EVOLUTION AND HOMOSEXUALITY: A REVIEW

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NATURAL SELECTION AND HOMOSEXUALITY

The main theories of evolution include natural selection, genetic drift, genetic mutation and gene flow. To completely explain evolution, these theories have to supplement each other. The most accepted theory and the one mostly referred to is natural selection. Natural selection is defined as “the preservation of favorable variations and the rejection of injurious variations. Variations, either useful or injurious, would not be affected by natural selection, and would be left a fluctuating element.¹ Thus, based on natural selection, the offspring will have advantageous traits leading to a greater chance for survival. This forms the basis of the concepts of survival of the fittest and differential reproduction. Natural selection depends upon variation in reproductive success or fitness among individuals in populations.²
Scientists have long been puzzled over how evolution could explain homosexuality, given the fact that homosexuals produce fewer children than do heterosexual individuals. Hamer and Copeland report that young to middle aged homosexual males had approximately one tenth as many children as their heterosexual brothers. Bell and Weinberg found that gay men had one-fifth as many children as the heterosexual reference group. This would lead one to expect that whatever a population’s initial homosexuality rate was, this rate would soon diminish to zero. Jeff Kirby also sought for an answer for this question stating:

If one assumes that human sexual orientation evolves by individual natural selection, then, given the assumed differential reproductive output of heterosexuals and homosexuals, one would anticipate that homosexual orientation, once present in the population, would be driven to extinction over the course of many generations.

PREVALENCE OF HOMOSEXUALITY IN HUMANS (MALES VS. FEMALES)

Sell et al. examined the prevalence of not only homosexual behavior but also sexual attraction to the same sex that had not resulted in sexual behavior in the United States, the United Kingdom, and France using the HOPE international Survey of AIDS-Risk behavior. They found that 6.2, 4.5, and 10.7% of males and 3.6, 2.1, and 3.3% of females in the United States, United Kingdom, and France, respectively, reported having had sexual contact with someone of the same sex in the previous 5 years. They also found 8.7, 7.9, and 8.5% of males and 11.1, 8.6, and 11.7% of females in the United States, the United Kingdom, and France, respectively, report some homosexual attraction but no homosexual behavior since age 15.
HOMOSEXUALITY IN ANIMALS (Examples Of Homosexuality In Animals)

BONOBOS
Bonobos have a matriarchal society, being noted for female homosexuality, although both males and females engage in heterosexual and homosexual behavior. Homosexual behaviors in bonobos represent the highest among any species. Dutch primatologist Frans de Waal noted from his studies that bonobos perform sexual activities to avoid conflict. He also noted that anything that arouses the interest of more than one bonobo at a time will result in sexual contact; mounting each other, scrotal or genital rubbing. He believes that they use sex to divert attention and to defuse tension.\(^7\)

JAPANESE MACAQUES
The Japanese macaque, also known as the "snow monkey", represents an excellent example for studying issues related to sexual preferences in animals. Some females of this species choose female partners even when presented with an opposite sex alternative. Female Japanese macaques, in certain populations, routinely engage in both heterosexual and homosexual behavior and are best characterized as being bisexual in behavior.\(^8\)

SHEEP
Sheep (Ovis aries) have attracted so much attention in that some rams seem to have an exclusive homosexual orientation. Dr. Charles E. Roselli et al. (Oregon Health and Science University) states that “homosexuality in male sheep (found in 8% of rams) is associated with a region in the rams' brains which the authors call the "ovine Sexually Dimorphic Nucleus" (oSDN) which is half the size of the corresponding region in heterosexual male sheep. The dense cluster of neurons that comprise the oSDN, express cytochrome P450 aromatase. Aromatase mRNA levels in the oSDN were significantly greater in female-
oriented rams than in ewes, whereas male-oriented rams exhibited intermediate levels of expression. These results suggest that:

Naturally occurring variations in sexual partner preferences may be related to differences in brain anatomy and its capacity for estrogen synthesis. Given the potential unaggressiveness of the male population in question, the differing aromatase levels may also have been evidence of aggression levels, not sexuality. It should also be noted that the results of this study have not been confirmed by other studies.⁹,¹⁰,¹¹

