THE BIOLOGICAL ROOTS OF GENDER IDENTITY DISORDER

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Liberal and Professional Studies 199

CAPITAL UNIVERSITY,

NOVEMBER 2002

Introduction

Most of us never give a thought to our gender identity. We are born male or female, and that is all we need to know. We may spend years figuring out what it means to be our gender yet we never question, Am I am really a wo/man? Imagine waking up one morning and looking in the mirror. What would it feel like if the face that looked back was not yours? Take it a step further: imagine you are suddenly transformed into the opposite gender; you still clearly remember yourself as you used to be, your feelings haven't changed, your personality is still the same, yet your body is totally wrong from what you recall. In this miraculous transformation, imagine that everyone who you know only remembers you with the body you now have. Everyone you meet responds to you as if you are this new body, calling you "sir", when inside you are screaming "it's Ms." How would it feel to have to use a public restroom, go clothes shopping, make love or any of the other daily events? Now project this feeling out— day after day having a body that says one gender and a mind that knows it is another. This is a small taste of what it is like to have a Gender Identity Disorder (GID).

Gender Identity Disorder is a very complex situation. Currently there is no theory the encompasses all the manifestations of this problem. Additionally, there is no test to verify one's claim of being gender dysphoric. Until there is external validity of a gender dysphoric persons feeling state these people are doomed to live in a world that denies their reality and blocks the available avenues to their happiness.

In any discussion of GID and transsexualism it is important to understand the terminology in current use. As our understanding of GID has grown the language has

evolved to reflect great understanding of the problem. Unfortunately, over the years many different terms have been employed, and many of these are still found in the literature. In this paper Gender Identity Disorder and transsexualism will be referred to interchangeably.

One of the major questions currently being debated within the GID community is that of Nature vs. Nurture. Learning if the gender conflicted person is born this way has far reaching implications in the areas of treatment, self acceptance and societal perceptions. For many years GID was seen as solely a psychological aberration. Many theories have been presented to try to explain the roots of Gender Identity Disorder. Most of these theories have their beginnings in Freud's general theory of sex (Freud, 1910 & 1928). Crossdressing, transsexualism and other gender dysphoria were viewed as a type of castration anxiety, where a young boy had viewed his mother naked, noticed the lack of a penis and worried that this too would happen to him (cited in Bullogh, V.L., 2001). One of the major problems with psychological theories was that they neither described most gender conflicted persons nor offered any cure. As Brown and Rounsley (1996) stated: "As important as environmental factors may be, to date they have not given us any more conclusive answers for causation than hereditary influences have" (p. 25). Until about 10 years ago the literature was pretty quiet regarding anything other than psychological explanations for transgender behavior. The notable execptions to this were Harry Benjamin (1964) and John Money (1955). Benjamin was the first to theorize a biological component to transsexualism. One of Money's major contributions was the concept of gender as distinct from one's body sex. Both of these researchers have provided the framework for expanding our knowledge of

Gender Identity Disorder and its causes (cited in Bullogh, V. L., 2001).

There is now a large enough pool of data on various aspects of GID to begin to look for patterns and association. It is the intention of this paper to review the current research regarding biological factors that may influence Gender Identity Disorder and draw appropriate conclusions.

Animal Studies

Research on animals gave some of the first clues that sexual differentiation did not end with development of external genitalia. The sexual differentiation of the brain takes place much later in fetal development than the development of the genitalia and continues after birth. Studies have shown that if a male rat is castrated shortly after birth he will develop female behavior traits. Conversely, a female rat given testosterone shortly after her birth will develop male behaviors. Similar studies done with other lower mammals have born the same results. Clearly, hormones have a very strong effect on gender development long after development of the genitalia. The sexual differentiation of the brain seems to be able to be influenced by other factors than just sex chromosomes (Gooren, 1993).

How does this information relate to human sexual development? As Gooren (1993) notes, the human brain also undergoes a degree of sexual differentiation. There have been 3 areas so far identified as being sex-dimorphic. One of theses areas, the sex-dimorphic nucleus in the hypothalamus, does not complete its differentiation until the 3rd or 4th year after birth. This seems to mean that long after birth, after it was decided that you are a male or female your brain is still in the process of sexually differentiating itself.

