an extreme example, male prisoners label as homosexual any man penetrated orally or anally by a penis (Sagarin, 1976), even unwillingly. Less extremely, many heterosexual men just don’t understand how a man could enjoy letting himself be penetrated in any way.

This corner is also one in which individuals would respond with an LH surge after an estrogen challenge. For the women here, this would be expected, but in homosexual men, its apparent presence has caused a major controversy (Dörner, 1979, and discussion thereof; Dörner, Rohde, Stahl, Krell, & Masius, 1975; Ricketts, 1984; Weinrich, 1981). The first reports that some homosexual men may exhibit an LH surge in response to estrogen challenge (Dörner et al., 1975) were greeted skeptically (“Discussion,” 1979; Meyer-Bahlburg, 1976) but have recently been replicated by Gladue, Green, and Hellmann (1984), who found an average LH surge in homosexual men (dosed with estrogen) about halfway between the lack of response in heterosexual men and the clear-cut surge seen in heterosexual women. Whether the theory will survive further attempts at replication remains to be seen.

Further Placements

Now separate Figure 1 into two figures—one for XX individuals and one for XYs—and erase the lines separating the four corners from each other. This lets us consider centering the distributions of other traits at intermediate points—see Figure 2.

On the XX graph (Figure 2a), we have placed female-to-male (F-M) transsexuals in the previously blank spot in the upper right—exactly where heterosexual men are on the corresponding XY graph. We made this placement not with hormonal evidence (of which there is little) but on the basis of continuity with the other placements and of certain facts known about their behavior (Futterweit, Weiss, & Fagerstrom, 1986). F-M transsexuals, for example, appear to have an easier time “passing” as a member of their chosen gender than do M-Fs (Fleming, Costos, & MacGowan, 1984; Fleming, MacGowan, & Costos, 1985; Green, 1974; Sørensen & Hertoft, 1982).
We would also distribute female adrenogenital patients along the X axis, centering their distribution approximately at the midpoint of the masculinization axis. The prenatal androgenization these women underwent apparently increases the probability that they become bisexual or lesbian (Ehrhardt, Evers, & Money, 1968; Money et al., 1984).

**Figure 2a. XX Chromosomes**

**Figure 2b. XY Chromosomes**

*Figure 2.* The periodic tables, separated by sex, on scales that are not necessarily comparable across sex. Those with XX sex chromosome configurations are in the upper diagram (Figure 2a); those with XY sex chromosomes are in the lower (Figure 2b). A typical female remains at the origin, without biobehavioral masculinization and without biobehavioral defeminization (2a, lower left corner). A typical male becomes masculinized and defeminized (2b, upper right corner). Atypical XXs can be partially or completely defeminized (2a, upper half) and/or partially or completely masculinized (2a, right half). Atypical XYs can remain undefeminized (2b, lower half) and/or be incompletely masculinized (2b, left half). The periodic table theory proposes that certain homosexuals (of either sex) can be placed in the lower-right-hand quadrant (of the appropriate diagram). For details on this and on the placement of other sexually atypical individuals, see text.
On the XY graph (Figure 2b), we have centered the distributions for M-F transsexuals in the upper left, for male heterosexuals in the upper right, and for male homosexuals in the lower right, as explained above. If there are among genetic males (Blanchard, 1985, p. 248) "homosexual transsexuals" (those attracted to men), "heterosexual transsexuals" (those attracted to women), and "asexual transsexuals" (those not particularly attracted to sexual relations with either sex), then we would place the "asexual" transsexual group upper left, the "homosexual" transsexual group lower left, and the "heterosexual" transsexual group upper middle (near heterosexual transvestites, who sometimes decide later in life to undergo sex reassignment). We have centered the distribution for heterosexual transvestites in the upper middle, between heterosexuals and transsexuals, and for homosexual cross-dressers (so-called "drag queens") in the lower middle, between male homosexuals and so-called "homosexual" transsexuals.

