11

Sexual Orientation

Surely one of the most controversial areas of human behavior is that of sexuality and sexual orientation. Both psychology and behavioral genetics are now wracked with divisive arguments about the origins of sexual orientation. In fact, psychologists have been arguing about what causes homosexuality for more than 100 years, and they are actually further from consensus now than they were a decade or two ago. Psychological explanations of homosexuality, based on the teachings of Freud, were widely accepted until fairly recently. But Freudian explanations have wilted in the face of conflicting data, and most psychologists have concluded that a new theory of sexual orientation is needed. Similarly, behavioral geneticists are deeply divided about the validity and significance of several recent high-profile studies on the inheritance of sexual orientation.

Freud believed that every child is inherently bisexual at birth, but during a particular stage of development that occurs at about 4 years of age, this changes. Children learn to suppress sexual feelings toward members of the same sex, and to direct sexual feelings toward members of the opposite sex. Freud proposed that male homosexuality originates when this developmental stage is blocked, perhaps because of the presence of a domineering mother figure or the absence of a strong father figure. This "psychodynamic theory" of homosexuality predicts that homosexual men would tend to be emotionally distant from their father and perhaps emotionally dependent on their mother. However, when this prediction is actually tested, it is usually found to be quite weak.

Toward a Biological Explanation of Homosexuality

Beginning in the 1950s, animal research began to show a very potent effect of hormones on the development and differentiation of the brain. It was found, for example, that the sexual behavior of rats and mice could be radically altered by exposure to the male hormone testosterone during a critical window of time during development. Of perhaps more relevance to humans is the fact that female monkeys exposed to testosterone during prenatal development tend to play with other monkeys in a manner more typical of male monkeys. This latter observation is especially intriguing because some scientists contend that, in childhood, boys who will later become homosexual tend to play in a manner more typical of girls. Early play may thus be revealing the incipient presence of a male or female identity, shaped in part by hormonal exposure prior to birth. But, if it is true that prenatal hormone exposure can affect later sexual orientation, one must wonder what the factors are that determine prenatal hormone exposure. It is of course possible that prenatal hormone exposure is affected by both genetic and environmental factors, since stress can affect hormone secretion.[86]

Early observations on the link between hormone exposure and animal behavior led to development of a "neurohormonal theory" of sexual orientation. This theory has received much support recently from a wide range of different observations and experiments.[85] For example, it has been noted that women who were prenatally exposed to DES (diethylstilbestrol, a potent blocker of the female hormone estrogen) tend to report homosexual feelings more often than women who were not prenatally exposed to DES. Since DES was extensively used to maintain problem pregnancies during the 1950s, a substantial number of women were prenatally exposed to this artificial hormone. The fact that women exposed to DES tend to have sexual feelings more typical of men suggests that this hormone can have an effect on humans that is at least conceptually similar to the effect of testosterone exposure in monkeys. It is also known that early childhood play typical of the opposite sex is the single best predictor of homosexuality, which implies that sexual orientation must be set at a very young age, or perhaps even prior to birth.[87]

But far more convincing evidence of a hormonal basis for homosexuality has been obtained recently. Several very striking hormonal anomalies have been discovered in gay men, suggesting that homosexual men may have hormonal responses that are intermediate between heterosexual men and heterosexual women.[88] In one study, homosexual and heterosexual volunteers were recruited by advertisement and by word of mouth, and volunteers were subjected to an in-depth interview to establish their sexual orientation. Then a hormone was administered to a group of 14 avowed gay men, and the physiological responses of these men were compared to those of 17 straight men and 12 straight women. A single dose of estrogen was given to individuals in all three groups, and then the amount of a second hormone, called luteinizing hormone (LH), was measured in the bloodstream. In straight women, estrogen administration caused a dramatic rise in LH over the course of 3 days, while in straight men estrogen actually caused a depression of LH over the same time period. In gay men, estrogen caused a rise in LH similar to, and almost as large as, the rise seen in straight women. These results suggest that gay men have hormonal responses that are midway between that which is typically male and that which is typically female. There are any number of reasons why this is so, but the important point is that there seems to be an actual biological indicator or "marker" of homosexuality in at least some gay men.