(cited in Green and Young 1999). While identifying sub groups of transsexuals is very important to our overall knowledge of the subject, it does complicate the tasks of researchers. Future studies may need to look at individual sub groups directly to identify causes. Green and Young's (1999) data points more towards a relationship between sexual orientation and dermatoglyphics rather than transsexualism and dermatoglyphics. Further studies are clearly needed in this area, specifically comparing homosexual males and homosexual transsexuals.

A third study (Zucker, et. al., 2001) looked at handedness in boys with Gender Identity Disorder. The basic thesis behind this study is that the ratio of right handed to left handed people within the population is very constant— with 90% of the population being right handed. Changes to this ratio in a sample group are most likely caused by prenatal or perinatal effects. Should a sample of GID boys show a marked skewing of this ratio, this might be indicative of a biological effect causing both the GID and handedness. The results of this study did show a significantly higher rate of left handedness in the boys diagnosed with gender Identity Disorder.

Markers such as handedness and dermatoglyphics are useful tools in unraveling the causes of Gender Identity Disorder. Caution must be taken when evaluating these studies. The effect (when found) often only applies to a small portion of the sample, statistically significant but not global. The other difficulty is attributing a cause to the effects. Zucker, et.al. (2001) postulated a number of factors that could influence both handedness and GID including both genetic and hormonal effects.

Familial Trends

Some early clues that transsexualism has a biological component came from finding of siblings with G1D or transsexualism in 2 or more of the siblings (Green R., and Stoller R., 1971) (More, B. et. al. 1973) (Sabalis, R., et al. 1974) (cited in Green and Keverne 1999). Statically, the chances of 2 siblings both developing something as rare as transsexualism is very small, given only a psychological cause. Green (2000) estimated the likelihood of a pair of siblings both developing transsexualism randomly at 1/100,000,000. These case studies led researchers to look for causation beyond a nurturing effect. Since most of the studies were case studies of a single family, researchers need to look at large samples to see if this effect was just a random chance occurrence or a more substantial effect.

One way of looking for a heritable effect is by examining family pedigrees. One study (Turner, 1995) identified a linkage between male homosexuals and a deficit in the number of uncles. Turner (1995) identified a likely possible cause for the transmission of homosexuality along maternal lines to a semi-lethal condition on the Xq 28 gene (cited in Green and Keverne 1999). As a follow up to this study Green and Keverne (1999) looked at ratios of maternal aunts to uncles among transsexuals. Their findings closely replicated the work of Turner (1995) finding a much higher ratio of aunts to uncles among the transsexual sample. The ratio was even higher when looking at the homosexual transsexual subset. Green and Keverne postulated a number of potential causes of this effect most having to do with a genetic fault, giving rise to hormone sensitivities or other genetic abnormalities. The authors did note that genetic/hormonal factors most likely create only a predisposition towards transsexuality. Nurturing and post birth environmental events would also be factors involved in the final outcome of

one's expressing transsexualism.

Coolidge, et. al., (2002) again looked at heritability and GID. Their findings supported previous studies that GID does seem to have a strong heritable component. In their discussion Coolidge, et. al.(2000) made note that environmental factors could not be ruled out as the cause. They then went on to state that the better fitting model is one that has to do with heritable factors. Additionally, the authors noted that there was little or no cocurrent psychopathology found among the sample population.

Brain Differentiation

In most ways transsexuals do not differ from their same sex counterparts. Genetically and hormonally the transsexual body is very much the same as the general population's. Looking for any differentiation is an important step in identify causes of transsexualism. One study that was able to identify inherent differences between transsexuals and their same sex counterparts was done by Zhou, et. al., (1995). These researchers identified differences in the brains of transsexuals. These differences were found in an area called the central subdivision of the bed nucleus of the stria terminalis (BSTc). This area of the brain is thought to coordinate sexual activity. The researchers found that the number of neurons in this area within the brains of the transsexuals matched those found in the brains of the opposite sex. There is a much higher number of BSTc cells in the male brain. The Transsexual brains were much closer to the numbers found in female brains than in males. The researchers were able to rule out the effects of transsexual hormone replacement therapy as the cause of this difference. This was the first study to show a specific difference in the brains of transsexuals from their same sex

counterparts. The biggest difficult with this study is that the level of analysis required to examine this portion of the brain requires the brain to be autopsied. Therefore only brains from deceased persons can be used. As techniques of brain imaging achieve greater definition it is hoped that studies such as this will soon be able to be done on living brains.

