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Finding the Switch

by Robert Kunzig



If there is one thing that has always seemed obvious about homosexuality, it's that it just doesn't make sense. Evolution favors traits that aid reproduction, and being gay clearly doesn't do that. The existence of homosexuality amounts to a profound evolutionary mystery, since failing to pass on your genes means that your genetic fitness is a resounding zero.

"Homosexuality is effectively like sterilization," says psychobiologist Qazi Rahman of Queen Mary College in London. "You'd think evolution would get rid of it." Yet as far as historians can tell, homosexuality has always been with us. So the question remains: If it's such a disadvantage in the evolutionary rat race, why was it not selected into oblivion millennia ago?

Twentieth-century psychiatry had an answer for this Darwinian paradox: Homosexuality was not a biological trait at all but a psychological defect. It was a mistake, one that was always being created anew, in each generation, by bad parenting. Freud considered homosexuality a form of arrested development stamped on a child by a distant father or an overprotective mother. Homosexuality was even listed by the American Psychiatric Association as a mental disorder, and the idea that gays could and should be "cured" was widely accepted. But modern scientific research has not been kind to that idea. It turns out that parents of gay men are no better or worse than those of heterosexuals. And homosexual behavior is common in the animal kingdom, as well—among sheep, for instance. It arises naturally and does not seem to be a matter of aloof rams or overbearing ewes.

More is known about homosexuality in men than in women, whose sexuality appears more fluid. The consensus now is that people are "born gay," as the title of a recent book by Rahman and British psychologist Glenn Wilson puts it. But for decades, researchers have sought to identify the mechanism that makes a person gay.

Something seems to flip the sexuality switch before birth—but what? In many cases, homosexuality appears to be genetic. The best scientific surveys put the number of gays in the general population between 2 and 6 percent, with most estimates near the low end of that range—contrary to the 10 percent figure that is often reported in the popular media. But we know gayness is not entirely genetic, because in pairs of identical twins, it's often the case that one is gay and the other is not. Studies suggest there is a genetic basis for homosexuality in only 50 percent of gay men.

No one has yet identified a particular gay gene, but Brian Mustanski, a psychologist at the University of Illinois at Chicago, is examining a gene that helps time the release of testosterone from the testes of a male fetus. Testosterone masculinizes the fetal genitalia—and presumably also the brain. Without it, the fetus stays female. It may be that the brains of gay men don't feel the full effects of testosterone at the right time during fetal development, and so are insufficiently masculinized.

But if that gene does prove to be a gay gene, it's unlikely to be the only one. Whatever brain structures are responsible for sexual orientation must emerge from a complex chain of molecular events, one that can be disrupted at many links. Gay genes could be genes for hormones, enzymes that modify hormones, or receptors on the surface of brain cells that bind to those hormones. A mutation in any one of those genes might make a person gay.

More likely it will take mutations in more than one gene. And that, as Rahman and Wilson and other researchers have suggested, is one solution to the Darwinian paradox: Gay genes might survive because so long as a man doesn't have enough of them to make him gay, they increase the reproductive success of the woman he mates with. Biologists call it "sexually antagonistic selection," meaning a trait survives in one sex only because it is useful to the other. Nipples—useless to men, vital to women—are one example, and homosexuality may be another. By interfering with the masculinization of the brain, gay genes might promote feminine behavior traits, making men who carry them kinder, gentler, more nurturing—"less aggressive and psychopathic than the typical male," as Rahman and Wilson put it. Such men may be more likely to help raise children rather than kill them—or each other—and as a result, women may be more likely to choose them as mates.

In this way, over thousands of generations of sexual selection, feminizing genes may have spread through the male population. When the number of such genes exceeds a certain threshold in a man, they may flip the switch and make him want to have sex with other men. Evolutionarily speaking, that is bad for him. But for the women who are doing the selecting, the loss of a small number of potential mates may be a small price to pay for creating a much larger number of the kind of men they want.

Some gay genes may benefit women more directly—to the detriment of their own sons. The evidence comes from groundbreaking studies by Andrea Camperio-Ciani, a researcher at the University of Padua in Italy. Camperio was interested in understanding the evolutionary paradox and began by replicating a family-tree study done in the early 1990s by geneticist Dean Hamer of the National Institutes of Health. Hamer had concluded that some cases of homosexuality are passed down on the X chromosome, which a boy receives from his mother. Camperio and his colleagues compared the family trees of gay men to those of straight men, and confirmed that homosexuals had more gay male relatives on their mother's side than on their father's side—which suggests an X-linked trait. But the Italian researchers also found something more intriguing: Compared with the straight men, the gay men had more relatives, period.