This study, like most other studies, had faults that weaken the conclusions, but overall the study was fairly strong. It is possible that gay men willing to participate in such a study are not typical of all gay men; many gays are not comfortable enough with their sexuality to participate in a study that requires the open admission of sexual orientation. In fact, men in this study were chosen so that they may have represented opposite ends of a spectrum of sexual preference. Heterosexual men in this study reported having had no homosexual experiences since puberty, and the homosexual men reported a pattern

of male-oriented sexual behavior since puberty. According to Kinsey, only 4% of gay men are exclusively homosexual after puberty, so this may have been an unusual group of gay men. Several recent studies have been unable to completely replicate this early study, so it is also possible that the results are simply wrong. Nevertheless, the early study found several fascinating differences between gay and straight men, and these differences are consistent with a hormonal theory of homosexuality.

It should be noted that the gay community strongly favors a biological explanation, rather than a psychodynamic explanation, for homosexuality. While it is possible that gays favor a biological explanation because they have greater insight into the origins of their own sexuality, there may also be a hidden agenda at work. The psychodynamic explanation of homosexuality implies an element of personal choice in being gay, whereas the hormonal explanation of homosexuality implies no such choice. If no element of choice is involved, then homosexuality is more like a fact of life or a biological necessity, than a moral failing or perversion. Many gays believe that tolerance from the straight community is more likely to be achieved if straights perceive that gays had no choice but to become homosexual. Thus, there could be a reason for at least some gay scientists to try to prove that homosexuality is innate. This is an important point because several very controversial studies have been published by openly gay scientists.

Homosexuality and Brain Structures

One of the most controversial studies published in the last several years was a study of brain structure in homosexuals, since this study concluded that characteristic structural differences exist between heterosexual and homosexual men.[89] This study was published in *Science* magazine, one of the most influential and authoritative publications in all of science, by an openly gay neuroscientist. The study was widely publicized by the news media because it made the dramatic claim that sexual

orientation could be based, at least in part, on biological differences in a critical brain structure. Yet the study was so deeply flawed that it is arguable whether it should have been published at all, let alone in the hallowed pages of *Science*.

This controversial paper described the results of a series of measurements made of the size of a particular brain structure, called the third nucleus of the anterior hypothalamus. Interest was focused on this brain region for several reasons. Previous work by other scientists had shown that the anterior hypothalamus is involved in the regulation of sexual behavior. Male monkeys with an injury to the anterior hypothalamus have an impaired ability to display heterosexual behavior, yet their sex drive is nonetheless intact, causing them to display sexual behavior to monkeys of the same sex. Other scientists had also shown that, in humans, there is a male–female difference in the size of the nucleus, such that this structure is significantly larger in men than in women.

The difference in size of the third nucleus between men and women could be interpreted in another way entirely: perhaps a small third nucleus is characteristic of individuals sexually interested in men, whereas a large third nucleus is characteristic of individuals who are sexually interested in women. To test this idea, measurements were made in brain tissue from gay and straight men, as well as in brain tissue from straight women, to test the prediction that the size of the third nucleus in gay men would be more similar to that of straight women than to that of straight men. Measurements could not be made in living subjects, since the structures cannot be visualized by magnetic resonance imaging (MRI), and are located in the deep central portion of the brain. Therefore, the measurements had to be made in tissue removed at autopsy from subjects who had died for a range of reasons. Tissue was obtained from 19 homosexual men, 16 men who were presumed to be heterosexual, and 6 women also presumed to be heterosexual. Brain tissue was preserved and sliced into thin sections, to be viewed by microscope. The physical dimensions of all four interstitial nuclei were measured in the anterior hypothalamus of all 41 subjects. It was

found that the third interstitial nucleus was the only nucleus that differed in size among the three groups of subjects, and this structure was twice as large in heterosexual men as in homosexual men or heterosexual women. On the face of things, this result tends to confirm the male–female difference that had been previously noted, and it also suggests that the third nucleus of a gay man is structurally more similar to that of a female than that of a heterosexual male brain. However, the range of variation in size of this structure was tremendous, and size classes were broadly overlapping between the groups. Nevertheless, the difference in size was statistically significant.