HYPOTHESES ON THE PRESENCE OF HOMOSEXUALITY IN ANIMALS

These are several hypotheses that scientists proposed to explain the presence of homosexual activities in animals:

- Increase in social bonding and cohesiveness:
- Homosexual behavior might increase the cohesiveness of individuals within species who perform homosexual behavior compared to species that do not. Some scientists evaluate cohesiveness by looking at party sizes of such species.¹²
- To moderate the cost of food:
- Females might have evolved systems that help them stay in mixed parties without incurring large costs from contest and scramble competition.¹²
- Social dominance:
- Males might establish dominance by copulating with other males. This might help them dominate within their group and also give them access to the opposite sex.¹³
- Provides practice for subsequent heterosexual encounters:
• Homosexual behavior might provide practice that would increase a male’s reproductive success in his subsequent heterosexual encounters.\textsuperscript{13}

• Indirect sperm translocation:
  • Males might engage in homosexual activity to transfer their sperm indirectly to females through a male intermediary. This can happen if sperm migrates to seminal vesicles of a mounted male.\textsuperscript{13}

• Sperm dumping:
  • Homosexuality might be a behavior that allows males to expel older, low quality sperm and possibly increase fertilization in subsequent copulations.

\textbf{STUDIES TO PROVE OR DISPROVE THESE HYPOTHESES}

\textbf{1. Increase In Social Bonding And Cohesiveness}

Takeshi Furuichi looked at party size difference between chimpanzees and bonobos and the studies the attempted to explain them. Party size is significantly larger in bonobos and some have attributed it to the unique homosexual behavior of bonobos. Female bonobos will approach their elders begging for food and soliciting genito-genital rubbing. Females will also sometimes ally with one another in agonistic interactions with adult males. Takeshi argues that the cohesiveness of females could be attributed to their unique sexual behavior, but this sexual behavior could also be used to cooperate effectively with unrelated females during times when female aggregation was necessary for survival. He believes that this cohesiveness is best explained by \textit{socio-ecological factors}; thus he states “The causal relationships between close female-female interindividual association and female cohesiveness remain unclear.” Another reason for cohesiveness is the \textbf{bond between mother and adult son}, which is the strongest social bond in bonobos. Male bonobos will tend to travel together and females will prefer to stay with their sons rather
than range alone or in small parties of females. A male's rank in the social hierarchy is determined by his mother’s rank.\textsuperscript{12}

In another species, Tribolium, Levan et al. state in their study that beetles lack courtship or agonistic interactions. Since they lack these characteristics, other social functions (e.g. social bonding, alliance formation and conflict avoidance) also seem unlikely.\textsuperscript{13}

2. To Moderate The Cost Of Food
Takeshi Furuichi believes that sexual behaviors \textbf{reduce the cost of feeding} efficiency incurred by attending mixed sex parties. Chimpanzees lived in dry habitats during some periods in the Pliocene compared to the large refugia forest which bonobos lived in. “Therefore, bonobos, whose habitats had more abundant food and smaller variation in food availability, probably evolved systems to help females stay in mixed parties without incurring large costs from contest and scramble competition”. “In bonobos, the unique genito-genital rubbing behavior between females and the tendency of immigrant females to form close social relationships with specific senior females may help the formation and maintenance of close association among females, which may facilitate the formation of alliances to combat harassment by males to protect priority of access to food resources.”\textsuperscript{12}

3. Social Dominance
Levan et al. tested multiple hypotheses for the maintenance of male homosexuality in flour beetles. He predicted “that certain males would consistently mount other males, and that dominant males might show a size advantage over subordinate male. In addition, this hypothesis predicts that dominant mounting males would show higher reproductive success”. His results showed that 32.1% of 26 male pairs kept switching roles from mounting to be being mounted. In the remaining pairs one male would frequently mount more, but there was no significant body mass difference between these mounting males. It
also noted that no reproductive advantage was evident when mate competitions were tested for a single female and that both mounted and mounting males were equally to copulate with females.\(^\text{13}\) Harari et al. found that small males mounted larger males during homosexual copulations in the weevil Diaprepes abbreviates, and they attribute that to the fact that females are generally larger and these homosexual copulations might have been mistakes in sex recognition.\(^\text{14}\)

