Biological Differences
What Are They And Why Are They Important?

Those of us outside the scientific community have known for a long time that the behavior and emotions of men and women are strongly affected by hormones. Some things are obvious way before science provides hard proof.

The earliest research about the effects of hormones on human behavior has been questioned because it was done exclusively by male biologists Recent research by both female and male biologists describes in much greater detail how hormones affect behavior in relationships between men and women (Lagato, M., Brizendine, L.).

New brain scan techniques, PET Scans and CAT Scans, show us anatomical differences in male and female brains. They also show major differences in neurological functioning. Now we can see how our brains are functioning while we are acting and reacting in real life scenarios. (Previously, we could only infer brain differences from autopsies.)

This chapter explains in basic terms what research tells us about how men and women differ biologically, and how these differences affect our relationships. While the scientific material is condensed to its' most basic form, it may still may seem daunting to some. Read this chapter more slowly than others if you like.

Above all, after reading the chapter, do the exercises at the end. These exercises will help make the information and conclusions personal and applicable. Knowledge of how you and your mate differ biologically can make a big difference in the ways you communicate, and therefore the depth and health of your relationship.

Keep in mind as you read that ***sex*** is a biologic term referring to anatomy. ***Gender*** is a social term referring to how our personalities work in social situations. Basically, when we speak of ***sex*** we are talking about the body. When we speak of ***gender*** we are talking about social patterns of behavior commonly classified as typically masculine, feminine, or androgenous.

In real life we can't keep these two terms separate. When we talk about ***gender***, we have to include ***sex***. Sex and gender happen at the same time, and influence each other. If this seems confusing, keep reading and think about it.

The very act of sexual intercourse at the beginning of life happens within a social context. In other words, when we have sex we do so as men and women who have been socialized to act in certain ways. Biological conception occurs within a gendered context, and gender occurs within a biologic context. ***It is most accurate to think of sex***

and gender interacting together in real life. Thus, our sexuality (hormones and anatomy) influence our social behavior, and our social behavior (gender patterns) influence the way our biology functions. At one and the same time we are both biologic and social creatures, male and female.

Gender Is Hard-Wired

While research about biology and gender dates back at least to the 1930's, we will skip the earliest research and start in the 1960's where the most revealing experiments have occurred. Some of the most thought provoking research was conducted with infants born with ambiguous (both male and female) genitalia.

Two scientists, Money and Erhardt, who believed that gender was entirely produced by social influence, decided (with parental permission) to surgically alter the genitals of infants born with ambiguous (both male and female) genitalia. These infants are referred to as hermaphrodites. Money and Erhardt believed that if they made the genitals of hermaphrodites either male or female, and the parents raised the children as if they were either male or female, these children would grow up to be well-adjusted males and females in accordance with how they were raised. That is, Money and Erhardt believed that if parents dressed and treated their children as exclusively male or female, regardless of their original genitalia, the children would simply follow the pattern of their upbringing and think of themselves male or female as defined by their social experience.

The most startling outcome of this research was that many of the infants who were surgically altered, and raised as the altered sex, never accepted their gender or sex. That is, many of these infants, despite their raising and surgery, grew up believing they were the opposite sex, trapped in the wrong body. The outcomes of many of these cases suggested that prenatal hormonal influences on the brain were of greater importance in determining gender identity than social influence (Diamond, 1997, pp. 199-211). That is, regardless of whether or not genitalia were altered to look and function as male or female, gender identity functioned independently. Altered subjects maintained an internal image of gender independent of genitalia or parental, peer, and other social influence. ***This result suggested that gender identity was primarily formed from biological determinants.***

Hormones Make Us Different

Contemporary research is advancing our understanding of hormones and behavior by leaps and bounds, altering the historical view previously summarized. The following is a quick sketch of what we now know, based on the recent book, Eve's Rib, written by Marianne J. Legato, M.D.. Dr. Legato founded the Partnership for Gender-Specific Medicine at Columbia University, where she is currently professor of clinical medicine in the University's College of Physicians and Surgeons. She is an excellent example of how

women have brought a more balanced perspective to our understanding of biology and gender.

Dr. Legato's research provides some fairly complicated views of how men and women differ biologically. While the reading may be slow going for most of us, it is presented here without alteration so as to maintain accuracy. Take your time and re-read sections if necessary.

"Women have a relatively higher concentration of estrogen than men. Both sexes have estrogen, progesterone, and testosterone, but in different concentrations (Legato, 2002, p. 202). In women the ovaries, and to a lesser degree, the adrenal glands make all three hormones. "The brain (in women) regulates the production of all three hormones in a cyclic, rhythmic pattern of ovarian stimulation."(Legato, p. 201)

Testosterone, in males, does not directly enter the fetal brain, but enters the brain cells, where an enzyme (chemical that changes the speed of chemical reactions without itself being changed) called *aromatase* converts it into estrogen." (Legato, p. 23). Ironically, it is technically estrogen, rather than testosterone, which is now believed to masculinize the fetal brain. The mother's estrogen is somehow protected from entering the fetal brain. Without testosterone in high levels there is not enough estrogen to change the female fetal brain to male, and the brain develops into that of a female. (Legato, p. 24)

"The varied actions of estrogen in the body are explained by specific differences in the estrogen receptors, and by the presence or absence of specific co-factors (other proteins that enhance or facilitate the action of estrogen)." "These co-factors are not only age-specific (present only at one stage of development) but also tissue-specific." (Legato, p. 33. Estrogen maintains the brain's plasticity, or ability to continually form new neuronal networks in order to change and record memory. Estrogen is an essential modulator and facilitator of the process, not only of making new memories, but also of making new cells to master and retain information (Legato, p. 33). Estrogen "increases the numbers of 'spines' on the *dendrites* (the fingerlike projections from the body of a nerve cell)." "Through these spines neurons communicate with one another by chemical messages released across spaces called synapses." "These chemicals are called *neurotransmitters*."(Legato, p. 33). Moreover, estrogen "increases blood flow to the brain and enhances the brain's use of glucose, which provides it with essential energy." (Legato, p. 33) Thus, in extremely important ways, estrogen is critical to cognitive functioning in both males and females.