However, this study was fatally flawed, because of the source of the brain tissue analyzed. Homosexual men were identified as homosexual, not by an in-depth interview, but rather because they were hospitalized for complications of AIDS. In fact, 100% of the 19 homosexual subjects died of AIDS, and these men were identified as homosexual on the basis of a medical history taken at hospital admission. Similarly, the heterosexual men were not classified as such on the basis of an interview; they were merely assumed to be heterosexual because of the numerical preponderance of heterosexuals in the population. Yet, among the group of 16 men assumed to be heterosexual, 38% died of complications of AIDS. This creates several major problems. First, it seems highly unlikely that 38% of a random sample of heterosexual men would die of AIDS; this may mean that some of the "heterosexual" men were in fact homosexual, or it may mean that some of these men were intravenous drug users. In any case, it is not a fair test to compare a group of homosexuals to a group that may be comprised of heterosexuals, closet homosexuals, and intravenous drug-users. Second, 100% of the gay men died of AIDS, whereas only 38% of the "straight" men died of AIDS. The AIDS virus is well known to cause progressive pathology in the brain of many individuals with AIDS. Therefore, it is quite possible that the differences observed in this study were actually related to the effects of the AIDS virus, not to any difference in sexual preference. Patients with AIDS frequently have a reduced level

of testosterone in their bloodstream, the result either of the virus or of treatment for the virus, so it is also possible that the reduced size of the nucleus could be caused by a hormone abnormality. When homosexual men in this study were compared to the 6 "heterosexual" men who died of AIDS, the observed size difference in the third nucleus almost disappeared. In summary, although the study may eventually be corroborated, it is simply not convincing in itself. The poorly done comparison between gay and "straight" men should have precluded publication in a preeminent journal like *Science*. The truth of the matter is that, had the study been published in a lesser journal, no one would have paid any attention to it.

More recently, another study identified a difference between gay and straight men in another brain structure. The newer study showed that the size of a part of the brain called the anterior commissure differed depending on sexual orientation.[90] This study also used brain tissue collected at autopsy from people who had died of AIDS and a range of other causes. Again there was a problem, because 80% of the homosexual men had died of AIDS, whereas only 20% of the heterosexual men had died of AIDS, although an effort was made to exclude all persons who showed any evidence of pathology affecting the brain tissue. But AIDS can cause subtle brain pathologies that might not be easily observed, so it is still possible that this is a problem. In any case, it was found that the anterior commissure is 13% larger in women than in heterosexual men. However, in homosexual men, the anterior commissure is 18% larger than in women and 34% larger than in heterosexual men. When a comparison was made between homosexual men without AIDS and heterosexual men without AIDS, it was found that the anterior commissure was still 35% larger in homosexual than in heterosexual men. This discrepancy could not be accounted for on the basis of differences in brain size, since the discrepancy remained when the size of the anterior commissure was corrected for differences in brain size.

The differences between homosexual and heterosexual men in the second study are probably not related to differences in

exposure to the AIDS virus. The AIDS virus is more likely to cause atrophy or shrinking of brain structures than it is to cause an increase in size, as was observed here. Furthermore, when homosexuals with AIDS were compared to homosexuals without AIDS, there was no significant difference in the size of the anterior commissure. Similarly, AIDS was not associated with significant atrophy of the anterior commissure in heterosexual subjects. Finally, microscopic examination of several brain tissue samples from AIDS patients showed no evidence of the sort of pathology that would lead to tissue swelling. All of these considerations suggest that the second study is stronger than the first.