4. Practice For Subsequent Heterosexual Encounters

Levan et al. looked to test this hypothesis and to do so beetles were either kept in male only groups (thus engaging in homosexual copulations) or the same aged beetles were kept in isolation. After 1-2 weeks mating rates were measured by offering each male a sequence of virgin black females. Each mated female was kept individually to determine insemination success. Results showed that the isolated males had significantly higher copulation rates, contrary to what was believed. This might have been attributed to the fact that the isolated males were more aroused while the grouped males were engaging in copulations that led to less sexual need. In regards to insemination, however, grouped and isolated males did not differ in their insemination success.\(^\text{13}\)

5. Indirect Sperm Translocation

In 1974, Carayon showed that in the anthocorid sperm migrates from a mounting male into the seminal vesicles of a mounted male during homosexual copulations. However, it is not known whether this sperm can be transferred to a female if this mounted male copulates with a female. It is also unknown whether Carayon’s findings occur in other insects. Haubruge et al studied T.castaneum (the confused flour beetle) and showed evidence that when a male mounts a previously mounted female, he can transfer sperm from that female to a different female when he mates with her. The authors proposed that such translocation can be facilitated by sperm getting trapped under spines on the male
Levan et al. conducted an experiment to see if similar mechanisms could happen with homosexual behaviors. To do this they randomly selected virgin black males and virgin wild-type males and allowed them to copulate once. Immediately after each male homosexual copulation, each male (the mounting and the mounted) was isolated to copulate once with a virgin black female, which was in turn then isolated for two weeks. By inspecting body color phenotype, they could detect whether sperm translocation between males had occurred. The results showed that in 6 out of 86 pairs, females produced progeny with body color phenotype indicating that were indirectly sires by their mate’s previous homosexual partner. However, in 3 of the 6 cases the indirect sire was the homosexual mounting male, while in the remaining 3 it was the mounted male. Moreover, in each of these 6 cases only a single progeny was indirectly sired representing only 0.5% of each females’ total progeny (the total progeny scored was 11765), indicating a low probability that these represent back mutations from black to wild-type and vice versa.

6. Sperm Dumping

Reinhardt reviewed evidence and showed that sperm motility, fertilizing ability and sperm competitive ability decline with age. He also found that younger sperm is more likely to be stored by female house crickets. This may be a reason why beetles or crickets perform homosexual behaviors to expel old sperm. Sperm dumping may also be selected when males cannot down-regulate their sperm production rate. Levan et al. point out that beetles have life-history features likely to result in selection for continues sperm production. When many females are present it is advantageous to produce large amount of sperm. Lewis showed that males can mate with seven different females within 15 minutes. However, when lower numbers of females are present the males may be incapable of down-regulating their sperm production and Levan et al believe that homosexual copulations may provide males with means for discarding sperm. Additional work is needed to experimentally test this hypothesis and to test it in other species.
HOMOSEXUALITY IN HUMANS

GENETIC OR ENVIRONMENTAL

There is a debate on whether sexual orientation is determined by genetics (nativism) or by environmental factors (environmentalism). Bailey and Pillard found that monozygotic twins are concordant for homosexuality 52% of the time, while dizygotic twins were only 22% of the time. Miller states that homosexuality is not carried on one gene but there are five genes that play a role in locating a male along a “homosexual-hypermasculine continuum”. According to Miller each gene has two alleles, one that moves the individual one step toward feminity and other toward masculinity. He gives this example “Imagine that each gene has the same effect. A male becomes homosexual only if he inherits all five homosexuality producing alleles. Computation shows that there is a 1 in 32 chance of this happening. Thus, slightly more than 3% of the males will be homosexual.”