Hormones are related to depression and anxiety in women and aggression in men. Depression is twice as frequent in women as in men, a difference which emerges in mid-adolescence (Legato, p. 37). While there are numerous social and cultural attributions for this difference (Legato, p. 37) hormones in women are at least partly to blame. "Ovarian steroids, whether naturally occurring or taken as replacement therapy) have a direct impact on mood." (Legato, p. 38)

"In general, estrogen produces a sense of well-being, while elevated progesterone levels (the hormone produced in the second half of the menstrual cycle, from the ovary that has released a mature egg) are correlated with negative moods." "This is dramatically apparent when women are given hormones either for birth control or to treat menopause-related conditions."(Legato, p. 38) "Some of the progestins (synthetic hormones) in those medications are more disturbing than others to individual women." "The depression and anxiety that accompany the progesterone phase of the cycle in women who use birth control pills can be eliminated or dramatically lessened by using a preparation with a different progestin." (Legato, p.38)

Men and women have differing hormonal responses to stress. Stress, or an unpleasant experience, increases the output of the adrenal gland. The adrenal glucocortcoids (the hormonal output of the adrenal gland, which, like gonadal hormones, act directly on the brain) "are controlled in the bloodstream by an elaborate feedback mechanism that involves the hippocampal area of the brain, the pituitary, and the adrenal glands themselves." (Legato, p. 40)

When women experience stress, "estrogen intensifies and prolongs the response of the adrenal glands." (Legato, p. 40) When men are given estrogen, their response to stress increases. (Legato, p. 40) This greater sensitivity to stress caused by estrogen correlates with girls becoming more susceptible to stress at puberty, when the incidence of depression in girls also increases strikingly. (Legato, p. 40)

In men, high levels of testosterone are associated with aggression, antisocial behavior, violent criminal behavior (Kreuz & Rose, 1972, pp. 321-322) and recently with success in athletic and nonathletic competitive events (Bernhardt,1997). While a robust relationship has been found between testosterone and aggression in humans, some researchers suggest a more complex relationship, which may tie testosterone together with other behaviors and experiences in a broader theory of dominance (Dabbs & Ruback, 1988). The vicarious experience of observing competitive events has been shown to influence testosterone, suggesting a complex social and biological relationship between testosterone and experience (Bernhardt, Dabbs, Fielden, & Lutter, 1997). Some researchers have found that the aggressive behavior of antisocial individuals with high testosterone is moderated by socioeconomic status (Dabbs & Morris, 1990; Bernhardt, 1997). Low serotonin levels, in conjunction with high levels of testosterone, are associated with aggression and dominance in animals (Gentsch, 1988; Bonson & Winter, 1992), leading to the theory that the effects of testosterone in humans is mediated by serotonin (Bernhardt, 1997).

Relationships between hormones and behavior are better understood in animals than humans, since research methods with humans are limited. In general, the specific chemical pathways through which hormones affect behavior are not clearly understood.

Essentially, we are only recently beginning to discover the important role of estrogen, in conjunction with testosterone, in forming the fetal brain, as well as maintaining healthy brain functioning in adults. We now know that estrogen increases

the sense of well-being, improves memory, but also increases responses to stress, and that progesterone is associated with negative moods. We also know that testosterone is associated with aggressiveness, dominance, anti-social behavior, success in athletic events, and sex drive.

It is especially important to remember, however, that hormones exist in a social environment, and in ways which we are only beginning to explore, are socially influenced. Thus, while we know that hormones influence behavior, the process, direction, and nature of that influence is still being researched and discovered. Future research may well find that while hormones influence behavior, behavior influences hormones.

Our Brains Are Different

"Men's brains are generally 15 to 20 percent larger than women's, but women's brains contain about 11 percent more neurons in one very specialized area of the cerebral cortex, just behind the eye, that is involved in recognizing tonal differences in language and music." "Women also have more extensive connections between neurons. "Other parts of the brain have differences that are mirror images, from hemisphere to hemisphere, depending on gender: the inferior parietal lobe (the part of the brain directly above the ear) is larger on the left in men and larger on the right in women." "This part of the brain processes the information we receive through vision and touch." (Legato, pp. 19-21)

The hypothalamus has been found to differ between heterosexual and homosexual men, and between men and women. The hypothalamus is the part of the brain that helps control hormone levels. In the hypothalamus the collection of cells called the sexually dimorphic nucleus, have almost twice as many cells in men than in women (Legato, p. 20). The corpus callosum is larger in women than in men. Even greater differences have been found between anterior and posterior portions of male and female brains than in the corpus callosum (Levy & Heller, 1992). However, we do not yet know what these differences in size actually mean for how men and women function.