These results are especially intriguing because the anterior commissure is not a structure known to be involved in sexual behavior. It is simply a tract of neurons that connects the right and left halves of the brain, which helps the two sides of the brain communicate with one another. There was no reason to suspect that this structure should in any way be related to sexual orientation. In humans, the anterior commissure mediates the transfer of visual, auditory, and olfactory information from one hemisphere to the other. The functional significance of a size difference in this structure is completely unknown, although men and women are known to differ somewhat in how the two sides of their brain function. For example, heterosexual women and homosexual men both tend to score higher on verbal tests and lower on tests of spatial visualization than do heterosexual men. Because it is possible that the size of the anterior commissure somehow determines how the two sides of the brain work together, it may be that there is less "lateralization," or lateral specialization, in the brain of subjects with a large commissure. But, although one can imagine how a large anterior commissure might contribute to better verbal ability in women, it is hard to imagine how a small anterior commissure could be related to better spatial ability in men.

The differences in brain structure between homosexual and heterosexual men suggest that homosexuality is not related to changes in any one brain structure. Rather it may be true that whatever factors originally cause homosexuality also cause a multiplicity of changes in the human brain. It may turn out that there are numerous structural differences between men and women, and between homosexual and heterosexual men. However, the limitation of both this study and the previous study is that structural differences between individuals do not prove that there are genetic differences between individuals. To put it another way, the fact that there are brain differences between homosexuals and heterosexuals does not prove that these brain differences cause the difference in sexual orientation; in fact, the structural differences could conceivably result from whatever made the subjects different in the first place. It seems unlikely that anything as clear-cut and obvious as the volume of a brain structure could be in any way informative about something as ambiguous and subtle as sexual orientation.

Homosexuality and the Modern "Split Twin" Experiment

Years ago it was noted that the brothers of homosexual men are more likely to be homosexual themselves than are the brothers of heterosexual men. However, this sort of observation does not address the issue of whether a familial trait is related to shared environment or to shared genes. This issue can only be addressed by examining men who share the same environment but who differ in the degree of their genetic relatedness. This is, of course, the workhorse of behavioral genetics: the split twin experiment. The strongest approach is to compare identical and fraternal twins with each other and with adopted male siblings, who have a similar environment but little or no genetic relatedness.

Recently a large study was published in which twins were used to determine the importance of shared genes in defining sexual orientation.[85] Male subjects were recruited for the study by placing advertisements in gay publications throughout the country, which probably means that only openly gay men were

recruited. The ad specified that subjects should be gay or bisexual men, with either male twins or adopted brothers of similar age. A telephone number was published so that interested subjects could contact the scientists doing the research. All potential subjects were interviewed in depth to verify that the men were appropriate subjects, then scientists made an effort to assess the sexual preference of the subjects' brothers. Sometimes this assessment was made indirectly, by questioning the subject about his brother, but if neither the subject nor the brother objected, the assessment was made in person or by a telephone interview. Interviews were obtained for a total of 115 men with identical or fraternal twins, and another 46 men with adoptive brothers. About 74% of the brothers of these subjects also participated, meaning that information about sexual preference could be obtained directly from the brother. The remaining 26% of brothers did not participate directly, so that information about their sexual preference was obtained indirectly from the subject. It is a major potential weakness that fully one-quarter of the brothers of the subjects did not directly participate in the study.