William Byne and Stein feel the term “homosexual gene” is “without meaning,” unless one would believe that a particular gene could influence the brain specifically to fulfill the desire to have sex with the same gender. Several genetic studies have indicated that male homosexuality runs in families, however this, of course, does not distinguish if homosexuality is environmentally or genetically linked.3,5,16

NON EVIDENCE SUPPORTED THEORIES IN HUMANS

There are several mechanisms on the evolution of homosexuality in the literature that try to explain this phenomenon. Some propose a direct genetic link and some propose an indirect genetic link.
• **Balance Polymorphism: Heterozygote Superiority**

This theory was proposed by Hutchinson in the late 1950s. It states that heterozygosity (having two different alleles) for a recessive condition has increased evolutionary fitness over homozygosity (having the same two alleles). The best example for this theory is sickle-cell anemia, a deadly blood disorder, in which its gene persisted for a long time in malaria-prone populations. Sickle-cell anemia Heterozygosity is fitter in malaria prone populations than both forms of homozygosity. When both alleles are positive for sickle-cell anemia, this will result in expression of the disease and early mortality, on the other hand when both alleles are negative for sickle-cell anemia the immunity for malaria is decreased and the individual is prone to malaria.\(^5\)

Scientists who believe in this theory suppose that homosexuality is a recessive condition and, similar in the sickle-cell anemia example, heterozygosity is superior to homozygosity in that they are more fit and have a greater tendency to reproduce than homozygosity. They also elude that the incidence of homosexuality is 5% which matches the incidence of sickle-cell anemia in malaria prone population.\(^5\)

Mcknight, in 1997, proposed his hypothesis that “women control the homosexual gene’s penetrance”. He believes women are attracted more to men who are heterozygous (homosexually-enabled), since they are similar to them, better lovers, better fathers and more sensitive. According to Mcknight, women will tend to reject homozygous individuals since they will be either homozygous heterosexuals and will be boorish and unfaithful, or they will be homozygous homosexuals and will have reduced fitness. To date, there is no evidence to support this theory.\(^16,17\)
• **Fertile Females**

This theory speculates that “the homosexual gene” is X-linked and hence found twice as frequently in females than in males. They also speculate that “the homosexual gene” can increases the reproductive fitness of women who carry it. If the sister (carrier) of a homosexual man has more children than average then this would compensate for her brother not having children and maintain “the homosexual gene”. However, this also means that for a woman to be homosexual (homozygous) her father has to be homosexual, and that is not the case for most homosexual women. There is also no evidence to support that female relatives of homosexuals have more children than average.\(^5\)

• **Hypervariability**

Another proposition for the evolution of homosexuality postulates that “the homosexual gene” has no selective advantage, but is in the gene pool because of gene mutation. One similar example is Fragile X syndrome in which the gene sequence elongates by mutation leading to severe cognitive impairment. Individuals with Fragile X syndrome almost have no reproductive fitness, yet the full mutation has survived in the gene pool and is present in 0.1% of all X chromosomes. There is no scientific evidence that supports that “the homosexual gene”, if present, is a hypervariable DNA sequence.\(^5\)

• **Kin Selection**

This theory arose as a response to a question; *why does altruism persist even though natural selective pressures are against it?* Altruism “is the renunciation of the self, and an exclusive concern for the welfare of others”. Mathematically, it is in the gene transmission favor if an individual reduces his reproductive effort if he can increase a sibling’s reproductive effort. For example, if a homosexual person has no children, but can increase
his sibling’s children by 100% then the number of total children will not decrease and altruism will prevail.\(^5\)

Altruism can be unconsciously, by biological variety, or consciously, by psychological variety. Examples of altruism would be a homosexual uncle finding a job for his nephew, a homosexual offering unpaid babysitting his siblings or even donating money to his relatives. To date, there is no evidence to support that having a homosexual relative increases reproductivity.\(^5\)

Dr. Rahman et al. “aimed to test the kin selection theory of homosexuality in males using a survey design. The results showed no significant difference between heterosexual and homosexual men in familial affinity, generous feelings (willingness to provide financial and emotional resources), and benevolent tendencies (such willingness to babysit). Overall little support was found for the kin selection theory of homosexuality in males.\(^{18}\)