Camperio did not quite know at first what to make of these results—or how they might help him understand the Darwinian paradox of homosexuality. Then one day, he was driving through the forest with his daughter, on the way to their country house. Their tradition was to play mathematical games to keep themselves entertained. This time, he began talking about a different puzzle. "I began explaining my research," Camperio recalls. "I explained to her that we found out that homosexuals come from large families. I told her that there is an inheritance from the mother—she's giving the homosexual genes to her son. I said, 'This is impossible—how can they be surviving?'"

His daughter, 15, replied, "But Dad, did you check if this factor that makes sons homosexual is not the same factor that makes the mother produce more children and have big families?"

Camperio stopped the car, looked her in the eyes, and said, "Shit! What is this? It's a great suggestion!"

The next day he left his daughter in the country and went back to the lab to investigate the idea. Sure enough, the mothers of homosexuals in the study did indeed have between a quarter and a third more children than the mothers of heterosexuals. Camperio also uncovered another dramatic finding: In families with gay sons, the aunts from the mother's side had many more children than the aunts on the father's side—the large families, in other words, were on the maternal side. Camperio realized his daughter was right. "There was something in the genes that, in the male, changed his sexual orientation, and in the female, increased her probability of having children," he says.

What could it be? Camperio spent the next few years going to gay men and begging them to let him interview their mothers and aunts—a daunting task in deeply Catholic Italy. In the end, it took him three years to get 30 subjects. When he interviewed the women, though, he found they had fewer miscarriages, fewer

infections, and used fewer contraceptives than the mothers and aunts of heterosexuals, though the differences were only slight. One difference, though, was not slight at all: The homosexuals' mothers and aunts had had between three and four times as many sexual partners. They seemed to really like having sex with men.

Camperio's explanation for all this relies, like Rahman and Wilson's hypothesis, on sexually antagonistic selection. Perhaps, he suggests, the mothers of some homosexuals have a "man-loving" gene. In women, it would be adaptive, causing them to have more sex and more children. But in men, the "man-loving" gene would be expressed differently, causing homosexuality. To the gay sons, that would be an evolutionary disadvantage—but one outweighed by the advantage to the mothers, who would have more than enough other children to compensate. And so gayness in men would persist in these families—as a side effect of a trait that is beneficial to the women.

But even Camperio says his results can explain no more than 20 percent of the incidence of homosexuality. "The more we study, the more we find there will be other mechanisms," he says. His research confirms that there are many ways to become gay—including, perhaps, one way that is much stranger than the rest.

The gay men in Camperio's study didn't just have larger families than the straight men. They also had more older brothers—and not just because they came from larger families. It's true across the board: The more older brothers a man has, the more likely he is to be gay. The "fraternal birth order effect" was first uncovered by Ray Blanchard and Anthony Bogaert of the Center for Addiction and Mental Health in Toronto, and has since been replicated by a dozen other studies.

For every older brother a man has, his chances of being gay go up by around a third. In other words, if you have two older brothers, you're nearly twice as likely to be gay—regardless of whether the older brothers are themselves gay. It is not possible to explain that as an effect of genetics.

Some researchers have tried to explain it as an effect the older brothers have on their sibling's environment. Perhaps a boy grows up homosexual, one argument goes, because the presence of older brothers means more incestuous sex play early in life. Or perhaps their presence makes his parents treat him differently.

But in another study, Bogaert found that it was only biological older brothers that contributed to the effect. Men who grew up with older stepbrothers or adopted brothers—brothers born of different wombs—were no more likely to become gay. Meanwhile, men with biological older brothers who died in infancy or who were raised separately—including brothers they had never even met and sometimes didn't even know about—did manifest the effect. In other words, the effect could

not be explained through upbringing.

If it wasn't genetic and it wasn't upbringing, then what could it possibly be? The answer is the prenatal environment—the result of something that occurs as the fetus develops in the womb.