Nevertheless, it was found that there was a significant and relatively strong effect of genes on sexual preference. More than half (52%) of the identical twins of gay men were also gay, while only 22% of the fraternal twins were gay.[85] Among the adoptive brothers, only 11% were gay, which confirms that there is a strong genetic component to sexual orientation. The fact that the incidence of homosexuality in adoptive brothers is not substantially higher than the population at large suggests that environment is actually a weak determinant of sexual preference. These reported differences were statistically significant, as there was less than one chance in 1000 that the results were arrived at by chance alone. Since this study involved completion of a questionnaire by all subjects, it was possible to compare heterosexual and homosexual men by several different criteria. For example, it was found that male heterosexuals could recall significantly more of their own aggressive behavior as children than could male homosexuals. Heterosexuals also recalled more childhood interest in sports than did homosexuals, and were less likely to

be involved in childhood play that was regarded as "sissy" by their friends.

A mathematical model was used to estimate the heritability of homosexuality, or that fraction of homosexuality that is likely to be explained solely on the basis of shared genes.[85] The best estimate is that heritability explains roughly half (54%) of the concordance between twins. Using the same model, it was calculated that shared environment likely explains none of the concordance between twins, and that unshared environment probably explains about 34% of the concordance between twins. Shared environment is that part of the environment that is actually common to both siblings, and probably represents virtually every aspect of home life. Unshared environment, which explained about one-third of the concordance between twins, is perhaps best regarded as that part of the environment external to the home (although, in some cases, the home may include unshared environment even for identical twins). If these results are correct, it implies that the environment is only weakly determining for sexual orientation. Because genetics is so important in determining sexual orientation, the oft-voiced fear that a homosexual teacher may lure his pupils into homosexuality is probably groundless.

Even though this study was good, it has certain weaknesses that could potentially invalidate its conclusions. Only 161 homosexual men were initially contacted for this study, which seems to be a relatively small number of men to examine a topic as complex and subtle as sexual preference. Furthermore, only 74% of the subjects' brothers responded to a questionnaire, so it is possible that the brothers who did participate are not a representative sample of men. There is a very strong possibility that homosexual brothers would be more likely to answer the questions at all, whereas heterosexual brothers might be more likely to answer the questions honestly. Finally, it is possible that a special "twin environment" contributes to the development of same-sex orientation, so that there are inherently more homosexuals among identical twins. This would mean that the estimate of heritability of sexual orientation is too high among

identical twins, and that the importance of the environment is underestimated. Yet despite these caveats, the levels of statistical confidence reported in this study are good; there is less than one chance in 1000 that results as strong as these could have been obtained by accident. Or, to put it another way, we can be roughly 99% certain that heredity has a strong impact on sexual preference.[85] These same scientists recently showed that there may also be a genetic basis for homosexuality in female identical and fraternal twins, so that both male and female sexual orientation appear to be strongly influenced by genetic factors.

Some of these results have been independently confirmed by another study that examined sexual behavior among 158 sets of male twins.[87] This study speculated that identical twins may have a more stressful prenatal environment than fraternal twins, as shown by the higher incidence of birth defects and fetal death among identical twins. Since prenatal stress can lead to homosexuality in animals, it is possible that identical twins are inherently more likely to be gay than are fraternal twins. In addition, identical twins are more likely to imitate each other or to cooperate with each other, so it is possible that, in some individuals without a strong sexual orientation, homosexuality may be a behavior learned from the twin. These latter possibilities hint that a "split twin" approach may not be sophisticated enough to investigate something as complex as sexual preference.

Evidence for a Genetic Basis of Homosexuality

Very recently, sophisticated techniques of molecular genetics were used to determine whether there is actually a genetic basis for homosexuality. This is possible because traits leave genetic trails that can be followed by molecular biology, and the pattern of transmittance of a trait from one generation to the next can be studied in great detail. If the pattern of transmittance of a trait across generations is characterized in this way, this can help determine whether or not the pattern is consistent with that of an inherited trait. In many cases, this type of pedigree analysis

can yield insight into the genetic mechanisms of inheritance for a particular trait, including the location of a particular gene on a particular chromosome.