There are XY individuals who, because of XY gonadal dysgenesis or other conditions, are relatively unmasculinized and may well not be defeminized. These uncommon individuals typically have erotic inertia due to low levels of testosterone in adulthood, so it is difficult to gather information about their sexual orientation—if, indeed, it makes sense to talk about such a trait in them (Raboch & Mellan, 1978, Raboch, Mellan, & Starka, 1977). But some of them, we believe, should probably be placed in the lower left corner. At least one such person—raised as a female, with feminine external genitals and streak gonads due to gonadal dysgenesis—has been tested for an LH surge and (as predicted by our theory) did show the response (Van Look et al., 1977).

Notice that sexual orientation per se is not distributed on our graphs in any simple way. For example, androgen-insensitive XY women on the XY graph occupy a spot taken by certain lesbians on the XX graph. Would the androgen insensitives be sexually attracted to women? Available evidence (Money et al., 1984) suggests not, although we have seen one XY woman who came out as a lesbian in mid-life. We believe sexual orientation is the result of a complex developmental process (see below) with antecedents and not rigid determinants in the biobehavioral masculinization and defeminization displayed on the graphs. There are, however, unexpected regularities in the tables which suggest a hypothesis about some of these antecedents.

Some Unexpected Regularities

We suspect developmental mechanisms are involved in the genesis
of the various gender transpositions (including homosexuality), which can be better understood in the light of our model.

Idealizing Femininity

On the XY graph, all three of the groups in the top half have a special relationship to femininity: Each group idealizes femininity in ways that are striking to those who don’t share the idealization. Let us list them, a bit teasingly: Many heterosexual men put their wives and girlfriends up on pedestals, many heterosexual transvestites dress the way their aunts did when they (the transvestites) were boys, and many M-F transsexuals believe that all their problems will be solved as soon as they have their genitals transformed. Likewise, at least two of the three groups on the bottom half of the XY graph idealize masculinity: Many drag queens complain about how hard it is to find a real man these days, which suggests that they want one, and many gay men spend time pumping up their masculinity at the local gym.

Fantasies About Lesbianism

There is another regularity along the upper half of the XY graph: the feelings these men have about lesbianism. First, many ordinary heterosexual men fantasize about lesbian sexuality (Hatfield, Sprecher, & Traupmann, 1978, Figs. 1-2; Kinsey, Pomeroy, Martin, & Gebhard, 1953, p. 486; Steinman, Wince, Sackheim, Barlow, & Mavissakalian, 1981, Figs. 1-3). Lesbian or pseudo-lesbian pornography aimed at male buyers is a big seller, and magazines like Playboy feature such photo spreads every few months. This sexual taste is hard to deduce from the first principles of any known theory of human sexuality. Second, some transvestites think of their feminine sides as lesbian, while they engage in sexual relations with their wives. Yates-Rist (1983) reported one married couple who bought a copy of The Joy of Lesbian Sex when the wife realized she had an interest in her husband’s fantasy. Beigel (1969, p. 111) mentions a similar couple, and the lesbian fantasy has been play acted in pornography aimed at heterosexual transvestites. Third, there are M-F transsexuals who want to have sex only with women, and who identify as lesbians (Feinbloom et al., 1976).

So all three groups have subgroups interested in lesbian fantasies. This regularity was not one we had sought to explain; it became clear after we had arranged the transpositions, on other grounds, as we do here.
**PERIODIC TABLE OF GENDER TRANSPOSITIONS**

Childhood Gender Nonconformity

What were the childhoods like of the various groups of people listed in our tables?

Consider the XX graph (Figure 2a), where the Western stereotype is "sugar 'n spice 'n everything nice." Although U.S. girls now have much more freedom than girls did even one generation ago, this seems not to have diminished their appetite for sweetness and delight—Strawberry Shortcake dolls, for example—at a particular developmental stage in sex-role awareness. Although the first prospective study of the exceptions—tomboys—is only now approaching completion (Green, 1974, is the initial report), retrospective reports suggest that a high proportion of lesbians were tomboys and that virtually all F-M transsexuals were. Given that childhood rough-and-tumble play and tomboyishness is one of the best verified consequences of masculinizing prenatal hormonal regimes (Ehrhardt & Meyer-Bahlburg, 1981), we would place many tomboys in childhood at the lower-right portion of our XX graph. Some other tomboys grow up to be heterosexual women, a fact whose conflict with our theory we will leave to the future to resolve (Weinrich, in press). Other lesbians, who were not tomboys in childhood, may well be those who end up in the upper left corner of Figure 2a and thus perhaps shared a childhood with the preheterosexual girls in the lower left.