- **Parental Manipulation**

Parents can influence their children in becoming homosexual either consciously or unconsciously. From a parent’s point of view, the important thing is to maximize the number of genes transmitted, it does not matter which child transmits it. For example, if parents have five children, each of which is expected to have two children each. If one of the children is influenced by the parents to become homosexual, he might help his siblings and aid them in having three children each, so the total number of grandchildren will be twelve instead of ten.\(^5\)

The difference between kin selection and “parental manipulation” is that kin selection the individual serves himself, while “parental manipulation” he serves his parents. There is no evidence to support this theory moreover, parents devote their resources and attention to
their children on the basis of reproduction and hence will give more attention to their heterosexual children which contradicts this theory.\textsuperscript{5}

A FORM OF ADAPTATION

In 1981, Mellen speculated that “it may well have been of adaptation value for protohuman males to become a little less brutally aggressive, a little more sensitive, a little more responsive to external influences, a little more communicative – all of which would have been possible through the retention of certain psychological traits of early adolescence or through the acquisition of a few particular feminine traits.”\textsuperscript{16}

BIRTH ORDER EFFECTS ON HOMOSEXUALITY

In 1996, Sulloway brought out a book showing that there were differences in career patterns of scientists depending on birth order. Much of his personality research can be interpreted as younger brothers have a more feminine life strategy. He states “Status-enhancing behavior is a firstborn tendency. It is also a ‘male tendency’. Cooperation is a lateborn tendency and it is also a ‘female’ tendency”. Eaton et al. found that birth order affects the activity levels in infants and in children. First-borns are usually more active, and since males are generally more active than females, this would be consistent with the belief that first-borns have more masculinity. Blanchard and Bogaert found that each additional older brother increases the odds of homosexuality by approximately 33%. The question now is whether this effect is genetic or environmental. Sulloway attributes the differences in the behavior to children experiences. The environment of the first born and the later born are very different. Children develop strategies for survival depending on the environment. Given what is known about brain development, personality traits exhibited in childhood do persist into adulthood.\textsuperscript{1}
CAN SEXUAL ORIENTATION BE CHANGED?

Professor Mark Yarhouse and Mr. Stanton Jones are among the few who published on this topic. In 2007, they published their results on a study they did titled (A Longitudinal Study of Religiously Mediated Change in Sexual Orientation) in which they tried to answer two questions: Is change of sexual orientation, particularly change of homosexual orientation, possible at all? And is the attempt to change sexual orientation harmful? Homosexual subjects were involved in Exodus ministries to try to change their sexual orientation. "Success took two forms. One form of success was an embrace of chastity with reduction in prominence of homosexual desire. These persons regard themselves as having reestablished their sexual identities in some way other than their homosexual attractions. The second form of success was marked by a diminishing of homosexual attraction and an increase in heterosexual attraction, with resulting satisfactory, if not uncomplicated, heterosexual adjustment". Their results showed 45% were improved (success), 40% were unchanged and 11% had gotten worse (i.e., divorced). They concluded that change of sexual orientation is possible for some individuals and not impossible. They also found that there were no evidence to support that change in sexual orientation was harmful on average for these individuals.¹⁹

CONCLUSION

Nowadays, homosexuality is not uncommon, but homosexuals have a less tendency to reproduce (less fitness) and hence it is hard to comprehend how evolution could explain why homosexuality is still present. Homosexuality is present in animals, and scientists have tried to study this phenomenon and come up with theories on its presence. However, humans are different from animals and theories on the presence of homosexuality in
animals may not apply to humans. For this reason, scientists have come up with theories on how homosexuality has maintained itself in humans through the years. Several studies and papers have been published, but nothing has been proven to be the cause. It is also not yet agreed upon if homosexuality is genetic or environmental. A large portion of our society today believes that sexual orientation can be changed and this has made homosexuality an even more controversial issue. Much more is needed to be done to fill the gaps and make this topic more understood.

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