If homosexuality is genetically influenced, there should be a significantly higher incidence of homosexuality within certain families than in the general public. To determine if this is correct, a study group of 114 self-acknowledged homosexual men was recruited through two AIDS outpatient clinics and through several gay organizations.[91] A pedigree analysis of these men was performed by asking each man about the sexual orientation of relatives, including father, sons, brothers, uncles, and male cousins. The major weakness of this type of approach is that it is not always possible to determine a person's sexual orientation without asking them, it is not always possible to ask, and some people may not be forthcoming even if they are asked. Thus, some of the relatives in this study might have been incorrectly classified as to their sexual orientation. Each of the men in the study also completed a detailed questionnaire that asked about his gender identification, sexual development, and sexual behavior, as well as a wide range of other questions related to personal and family medical history. The questionnaires revealed that most of the gay men in this study experienced their first attraction to another male by the age of 10, admitted to themselves that they were homosexual by the age of 16, and "came out of the closet" by the age of 22. Since the average age of the men in the study was 36, most of these men had spent essentially their entire adult life as practicing homosexuals. Finally, each of the men in the study gave a blood sample which was analyzed to build a genetic portrait of each study participant.

It was found that homosexuality is indeed strongly clustered in some families; among the brothers of men in this study, the incidence of homosexuality was nearly seven-fold higher than in the population at large. Among more distant relatives, the incidence of homosexuality was about three-fold higher on the maternal than on the paternal side of the family. About 8% of both maternal uncles and maternal male cousins were homosexual, whereas only 2% of the population at large is homosexual

according to the criteria used in this study. Because uncles and cousins share genetic information, yet are raised in separate environments, this strongly suggests a genetic explanation for homosexuality. But what is curious is that there were relatively few male homosexuals on the paternal side of the family, and very few female homosexuals on either side of the family. Many scientists might have guessed that homosexuality is genetically determined, but few of these scientists would have expected there to be a pattern suggesting that the trait is passed exclusively through the female line. Such evidence for maternal inheritance of homosexuality is truly startling. Moreover, the idea that male and female homosexuality are somehow inherently different, so that they do not cluster together in the same families, is also quite unexpected.

The fact that male homosexuality seems to be transmitted through the maternal line suggests that inheritance of the trait is somehow linked to inheritance of the X chromosome. Women have two X chromosomes, one contributed from each parent, so that unusual or aberrant genetic traits carried on this chromosome are usually not expressed. This is because even if one of the X chromosomes is aberrant or unusual, the other will likely be normal, and thus the normal version of the trait can still be expressed. But men carry only one copy of the X chromosome, contributed by their mother. Instead of a second X chromosome contributed by his father, each man instead inherits a Y chromosome from his father. This means that men have only one copy of those genes on the X and Y chromosomes; if that one copy of the gene happens to be aberrant or unusual, then there is no option but to express the gene. This means that men are much more likely to express X-linked traits than are women. The only way in which a woman can express an aberrant or unusual X-linked gene is if she inherits the same X-linked mutation from both parents. While this is not impossible, it is far less likely to occur than a man inherit one copy of an X-linked mutation from his mother.

The idea that homosexuality can be passed down from mother to son via the X chromosome is merely a hypothesis; a plausible but unproven explanation of the facts. This hypothesis

can be tested by carefully examining the genetic inheritance of both gay and straight men on the molecular level, to see whether the observed pattern of inheritance conforms to predictions of the hypothesis. If the observed and predicted patterns are the same, then the hypothesis may be correct, whereas if the observed and predicted patterns differ, the hypothesis is necessarily incorrect. This type of hypothesis testing can be very difficult to do, since the exact nature of the gene associated with homosexuality is not yet known, and because it is not yet possible to examine DNA directly, to test whether an unknown gene is present. Instead, scientists must test the DNA to determine whether certain gene markers are present. If an unknown gene on the X chromosome causes homosexuality, then all or most gay men should have this gene, as well as having other genes that are physically nearby on the same chromosome. If nearby genes can be identified, they can serve as markers to reveal the presence of the unknown gene for homosexuality. In other words, known marker genes that happen to be linked to an unknown gene can be used to reveal the presence of the unknown gene, in much the same way as fingerprints can reveal the presence of an unknown intruder.