Likewise, many gay men—and nearly all M-F transsexuals, fetishistic transvestites, and homosexual cross-dressers—report childhood sissiness and/or interest in feminine clothes, hair, makeup, or other accessories (Bell & Weinberg, 1978; Bell, Weinberg, & Hammer smith, 1981a; Zucker, 1985—although these reports have been prospectively verified only for homosexuals—Green, 1985, 1987; Weinrich, 1985). (However, many gay men as children were not positively sissy; they were instead not athletic or not rough-and-tumble competitive.) The sissiness of M-F transsexuals' childhoods is in doubt; such reports from the transsexuals themselves have sometimes not been verified by relatives, and prospective studies of sissy boys have not found any unambiguous cases of transsexualism to result (although the total number studied so far is well below what would be needed to encounter one such; see Weinrich, 1985).

On the other hand, there are some aspects of preheterosexual boys' childhoods that would be seen as decidedly homosexual if they were to take place in adulthood. Studies showing patterns both of informal and of institutionalized same-sex sexual activity going on among boys, or between men and boys, come from most corners of the globe and
most periods in history (Boswell, 1982; Carrier, 1980; Dover, 1978; Stoller & Herdt, 1985). Fuzzing out all the cultural variability for a moment, we are struck by the following generalizations: that adolescent boys in their sex play both insert and are inserted into; that this behavior is viewed as unremarkable; that most boys “grow out of it” (Money & Weinrich, 1983; Stoller & Herdt; Tindall, 1978); and that adolescent boys are often recruited to perform stereotypically feminine tasks for older males, sometimes even in cultures strikingly different from our own (in New Guinea: Hays, 1963; in Australia: Hardman, 1888; in Africa: Evans-Pritchard, 1970). We are not aware of any parallel institutionalization of bisexual behavior in girls in other cultures, nor of any expectation that some girls will help out older women in stereotypically masculine ways. Remember, however, that female sexual behavior has been much less studied than male, and societies often have a greater interest in restricting females’ sexual behavior, so more evidence here would be helpful.

Lesbians have on average an earlier age at first heterosexual coitus than heterosexual women do. No one has really known what to do with this bit of information, although it has been widely replicated (Bell, Weinberg, & Hammersmith, 1981b, p. 159; Saghir & Robins, 1973; Schäfer, 1977). We suggest that it be interpreted as an expression of autonomous sexual impulses: halting, tentative steps in the development of adolescent sexual interest, parallel in a way to the halting, tentative steps taken by adolescent boys. Those boys, after all, would dearly love to engage in coitus with females and often have to settle for “messing with” their male peers instead. Do adolescent tomboys also wish to engage in sexual relations with females—and likewise have to settle for their male peers instead? If so, notice that boy/tomboy sexual relations would appear to be heterosexual—and thus show up statistically as an earlier age at first coitus. Notice how our theory makes novel connections among facts that previous theories dismissed as inconsequential.

The Developmental Hypothesis

These speculations about childhood suggest the following hypothetical developmental model: (a) that the various aspects of gender identity, gender role, and sexual orientation in childhood are measurable on a single dimension of core gender identity; (b) that this one-dimensional distribution results from variation in prenatal or perinatal biobehavioral masculinization; (c) that such masculinization typically results in rough-and-tumble play in childhood; (d) which either causes or is merely noncausally associated with biobehavioral
defeminization, which begins in late prepuberty; (e) that puberty is the point at which the one-dimensional gender-identity distribution expands into the two-dimensional distribution we hypothesize for adult gender-typical behavior; and (f) that boys undergo a sort of sociosexual metamorphosis at puberty, whereas girls undergo a more continuous development.

These developmental aspects are sketched in Figure 3. We hypothesize that the aggressive, body-contact, rough-and-tumble activity of sports may serve, at least partially, as a biobehavioral defeminizing agent or as a bioassay for some other factor (presumably prenatal or from early childhood) that causes both rough-and-tumble play and biobehavioral defeminization to occur. Luria and Herzog (1983), for example, studied young children on playgrounds and found that boys’ and girls’ typical play was most different in prepuberty, perhaps earlier. At that age, boys were playing competitive and team sports whereas girls were involved in more cooperative play like skipping rope. We suggest that boys who excel at these rough-and-tumble sports will turn out to have lower-than-average incidence of homosexuality. Sports that require only speed or strength—like track, swimming, figure skating, and weightlifting—are not most popular with preadolescent boys and should turn out to have an average or above average number of homosexual men as skilled participants.