The Hypothalamus

Research with humans has focused on the hypothalamus, which functions as a control for the pituitary gland. The pituitary gland, referred to as "the master gland of the body," controls the hormone secretions of all other glands. Indirectly, then, the hypothalamus essentially regulates all hormone production. After puberty, a female differentiated hypothalamus produces female hormones in cycles, and a male differentiated hypothalamus produces male hormones (Breedlove, 1992). The hypothalamus also functions to convert unconscious psychological needs, such as hunger, thirst, and the need for sex, into perceived psychological needs or drives. Contemporary, though still controversial research, has focused on distinct areas of the hypothalamus,

referred to as nuclei, which, in theory, control not only the sex drive, but one's sexual orientation (LeVay, 1993; Swaab & Fliers, 1985; Swaab, Zhou, Fodor, & Hofman, 1997).

Research regarding sex and gender has centered on the identification and measurement of four centers of activity in the hypothalamus, referred to as nuclei. Essentially, these four nuclei are clusters of cells that, on a laboratory slide, resemble to the human eye distant galazies. The four nuclei are referred to as INAH1, INAH2, INAH3, and INAH4. Particular interest is focused on INAH3, as research reflects a robust statistical difference in the size of INAH3 when comparisons are made between heterosexual and homosexual brains (afforded from autopsies of sex (homosexual) and drug (heterosexual) acquired AIDS victims. The theoretical suggestion is that this difference in size represents a physiologic determinant of sexual preference in males (Allen, Hine, Shryne, & Gorski, 1989; LeVay, 1991). Conclusions about the hypothalamus, however, are questioned on methodological grounds. Essentially, Byne and Parsons question the laboratory procedures used by Allen and LeVay, and also the validity of drawing conclusions about normal brain activity from autopsied tissue (Byne & Parsons, 1993).

Brain Laterality

Contemporary research has also linked prenatal levels of testosterone to adult brain laterality, "with high levels (usually in male fetuses) associated with greater lateralization (Levy & Heller, 1992)." "Some studies have also suggested that the corpus callosum, the part of the brain that serves as the major communication route between the two hemispheres, is also influenced by prenatal sex hormones (e.g., deLacoste, Holloway, & Woodward, 1986. The implications of this research are unclear at this point in time (Witelson, Glezer, & Kigar, 1995).

Anterior/Posterior Brain Differences

Greater differences have been found between ***anterior and posterior sections of the brains*** of men and women than has been found in the corpus callosum.

Again, "Levy and Heller (1992) report that the relatively unstudied sex differences in anterior-posterior brain organization are even larger than the small, but well-documented sex differences in laterality, and recent research suggests that such differences may be directly related to adult sex differences in cognitive function (see also Kimura & Hampson, 1993; and Witelson, Glezer, & Kigar, 1995)."

A Summative Statement About Neuroendorinological, Brain Anatomy, and Genetic Differences

The forgoing examples of research in neuroendocrinology, anatomy, and genetics are representative, but by no means inclusive of the amazing amount of emerging research which is now informing our understanding of relationships between biology and gender. Each field of research presents its own conclusions. However, to

understand these findings holistically, a larger lens and summary of conclusions is required. Thus, we move to that lens.

At Puberty Girls and Boys Function Differently

Linda Mealy (Mealy, pp. 11-13) notes the following sex differences related to puberty. "Animal research (Ellis, 1986), and research with humans with unusual hormone levels (e.g., Kimura & Hampson, 1993; Reinisch & Sanders, 1992; Reinisch, Ziemba-Davis, & Sanders, 1991) as well as humans going through hormone changes or treatments (e.g., Van Goozen, Cohen-Kettenis, Gooren, Frijda, & Van de Poll, 1994; Wallen & Lovejoy, 1993) suggest that organizational effects of puberty occur in the brain as well as in other parts of the body."(Mealy, pp. 11-13)

1. ***Sex drive*** (males report more, on average, with effect sizes of around .50 to .80 depending on the measuring technique; Ellis & Symons, 1990; Geer & Manguno-Mire, 1996; Hyde, 1996; Knoth, Boyd, & Singer, 1988; Oliver & Hyde, 1993; Singer, 1985; Udry, Billy, & Morris, 1984; Udry, Talbert, & Morris, 1986)
2. ***Mathematical and certain spatial skills*** (males perform better, on average, with effect sizes ranging from .10 to .80; Galea & Kimura, 1993; Gaulin & Hoffman, 1988; Geary, 1996; Hyde, 1996; Sanders & Soares, 1986; Vasta & Liben, 1996; Voyer, Voyer, & Bryden, 1995; Wynn, Tierson, & Palmer, 1996)
3. ***Visual acuity*** (males are better, on average; Mackey & Johnson, 1994; Velle, 1987)
4. ***Sensitivity to taste, smell, sound, touch, and pain*** (females are more sensitive to all of these, on average; Ellis 1986; Velle, 1987)
5. ***Various attitudes, interests, and personality traits*** (females are more nurturant, less aggressive, more anxious, and less impulsive, less sensation seeking, and less risk taking, on average, than males; Daly & Wilson, 1985; Eagly & Steffen, 1986; Ellis, 1986; Feingold, 1994; Harris, Rushton, Hampson, & Jackson, 1996; Zuckerman, 1984, 1990; Zuckerman, Buchsbaum, & Murphy, 1980; Bernhardt, 1997)
6. ***Language Development and Verbal Skills***
   (females develop language earlier and reflect higher verbal skills (effect sizes ranging from .10 to as much as 1.2 in favor of females) .80 depending on the measuring technique; Ellis & Symons, 1990; Geer & Manguno-Mire, 1996; Hyde, 1996; Knoth, Boyd, & Singer, 1988; Oliver & Hyde, 1993; Singer, 1985; Udry, Billy, & Morris, 1984; Udry, Talbert, & Morris, 1986)

It is important to keep in mind, when considering these differences, that a great amount of diversity exists in cognitive ability within sexes. Some of the aforementioned variance is undoubtedly accounted for by a small number of males and females who

deviate radically from the norm. While differences in cognitive abilities do exist, most samples of men and women are more similar than different.