Some of the most interesting findings to date come from the work of Dorner, et al. (2001). This team looked very closely at the effects of hormonal substance on brain differentiation. Their finding show that estrogenic and androgenic hormones have a direct effect on how the brain organizes itself. Differing levels of these hormones affect various portions of the brain at various times. Anything that interferes with this differentiation will cause the brain to develop in a different fashion that what is "normal". Dorner et al. (2001) identified the following as possible and likely causes of improper brain differentiation:

1. Mutations or polymorphisms of genes, e.g.

a) mutations or polymorphisms of 21-hydroxylase genes in chromosome 6, e.g. heterozygous deletions of CYP 21 B or homozygous deletions of CYP 21 A or heterozygous point mutations in CYP 21 B

b) very rare mutations of the 3a-hydroxysteroid dehydrogenase gene on chromosome 1 and

c) mutations or polymorphisms on the X-chromosome, as published by Hamer et al.,

2. Epigenetic effects, such as

a) stressful situations can also affect sex hormone activities during sexual brain organization and

b) so-called "endocrine disrupters" were recognized to be possible epigenetic agents on ontogenesis for sexual brain organization; for instance the pesticide DDT and its metabolites display estrogenic, antiandrogenic,

> antigestagenic and inhibitory effects on the enzyme 3a-hydroxysteroid dehydrogenase, leading to increased levels of dehydroepiandrosterone as precursor of endogenous androgens and estrogens, especially of placental estrogens.

It is beyond the scope of this paper to explain how each of these mechanisms affect sex hormone level and therefore brain differentiation. What is important is that these effects exist. As more date is developed, a clearer understanding of how hormones affect the brain and how that, in turn, affects behavior will be understood. In closing, Dorner, et al. (2001) stated; "Most of all, our findings support the theory inaugurated in the 1970's that sex hormone activity in pre- and early postnatal life, which can be altered by genetic as well as epigenetic effects, are able to program sexual brain organization and hence sexual orientation, gender role behavior, and gender identity".

Summary of Findings

No psychological theory has come close to explain how GID develops nor provided any cure. The brain continues to differentiate long after the primary sex organs are developed. Sexual dimorphism can be influenced by hormones, during prenatal development and after birth. Transsexuals have been found to a higher ration of Aunts to Uncles, and greater degree of left handedness GID had been shown to have familial pattern The brains of transsexuals have shown similarities to the opposite body sex.

Conclusion

It is now possible to say that there is a biological root for Gender Identity Disorder. There is enough evidence to show that many of those who have a gender dysphoria are born with this condition. The actual biological mechanisms that causes one to feel a different gender than their bodies' sex are still unknown. Current theories lean towards a hormonal effect in the uterus that causes the brain to differentiate in a different direction from the body. Much more research is required in this area, and it is quite possible that a single answer will never be found. One's gender identity is a complex construct. Early childhood development may have much to do with how strong one's gender dysphoria expresses itself even if biologically there is a tendency in that direction. Further research is needed to look at the interplay between the born tendency and social/psychological effects. Only by understanding both nature and nurture can an adequate knowledge of Gender Identity Disorder be gained.

Very recently some data has started to surface about the effects of Endocrine Disrupting Chemicals (EDC's) . These substance include pesticides such as DDT's. There is now evidence that these chemicals have a feminizing effect on fishes and wildlife. There is some preliminary statistical evidence correlating a rise in transsexualism with usage level of these pesticides (Johnson, 2002). Much further research is needed on the effects of EDC's

Researchers are now able to look at how the brain processes information. Tools such as Functional MRI's (FMRI) are capable of showing real time pictures of the brain as it processes information in various areas. Recently, FMRI has been used to look at gender differences in the brain (Lee, Tatia M.C., et all, 2002). A body of knowledge is

developing that shows how males and females processes information. There are inherent differences in the way a male brain processes information verses the way a female brain processes information. It should now be possible to test those with GID and transsexualism to see if their brains processes information in a similar fashion to the gender that they identify with.

Gender Identity Disorder is moving out of the closet. As new information becomes available on the causes of this disorder, new treatment options will be developed for those suffering from GID. How biology and psychology act together is a fairly new area of inquiry. Identifying how these two interact regarding GID will have implication in many other areas. This can only help to increase our understanding of what it means to be human.

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