Indeed, many prehomosexual boys shrink from rough-and-tumble sports or are regular losers when they do play. This fact is noticed at once by parents and teasing peers who see it as a sign of sissiness—or, in our terms, as the incipient lack of defeminization. There are also the girls—tomboys—who want to be “one of the boys” and join the Little League team; according to our theory, this can result in, or result from, biobehavioral masculinization.

When adults become concerned by such childhood gender nonconformity, we see it as the intuitive suspicion—or mistaken hope—that boys’ athletic activities in sufficient doses do indeed help to defeminize the participant (and likewise, that preventing girls from participating would prevent defeminization). This speculation suggests that for males, the kind of aggressiveness involved in many rough-and-tumble sports is more than just a matter of fitness, health, or recreation; it is a significant milestone in their attainment of culture-typical masculinity. Whether achieving this milestone causes or is merely associated with defeminization can run either way in our theory.

Our placement of women on the XX graph suggests that female-to-male transsexuals and some lesbians would have similar childhoods.
Indeed, Ehrhardt, Grisanti, and McCauley (1979) found many similarities in the childhoods of lesbians and female-to-male transsexuals, with childhood cross-dressing differentiating the two groups, but other divergences emerging only at puberty. Note also that samples of female-to-male transsexuals show much less variability in their sexual object choice than samples of male-to-female transsexuals do (Hoenig & Kenna, 1974, Table VIII). This, too, is completely consistent with our theory.

Finally, consider point (f), above, which suggests a biobehavioral metamorphosis in boys at puberty. So-called “sissy” boys (Green, 1974), have an atypical gender role (and sometimes, more subtly, an atypical core gender identity) in childhood. But they grow up to differ in adulthood not so much on gender role as on sexual orientation. That is, their atypicality in gender-role metamorphoses into an atypicality in sexual orientation. Likewise, many nonsissy boys engage in sexual acts with other boys around puberty, yet turn on a dime—sociosexually speaking—and become exclusively heterosexual in adulthood. Indeed, there are cultures in which this occurs with regularity (Stoller & Herdt, 1985). Here, too, the term metamorphosis seems applicable. We can make sense of all these aspects of gender identity by hypothesizing that gender identity appears as a one-dimensional spectrum in childhood but broadens to two dimensions at puberty.
Conclusions

Many of our hypotheses direct attention to what had previously been considered minor sexological details—perhaps even trivial ones. This is the usual course of new ideas in science; exceptions and puzzles at first brushed off as inconsequential turn out to be crucial in devising tests of a new theory. Of course, we cannot prove that our theory will lead to a major revision of commonly accepted ones. But let us sketch some other scientific theories that mesh well with ours.

There is growing recognition in evolutionary biology of heterochrony: the notion that seemingly trivial differences in the rates of development of loosely coupled processes can have major effects on the resultant mature organism. A great deal of evolution apparently takes place by varying these seemingly inconsequential timing processes (Marx, 1984, provides an introduction for the lay scholar and a brief bibliography). In some species (many fish, for example), social conditions trigger events which turn adults from male into female or vice versa. Over evolutionary time, individuals can inherit tendencies to undergo this change earlier or later in development. In mammals, some individuals—called “males”—in some sense inherit a tendency to begin this process in utero and pretty much complete it during adolescence (although in humans it is never entirely complete; men continue to masculinize somatically gently throughout life). Other individuals—called “females”—in a similar sense inherit a tendency to delay most of this process until death (although women, too, somatically masculinize gently throughout life). The various processes of somatic development are loosely coupled, and evolution can act to speed up some components of it and to retard others. (Genitalia are, in their first fetal forms, identical but come to differ long before birth. Nipples become dimorphic only at puberty, and balding patterns diverge even later. Underarm hair is not strikingly different in the two sexes, even though its existence depends on androgens, whereas facial hair is strikingly different—although both kinds of hair begin their growth at puberty.)