A Summary of Our Biological Differences

Gender identity (the internal psychological sense of maleness or femaleness), which starts developing at approximately age two, and is firmly fixed by age four, is largely influenced biologically. The results of studies by Money and Erhardt strongly suggest that prenatal hormonal influences on the brain are of greatest importance in determining gender identity. Sociological studies further substantiate this conclusion. ***Assigned gender***, originally thought by many social scientists to be determined by parents, evidences itself so early that little attribution can now be given to social influence. While the evidence that adults stereotype babies by gender is quite strong, the evidence that such stereotyping makes a difference in children's behavior is quite weak. The relatively small amount of early gender patterns which are determined postnatally appear to be primarily the influence of children *on one another.* The influence of children on one another may very well represent deferred biological influences. ***Clearly, early and enduring patterns of both gender identity and gendered behavioral patterns are strongly influenced by biology.***

Male and female brains show significant anatomical differences. During the end of the first trimester and the beginning of the second trimester of pregnancy, some research suggests the fetal brain is organized by hormones. Research here is sparse and relies largely on the study of other mammals. Ethics in experimental methods with humans largely prevents the tracing of hormonal brain influences during early development. Some contemporary research has linked prenatal levels of testosterone to adult brain laterality, with high levels (usually in male fetuses) associated with greater lateralization. Some studies have also suggested that the corpus callosum, the part of the brain that serves as the major communication route between the two hemispheres, is influenced by prenatal sex hormones. We still do not know enough about the microbiological nature of communication in the corpus callosum to accurately attribute differences in size to differences in function. Emerging research with brain imaging techniques reveals male and female brains function differently as regards bilaterality. The relatively unstudied sex differences in anterior-posterior brain organization are even larger than the small, but well-documented sex differences in laterality. Implications of these greater differences are yet to be determined.

Recent research suggests that differences in male-female brain anatomy may be directly related to adult sex differences in cognitive function. Studies suggest that many of the major cognitive differences between the sexes have their beginnings in early fetal development. At a minimum, it is almost certain that infant levels of tactile sensitivity, motor activity, exploratory activity, and aggression are influenced by hormones acting on the brain during the second and third trimesters of fetal life. Other robust, cross-cultural differences that appear later may have their origin in differential hormonal influences on brain development. Among these are ***mathematical and certain spatial skills*** (males

perform better, on average, ***visual acuity*** (males are better, on average); ***sensitivity to taste, smell, sound, touch, and pain*** (females are more sensitive to all of these, on average); ***various attitudes, interests, and personality traits*** (females are more nurturant, less aggressive, more anxious, and less impulsive, less sensation seeking, and less risk taking, on average, than males); ***language development and verbal skills*** (females develop language earlier and reflect higher verbal skills).

In a separate category it is also important to note that ***robust differences exist in sex drive*** (males report more, on average, with effect sizes of around .50 to .80 depending on the measuring technique).

Three Broad Conclusions

First, biological research clearly indicates that it is most accurate to think of sex and gender as sociobiological, or biosociological variables related in a circular continuum of interactive causality***. That is, the social environment influences how we function biologically, and the biological environment influences how we function socially.***

Second, organizational theory***, (which holds that behavior is permanently shaped by the presence or absence of the male hormone prior to birth), is indirectly validated by the sum and thrust of contemporary biological research.*** Initially, the validity of biological research was questioned by feminists because of male bias. Since the 1960's a growing number of women biologists have not only created a more sexually balanced body of research, but also further validated the organizational effect of the presence or absence of male hormones, in conjunction with estrogen, prior to birth. ***Thus, in gender terms, contemporary research strongly validates that gender is strongly influenced by hormones during gestation.***

Third, it is important to keep in mind the limitations of biological research with humans. That is, research with humans is largely correlational, with the exception of genetic research. Even in genetics, indications are that both the biological and sociological environments interact in complex ways which are beyond the limits of both social and physical sciences to classify and quantify. ***Clearly, both gender and sexuality are strongly influenced by biology. The degree to which this is true, and the manner in which it occurs, are open questions awaiting more research.***

Why Are These Differences Between Men And Women Important?

Biological differences between men and women affect our behavior in intimate relationships. Clearly, because men tend to be more aggressive, dominant, think about sex more than women, relate to space differently, and focus more on tasks vs. talk, they come across very differently in relationships. Because women experience more fluctuations in mood and respond more to stress than men, have better memories about specific dates and events, and because women think less about sex, are less aggressive,

and are more oriented to connecting through conversation, women come across very differently than men in intimate relationships.

Differences in the way we come across in relationships can create a great deal of misunderstandings as well as false expectations about what behavior we can and should expect from the other. These misunderstandings and false expectations, in turn, can trigger negative feelings in relationships, causing couples to build walls instead of bridges between each other.

More is written in other chapters about how these differences affect the way we communicate. However, in this chapter it is mainly important to understand first how we are different, and second how these differences play out in our specific relationships.

In order to get a better idea how you and your partner are different, two sets of exercises are included that will help you explore and communicate about your differences. Assuming you both have read this chapter, and are now ready to talk specifically about how it applies to the two of you, you may proceed to the two sets of exercises below. Having taken the time to plow through this research, now take the time to more specifically get to know yourself and your partner, and how you are different.