So what happens in the womb to make a fetus gay? Researchers can only speculate, but Blanchard and Bogaert suggest the older-brother effect could result from a mother's immune reaction against her male fetuses. During her first male pregnancy, the mother's body reacts against some factor related to male fetal development. Her immune system detects male-specific proteins produced by the boy's Y chromosome—perhaps proteins located on the surface of his brain cells—and deems them foreign invaders. As a result, her body generates antibodies against them. Each successive male pregnancy strengthens this immune response. The next time she's pregnant, the anti-male antibodies cross through the placenta and influence the fetus's brain, interfering with the masculinization of his brain and making him gay.

It may even be that women with strong immune systems are more likely to produce gay sons. The reproductive advantages to her of having such a healthy constitution might outweigh the disadvantages of occasionally producing a son who will have no kids himself. Even if the immunization scenario is true, however, it explains only 15 to 30 percent of the cases of male homosexuality. "My theory is not meant to explain homosexuality in all males—obviously not in firstborn males," says Blanchard. "And it does not explain homosexuality in women at all." It's really just a "working hypothesis," says Bogaert, for a strange and puzzling phenomenon.

Most recently, Bogaert, Blanchard, and their colleagues have found that older brothers increase the likelihood of homosexuality only in men who are right-handed—even though left-handed men are more likely to be gay in general. "We don't really know what that means," says Bogaert. It's one more piece of evidence, though, that homosexuality is determined biologically, before birth—just like handedness. As often happens with science, the mystery deepens and becomes more complicated before the ultimate pattern finally reveals itself.

So how do the pieces fit together? So far, they don't. Rather, they exist side by side. "There is no all-inclusive explanation for the variation in sexual orientation, at least none supported by actual evidence," says geneticist Alan Sanders of Northwestern University. It's one of the most consistent themes to emerge from the literature on homosexuality: the idea that there are many different mechanisms, not a single one, for producing homosexuality. Neither Camperio nor Bogaert sees much of a connection between the female-fecundity theory and the older-brother effect. "They are somewhat disparate," Bogaert says. "But that is compatible with the idea that there are multiple biological pathways affecting sexual orientation."

The biggest gap in the science of homosexuality concerns lesbians: Much less research has been done on them than on men. That's because women's sexuality seems to be more complicated and fluid—women are much more likely to report fantasizing about both sexes, or to change how they report their sexual orientation over time—which makes it harder to study. "Maybe we're measuring sexual orientation totally wrong in women," says Mustanski. Rahman and Wilson suggest that lesbianism might result from "masculinizing" genes that, when not present to excess, make a woman a more aggressively protective and thus successful mother—just as feminizing genes might make a man a more caring father.

Right now, there is no one all-inclusive solution to the Darwinian mystery of why homosexuality survives, and no grand unified theory of how it arises in a given individual. Homosexuality seems to arise as a result of various perturbations in the flow from genes to hormones to brains to behavior—as the common end point of multiple biological paths, all of which seem to survive as side effects of various traits that help heterosexuals pass along their genes.

"It's the fundamental question for the next 10 years," says Mustanski. "How do these things interact? What is the model that explains all these things?" — *Robert Kunzig*

The Gay Science

Test your knowledge about breaking research on homosexuality. True or false:

1. 10 to 12 percent of men are gay.
2. Gay men have longer, thicker penises than straight men, on average.
3. As children, most gay men display gender-bending behavior, like dressing up in their sisters' clothes or playing with dolls.
4. In general, gay men are worse than straight men at certain cognitive skills, like reading maps, spatial orientation, finding missing objects, and packing trunks.
5. Lesbians are better than straight women at certain spatial, navigational, and language tasks.
6. Men with the most masculine voices tend to be straight.
7. Gay men often have distant fathers, suggesting that levels of childhood affection have an effect on sexual orientation.
8. The more older brothers you have, the more likely you are to be gay.
9. Sexual orientation correlates with whether you are right- or left-handed.
10. The ratio of the lengths of the second to fourth fingers predicts sexual orientation.

ANSWERS: 1. False: 2 to 6 percent of men are gay. 2. True. 3. True. 4. True. 5.

True. 6. False. The voices rated as most masculine are those of gay men (and the most feminine are those of lesbians). 7. False, though some fathers may become distant in reaction to childhood gender nonconformity of boys who are born gay. 8. True. 9. True. Homosexuals are 39 percent more likely to be left-handed or ambidextrous. 10. True.

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