Our developmental hypothesis, then, is that in humans (and perhaps most primates as well), masculinization has become, through heterochrony, somewhat or greatly decoupled from feminization. This decoupling provides evolution the opportunity to produce human beings with novel combinations of masculinization and feminization—combinations difficult to elicit under natural conditions in a species (such as rats) where the two processes are more tightly coupled. These
novel combinations can then be acted upon by natural selection, but each would have strikingly different effects on the evolutionary fates of their carriers in different societies. (Note that these variations need not be viewed as pathological any more than variations in handedness, height, or eye color are.)

We have devoted this paper to explaining the patterns revealed by arranging the gender transpositions in a particular tabular form. Many previous attempts to understand the gender transpositions have arranged them in a linear pattern—for example, the notion that male homosexuals are on average more feminine than heterosexuals but less so than transsexuals (e.g., Blanchard & Freund, 1983; see also Meyer-Bahlburg, 1984, p. 398). There are occasional exceptions; Money (1974) arranged the transpositions in an array tantalizingly similar to ours but rearranged them in a later publication (Money, 1980). As mentioned above, arrangement alone does not explain the transpositions, but explanations may result if the underlying processes creating the arrangement are revealed.

For example, consider MIS. MIS apparently requires testosterone for its action (Ikawa, Hutson, Budzik, MacLaughlin, & Donahoe, 1982). This alone could suggest that there would be two classes of men in which defeminization does not occur: (a) those in which testosterone caused ordinary masculinization, but defeminization failed to occur because of an atypical (not necessarily clinically “abnormal”) interaction between testosterone and MIS or a low activity of MIS alone; and (b) those in which testosterone itself fails to produce the activity necessary to activate MIS. Because this work is so new, we hesitate to commit ourselves to the possibility that the first group includes gay men without sissy childhoods and the second includes gay men who were sissies. But the hypothesis is tempting. It would explain why M-F transsexualism is so rare in comparison to male homosexuality: If the defeminizing hormone requires the masculinizing one, it would be difficult to produce individuals who are defeminized but not masculinized. And it would explain why so few tomboys grow up to become F-M transsexuals: because masculinization in women would ordinarily not have any effect on defeminization, since women don’t produce MIS. A recent report (Futterweit et al., 1986) points to ovarian pathologies in a substantial fraction of F-M transsexuals; do the ovaries in these women produce MIS or other defeminizing substances?

Here’s another possible underlying cause of part of our table. Ikawa et al. (1982) found that dihydrotestosterone is not required for MIS to
operate. This might explain the ease with which some 5-alpha-reductase-deficient hermaphrodites change their sex of assignment from female to male (Imperato-McGinley, Peterson, Gautier, & Sturla, 1979; but see Money, 1976): the defeminizing components of their psychoendocrine systems are intact, so defeminization is possible; and the reassignment takes place at puberty (when the phallus grows)—the time at which we suggest that defeminization would take place ordinarily.

Likewise, if MIS requires testosterone—but not testosterone receptors—to exert its defeminizing effects, it would also explain why androgen insensitive XY women defeminize.

All these possibilities are speculative, because so little is known about MIS. But such information may turn out to provide a biological basis for the periodic table model, just as the physics of electrons and orbitals turned out to explain the chemical periodic table.

We do not see our model as excessively biological, although we have presented mostly biological evidence. Theories, after all, should be described not with a single, one-dimensional measure of nature versus nurture but should be described in at least two dimensions, one for nature and nurture. Hence, the effects of this paper are best described as moving models from ones in which only social/psychological principles are used to ones in which these principles are combined with biological ones.

Is it really an advance to boil human beings (and human theories) down to the relative positions on two dimensions, rather than just one? Perhaps not. But we hope this theory will point toward understanding human behavior on several dimensions, not just two. We are stuck, at the moment, with less clarity than we’d like and some fuzzy correlational predictions. But that’s where chemists were stuck a few decades ago, after first noticing the regularities among the various chemical elements. Perhaps in another few decades sexologists will have a periodic table of the sexual elements more worthy of the name.

References


PERIODIC TABLE OF GENDER TRANSPOSITIONS


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