Applied Exercises
Designed To Make Your Knowledge Specific
To You and Your Mate

Exercise One: *To Be Conducted By Yourself (Intrapersonally).*

1. Remembering what you have read, state and describe your sex and gender. That is, state how you see yourself as male or female. In other words, what patterns of your actions (behavior), thoughts (they way you think) and feelings (the way you feel) tell you that you are a male or female? How do you think you should act, as a man or as a woman, in your relationship?

2. How do your parents describe your behavior, according to gender patterns, in your early years, say between two and six years of age? If they haven't told you, or you don't remember, and your parents are available, ask them how you were during your early years.

3. How has your gender behavior changed over time? Have you become more or less male or female during your life time?

Exercise Two: ***To Be Conducted Interpersonally*** (with your opposite sex partner).

1. Describe to your partner how you respond to stress, physically and emotionally. Discuss how the two of you differ?

2. What are your dominant feelings? How do they differ?

3. What, if any, biological elements do you attribute to your feelings?

4. Share with your partner what you wrote in exercise one.

5. Discuss what you have discovered about how the two of you differ according to your sex and gender patterns. Sum up what you have learned about each other and how you are different.

References

Allen, L., Hines, M., Shryne, J., and Gorski, R., "Two Sexually Dimorphic Cell Groups in the Human Brain," *Journal of Neuroscience,* **9 (2)** (1989), pp. 497-506.

Allen, Laura, "Sex Differences in the Corpus Callosum of the Living Human Being," *Journal of Neuroscience* **11 (4)** April 1991, pp. 933-942.

Bailey, Michael J., Pillard, Richard, "A Genetic Study of male Sexual Orientation," *Archives of General Psychiatry*, **48**, December, 1991, pp. 1089-1096.

Bailey, Michael J., Pillard, Richard, "Heritable Factors Influence Sexual Orientation in Women," *Archives of General Psychiatry*, **50**, March 1993, pp. 217-223.

Beach, Frank A., "Hormonal Factors Controlling the Differentiation, Development and Display of Copulatory Behaviors in the Ramstergig (!) and Related Species, " in E. Tobach, L. R. Aronson, and E. Shaw, eds., The Biopsychology of Development, New York: Academic Press, 1971, pp. 249-96. Fausto-Sterling, Ann, "Society Writes Biology, Biology Constructs Gender," *Daedalus*,**16** (1987), 61-76.

Becker, J. B., Breedlove, S. M. & Crews, D. (1992) Behavioral Endocrinology. Cambridge, MA: MIT Press.

Bernhardt, P. C., Influences of Serotonin and Testosterone in Aggression and Dominance: Convergence With Social Psychology," *Current Directions in Psychological Science*, **6, (2),** April 1997.

Bernhardt, P.C., Dabbs, J. M., Jr., Fielden, J. A, & Lutter, C. (1997). Testosterone change during vicarious experiences of victory and defeat in spectators of sporting events. Manuscript submitted for publication.

Bonson, K.R., & Winter, J.C. (1992). Reversal of testosterone-induced dominance by the serotonergic agonist quipazine. *Pharmacology, Biochemistry, and Behavior*, **42**, 809-813.

Braza, F., Braza, P. Carreras, M. R. & Munoz, J. M. (1997) Development of sex differences in preschool children: Social behavior during an academic year. *Psychological Reports*, **80**, pp. 179-188.

Breedlove, S.M. (1992). Sexual differentiation of the brain and behavior. In J.B. Becker, S. M. Breedlove, & D. Crews (Eds.) Behavioral Endocrinology. Cambridge, MA: MI Press.

Buchannan, C. M., Eccles, J. S., & Becker, J. B. (1992). Are adolescents the victims of raging hormones: Evidence for activational effects of hormones on moods and behavior at adolescence. *Psychological Bulletin*, **111**, pp. 62-107.

Burr, Chandler, A Separate Creation: The Search For The Biological Origins of Sexual Orientation, Hyperion: New York, 1996, pp. 199 – 205.

Burr, Chandler, A Separate Creation: The Search For The Biological Origins of Sexual Orientation, Hyperion: New York, 1996, pp. 233-234.

Burr, Chandler, A Separate Creation: The Search For The Biological Origins of Sexual Orientation, Hyperion: New York, 1996, p. 259.

Butterworth, G. (1997). *What is special about pointing?* Presented at the School of Psychology, University of Queensland, Brisbane Australia, November 28, 1997.

Byne, W., Parsons, B., "Human Sexual Orientation: the Biologic Theories Reappraised," in *Archives of General Psychiatry* **50**, March 1993, pp. 228-239.

Dabbs, J.M., & Morris, R. (1960). Testosterone, social class, and antisocial behavior in a sample of 4,462 men. *Psychological Science,* **1**, 209-211.

Dabbs, J.M., & Ruback, R.B. (1988) Saliva testosterone and personality of male college students, *Bulletin of the Psychonomic Society*, **26**, 244-247.

Daly, M., & Wilson, M. (1985). Child abuse and other risks of not living with both parents. *Ethology and Sociobiology*, **6**, pp. 197-210.

De LaCoste, C., & Holloway, R., "Sexual Dimorphism in the Human Corpus Callosum," *Science* **216**, June 25, 1982, pp. 1431-1432.

Diamond, M. (1997), Sexual identity and sexual orientation in children with traumatized or ambiguous genitalia, *Journal of Sex Research*, **34**.

Eagly, A. H., & Stefflen, V. J. (1986).Gender and aggressive behavior: A meta-analytic review of the social psychological literature. *Psychological Bulletin*, **100**, pp. 309-330.