To test the idea that homosexuality is passed down on the X chromosome, gene markers on the X chromosome were examined in a group of 40 homosexual men who also had homosexual brothers. This sample of men was chosen simply because it increased the likelihood of identifying the gene for homosexuality, although it could well be argued that this is a very unusual group of men. Blood samples from these 40 gay men and their brothers were tested, together with blood samples from their mothers and other siblings whenever possible. It was found that one portion of the X chromosome seemed to carry a gene associated with homosexuality; 33 of the 40 gay sets of brothers were concordant for gene markers within this small region. The fact that 7 of the 40 gay brothers were not concordant for gene markers in this region probably means that there are other genetic or nongenetic sources of homosexuality.[91] Of course, these results must be replicated and extended before full faith

should be put in them, but this study appears to have been very carefully done.

Genes and Human Sexuality

If homosexuality is indeed genetically determined, it is fair to ask why there should be a gene for a behavior pattern that is, in an evolutionary sense, strongly selected against. On average, gay men have five times fewer children than straight men, even when those gay men who marry and try to live a heterosexual life are included.[85] If straight men, who are numerically dominant in the first place, also have five times as many children per capita as gay men, the proportional genetic contribution of gay men to succeeding generations must diminish over time. Evolutionary fitness, in the sense of Charles Darwin, is proportional to the genetic contribution of an individual to succeeding generations. This means that gay men have low evolutionary fitness, since straight men make a much larger genetic contribution to the next generation. So why does homosexuality persist in the gene pool at all?

Conceivably, "gay genes" could have adaptive value if they predisposed gay persons to assist in the rearing of related offspring. For this to be true, the child care provided by gay men and women would have to strongly increase the chances of survival of their nieces and nephews who share the same genetic heritage. By increasing the survival of these children, homosexuals would indirectly increase their own proportional contribution to the next generation. Yet this seems to be patent nonsense; for this type of indirect effect to be true, the nieces and nephews of gay men would have to enjoy a much higher rate of survival than normal, and this is not true. This type of indirect benefit of "gay genes" would also imply that child care should be a major component of gay culture, which it apparently isn't. Although some gay men and women rear their own children or even adopt other children, this is the exception rather than the rule. Nevertheless, the fact that homosexuality persists as a trait, despite putting homosexuals at an apparent evolutionary disadvantage, suggests that homosexuality is, in some sense, an adaptive trait.

Perhaps the putative "gay gene" confers some subtle survival advantage to women who bear the trait but are not themselves homosexual. If women who carry the homosexual gene are somehow able to bear more children over time, this type of evolutionary advantage could offset the evolutionary disadvantage experienced by men who express the homosexual gene.[92] This hypothesis of "balancing selection" could be tested by determining whether the sisters of gay men have more children on average than the sisters of straight men. Alternatively, the gay gene may be created by mutation at a rate high enough to offset the loss of old mutations from the gene pool. Perhaps the X chromosome is somehow unstable and particularly likely to mutate, so that new mutations of the gay gene are commonplace. This hypothesis could be easily tested, because it would imply that the structure of the X chromosome should be somehow different in diverse gay men. However, it should be clearly stated that it is sheerest speculation that the gay gene, if it even exists, confers some sort of selective advantage.

Several recent studies do strongly suggest that there is at least one gene whose gene product is associated with homosexual behavior. It may be that the gene product made by the X chromosome is a hormone or hormone receptor, which could have an effect during a certain developmental window, or it may be that the nature of this gene product is completely unknown. Although no mechanism is known for how a gene product could affect sexual behavior, this deficit in our understanding does not argue against the finding itself. In many cases, an observation was made long before scientists were prepared to offer an explanation for the observation. As an example, bumblebees can fly, even though theorists can prove conclusively that they shouldn't be able to get off the ground.