Ellis, L. (1986). Evidence of neuroandrogenic etiology of sex roles from a combined analysis of human, nonhuman primate and nonprimate mammalian studies. *Personality and Individual Differences*, **7**, pp. 519-522.

Ellis, G., & Symons, D. (1990). Sex differences in sexual fantasy: an evolutionary psychological approach. *Journal of Sex Research*, **27**, pp. 527-555.

Fagot, B. I., & Leinbach, M. D. (1993). Gender role development in young children: From discrimination to labeling. *Developmental Review*, **13**, pp. 205-224.

Fagot, B. I.(1995). Psycholosocial and cognitive determinants of early gender-role development. *Annual Review of Sex Research*, **6**, pp. 1-31.

Faulk, D. (1997). Brain evolution in human females. In L. D. Hager (Ed.), Women in Human Evolution. New York: Routledge.

Fausto-Sterling, Anne, Myths of Gender: Biological Theories About Women and Men, 2nd Edition, Harper-Collins, 1985.

Feingold, A. (1994). Gender differences in personality: A meta-analysis. *Psychological Bulletin*, **116**, 429-456.

Fenson, L., Dale, P. S., Reznick, J. S., Thai, D., Bates, E., Hartung, J. P., Petchick, S., & Reilly, J. S., (1993). MacArthur Communicative Development Inventories: User's Guide and Technical Manual. San Diego, CA: Singular.

Fox, E. L., Bowers, R. W., & Foss, M. L. (1993). The Physiological Basis for Exercise and Sport (5th ed.). Madison, WI: WCB Brown Benchmark.

Freedman, D. G. (1979). Human Sociobiology: A Holistic Approach. New York: Free Press.

Galea, L. A. M., & Kimujra, D. (1993). Sex differences in route learning. Personality and *Individual Differences*, **14**, pp. 53-65.

Gaulin, S. J. C., & Hoffman, H. A. (1988). Evolution and development of sex differences in spatial ability. In L. Betzig, M. Borgerhoff Mulder, & P. Turke (Eds.), Human Reproductive Behavior: A Darwinian Perspective. Cambridge, UK: Cambridge Univ. Press.

Geary, D. F. (1996). Sexual selection and sex differences in mathematical abilities (with commentary and rejoinder). *Behavioral and Brain Sciences*, **19**, 229-284.

Geer, J. H., & Manguno-Mire, G. M. (1996). Gender differences in cognitive processes in sexuality. *Annual Review of Sex Research*, **7**, pp. 90-124.

Gentsch, C. (1988). Competition for sucrose pellets in triads of male Wistar rats: Effects of three serotonergic drugs. *Progress in Neuropsychopharmacology, Biology, and Psychiatry,* **12**, 639-651.

Gordon, J. W., & Ruddle, F. H. (1981). Mammalian gonadal determination and gametogenesis. *Science*, **21**, pp. 1265-1271.

Gottlieb, G., "Environmental and Behavioral Influences on Gene Activity," *Current Directions in Psychological Science*, **9, (3),** June 2000.

Green, R., The "Sissy Boy Syndrome, and the Development of Homosexuality. New Haven, CT: Yale University Press, 1987.

Grumbach, M. M., & Styne, D. M. (1992). Puberty: Ontogeny, neuroendocrinology, physiology and disorders. In J. D. Wilson & D. W. Foster (Eds.), Williams Textbook of Endocrinology (8th ed.). Philoadlphia: W. B. Saunders.

Halpern, D. F. (1992). Sex Differences in Cognitive Abilities (2nd ed.). Hillsdale, NJ: Erlbaum.

Halpern, D. F., & Crothers, M. (1997). Sex, sexual orientation, and cognition. In L. Ellis & L. Eberts (Eds.), Sexual Orientation: Toward Biological Understanding, Westport, CT: Praeger.

Hamer, D. H., Hu, S., Magnuson, V., Hu, N., Pattatucci, A. M. I., "A Linkage Between DNA Markers on the X Chromosome and male Sexual Orientation," *Science* **261** (July 16, 1993), pp. 321-327.

Hamer, D. H. & Pattatucci, A. et. al., "Linkage Between Sexual Orientation and Chromosome Xq28 in Males But Not in Females," *Nature Genetics* **11** (November, 1995).

Hampson, E., & Kimura, D. (1992). Sex differences and hormonal influences on cognitive function in humans. In J. B. Becker, S. M., Breedlove, & D. Crews (Eds.), Behavioral Endocrinology, Cambridge, MA: MIT Press.

Haqq, C. M., King, C.-Y., Ukiyama, E., Falsafi, S., Haqq, T. N., Donahoe, P.K., & Weiss, M. A. (1964), Molecular basis of mammalian sexual determination: Activation of Mullerian Inhibiting Substance gene expression by SRY. *Science*, **266**, pp. 1494-1500.

Harris, J. (1995). Where is the child's environment? A group socialization theory of development. *Psychological Review*, **102**, pp. 458-489.

Harris, J. A., Rushton, J. P., Hampson, E., & Jackson, D. N. (1996). Salivary testosterone and self-report affressive and pro-social personality characteristics in men and women. *Aggressive Behavior*, **22**, pp. 321-331.

Hyde, J. S. (1996). Where are the gender differences? Where are the gender similarities? In D. Buss & N. Malamuth (Eds.), Sex, Power, Conflict: Evolutionary and Feminist Perspectives. New York: Oxford Univ. Press.

Hyde, J. S., & Linn, M. C. (1988). Gender differences in verbal ability: A meta-analysis. *Psychological Bulletin*, **104**, 53-69.

Jacklin, C. N., & Reynolds, C. (1993). Gender and childhood socialization. In A. E. Beall & R. J. Sternberg (Eds.). The Psychology of Gender. New York: Guilford.

Jacklin, C., Snow, M., & Maccoby, E. (1982). Tactile sensitivity and muscle strength in newborn boys and girls. *Infant Behavioral Development*, **4**, pp. 261-268.

Kimura, D., & Hampson, E. (1993). Neural and hormonal mechanisms mediating sex differences in cognition. In P.A. Vernon (Ed.) Biological Approaches to the Study of Human Intelligence. Norwood, NJ: Ablex.

Knoth, R., Boyd, K., & Singer, B. (1988). Empirical tests of sexual selection theory: Predictions of sex differences in onset, intensity, and time course of sexual arousal. *Journal of Sex Research*, **24**, pp. 73-89.

Kreuz, L.E., & Rose, R.M. (1972). Assessment of aggressive behavior and plasma testosterone in a young criminal population. *Psychosomatic Medicine,* **34**, 321-332.

Legato, Marianne J., Eve's Rib, Harmony Books: New York, N.Y., 2000.

LeVay, S., "A Difference in Hypothalamic Structure Between Heterosexual and Homosexual Men," *Science* **253** (August 30, 1991), pp. 1034-1037.

LeVay, S. (1993). The Sexual Brain. Cambridge, MA: MIT.

Levy, J. & Heller, W. (1992). Gender differences in neuropsychological function. In A. A. Gerall, H. Moltz, & L.L. Ward (Eds.), *Handbook of behavioral neurobiology* (Vol. 11). *Sexual differentiation*. New York: Plenum.

Lieberman, L. S. (1982). Normal and abnormal sexual dimorphic patterns of growth and development. In R. L. Hall (Ed.), Sexual Dimorphism in Homo sapiens. Westport, CT: Praeger.

Linn, M. C., & Petersen, A. C. (1985). Emergence and characterization of sex differences in spatial ability: A meta-analysis. *Child Development*, **56**, pp. 1479-1498.

Lytton, H., & Romney, D. M. (1991). Parents' differential socialization of boys and girls: A meta-analysis. *Psychological Bulletin*, **109**, pp. 267-296.

Maccoby, E. E. (1988). Gender as a social category. *Developmental Psychology*, **24**, pp. 755-765.

Maccoby, E. E. (1990). Gender and relationships: A developmental account. *American Psychologist*, **45**, pp. 513-520.

Maccoby, E. E. (1998). The Two Sexes: Growing Up Apart, Coming Together. Cambridge, MA: Belknap Press.

Maccoby, E. E. & Jacklin, C. N. (1974). The Psychology of Sex Differences. Stanford, CA: Stanford Univ. Press.

Mackey, W. C., & Johnson, J. W. (1994). Gender dimorphism of a visual anomaly: A deductive prediction based on an ethological model. *Journal of Genetic Psychology*, **155**, pp. 219-231.

McClintock, M. K., & Herdt, G. (1996). Rethinking puberty: The development of sexual attraction. *Current Directions in Psychological Science*, **5**, pp. 178-183.

McLaren, A. (1990) What makes a man a man? *Nature*, **346**, pp. 1216-1217.

McEwen, B. B. (1981). Neural gonadal steroid actions, *Science*, **211**, pp. 1303-1311.

Mealy, Linda, Sex Differences: Developmental and Evolutionary Strategies, Academic Press, Harcourt-Brace & Company, 2000, pp. 13-23.

Mealy, Linda, Sex Differences: Developmental and Evolutionary Strategies, Academic Press, Harcourt-Brace & Company, 2000, pp. 182-184.

Mealy, Linda, Sex Differences: Developmental and Evolutionary Strategies, Academic Press, Harcourt-Brace & Company, 2000, pp. 200-201.

Money, J. (1968/1964). Sex Errors of the Body and Related Syndromes. Baltimore, MD: Brookes.

Oliver, M. B., & Hyde, J. S. (1993). Gender differences in sexuality: A meta-analysis. *Psychological Bulletin*, **114**, 29-51.

Money, J., Ehrhardt, A. A., Man and Woman, Boy and Girl: Differentiation and Dimorphism of Gender Identity from Conception to Maturity, Johns Hopkins University Press, 1972.

Phoenix, C. H., Goy, R. W., Gerall, A. A., Young, W. C., "Organization Action of Testosterone Propionate on the Tissues Mediating Mating Behavior in the Female Guinea Pig," *Endocrinology*, **65** (1959), 369-82.

Reinisch, J. M., Rosenblum, L. A., Rubin, D. B., & Schulsinger, M. F. (1997). Sex differences emerge during the first year of life. In M. R. Walsh (Ed.), Women, Men, and Gender: Ongoing Debates. New Haven, CT: Yale Univ. Press.

Reinisch, J. M. & Sanders, S. A. (1992). Prenatal hormonal contributions to sex differences in human cognitive and personality development. In A. A. Gerall, H. Moltz, & I> L. Ward (Eds.), Sexual Differentiation: Handbook of Behavioral Neurobiology (Vol. 11), New York: Plenum.

Reinisch, J. M., Ziemba-Davis, M., & Sanders, S. A. (1991). Hormonal contributions to sexually dimorphic behavioral development in humans. *Psychoneuroendocrinology*, **16**, pp. 213-278.

Resnick, S. M., Gottesman, I. I., & McGue, M. (1993). Sensation seeking in opposite-sex twins: An effect of prenatal hormones? *Behavior Genetics*, **23**, pp. 323-329.

Sanders, B., & Soares, M. P. (1986). Sexual maturation and spatial ability in college students. *Developmental Psychology*, **22**, pp. 199-203.

Shaywitz, B. A., Shaywitz, S. E., Pugh, K. R., Constable, R. T., Skudlarski, P., Fulbright, R. K., Bronen, R. A., Fletcher, J. M., Shankweller, D. P., Katz, L. & Gore, J. C. (1995). Sex differences in the functional organization of the brain for language. *Nature*, **373**, pp. 607-609.

Singer, B. (1985). A comparison of evolutionary and environmental theories of erotic response. Part II: Empirical arenas, *Journal Sex Research*, **21**, pp. 345-374.

Stern, M., & Karraker, M. K. (1989). Sex stereotyping of infants: A review of gender labeling studies, *Sex Roles*, **20**, pp. 501-522.

Swaab, D. F., & Fliers, E. (1985). A sexually dimorphic nucleus in the human brain. *Science*, **228**, 1112-1115.

Swaab, D. F., Zhou, J-N., Fodor, M., & Hofman, M. A. (1997). Sexual differentiation of the human hypothalamus: Differences according to sex, sexual orientation, and transsexuality. In L. Ellis & L. Ebertz (Eds.), *Sexual orientation: Toward biological understanding*. Westport, CT: Praeger.

Taylor, M. G. (1996). The development of children's beliefs about social and biological aspect of gender differences. *Child Development*, **67**, pp. 1555-1571.

Thorne, B. (1993). Gender Play: Girls and Boys in School. New Brunswick, NJ: Rutgers, Univ. Press.

Turkheimer, E. (2000). Three laws of behavior genetics and what they mean. *Current Directions in Psychological Science*, **9**, (5), pp. 160-164.

Turkheimer, E. & Gottesman, I. I. (1991). Simulating the dynamics of genes and environment in development, *Development and Psychopathology*, **8**, pp. 667-677.

Udry, J. R. (1994). The nature of gender, *Demography*, **31**, pp. 561-573.

Udry, J. R., Billy, J. O. G., & Morris, N. M. (1984). Serum androgenic hormones motivate sexual behavior in adolescent boys. *Fertility and Sterility*, **42**, pp. 683-685.

Udry, J. R., Talbert, L. M., & Morris, N. M. (1986). Biosocial foundations for adolescent female sexuality. *Demography*, **23**, pp. 217-230.

Van Den Wijngaard, Marianne, Reinventing The Sexes, (Indiana University Press, 1997).

Van Goozen, S. H. M., Cohen-Kettenis, P. T., Gooren, L. J. G., Frijda, N. H., & Van de Poll, N. E. (1994). Activating effects of androgens on cognitive performance: Causal evidence in a group of female-to-male transsexuals. *Neuropsychologia*, **32**, pp. 1153-1157.

Vasta, R., & Liben, L. S. (1996). The water-level task: An intriguing puzzle. *Current Directions in Psychological Science*, **5**, pp. 171-177.

Velle, W. (1987). Sex differences in sensory functions. *Perspectives in Biology and Medicine*, **30**, pp 491-522.

Voyer, D., Voyer, S., & Bryden, M. P. (1995). Magnitude of sex differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin*, **117**, pp. 250-270.

Wallen, K., & Lovejoy, J. (1993). Sexual behavior: Endocrine function and therapy. In J. Schulkin (Ed.), Hormonally Induced Changes in Mind and Brain. NewYork: Academic Press.

Whitam, Frederick L., & Mathy, Robin M., *Male Homosexuality in Four Societies: Brazil, Guatemala, the Philippines, and the United States*, New York: Praeger, 1986; and Whitam, Gederick L., & Daskalos, Christopher T., "Male Sexual Orientation, Femininity, and Childhood Cross-Gender Behavior in Four Societies: Brazil, Peru, Thailand, and the United States," presented at the Society for the Scientific Study of Sexuality, Miami, November, 1994.

Whitam, F. L., "Culturally Invariable Properties of male Homosexuality: Tentative Conclusions from Cross-Cultural Research," *Archives of Sexual Behavior* **12 (3),** 1983.

Whiting, B. B., & Edwards, C. P. (1988). Children of Different Worlds: The Formation of Social Behavior. Cambridge, MA: Harvard Univ. Press.

Witelson, S.F., Glezer, I.I. & Kigar, D.L. (1995). Women have greater density of neurons in posterior temporal cortex. *Journal of Neuroscience*, **15**, 3418-3428.

Wynne, T. G., Tierson, F. D., & Palmer, C. T. (1996). Evolution of sex differences in spatial cognition. *Yearbook of Physical Anthropology*, **39**, pp. 11-42.

Zucker, K. J., Wilson-Smith, D. N., Kurita, J. A., & Stern, A. (1995). Children's appraisals of sex-typed behavior in their peers. *Sex Roles*, **33**, pp. 703-725.

Zuckerman, M. (1984). Sensation seeking: A comparative approach to a human trait. *Behavioral and Brain Sciences*, **7**, pp. 413-471.

Zuckerman, M. (1990). The psychophysiology of sensation seeking. *Journal of Personality*, **58**, pp. 313-345.

Zuckerman, M., Buchsbaum, M. S., & Murphy, D. L. (1980). Sensation seeking and its biological correlates. *Psychological Bulletin*, **88**, pp. 187-214.