

The following is a series of snippets by Greg Cochran culled from postings to various discussion groups. It gets across the important ideas and is more fun than reading the usual stuffy academic paper. Cochran is a physicist in Albuquerque.

Here are some references to the gay sheep:

Perkins, A., and J. A. Fitzgerald. Luteinizing hormone, testosterone, and behavioral response of male-oriented rams to estrous ewes and rams. *J. Anim. Sci.* 70:1787-94, 1992.

Perkins, A., J. A. Fitzgerald, and G. E. Moss. A comparison of LH secretion and brain estradiol receptors in heterosexual and homosexual rams and female sheep. *Horm. Behav.* 29:31-34, 1995.

Resko, J. A., A. Perkins, C. E. Roselli, et al. Endocrine correlates of partner preferences behavior in rams. *Biol. Reprod.* 55:120-26, 1996.

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The kind of preferential homosexuality seen in human males is very rare. I know of only one other species in which something similar is known to exist. And of course it should be rare, if there is anything to neodarwinism. The existence of a significant fraction of males that show sexual interest in other males and no interest in females is just as much an evolutionary anomaly as, say, a few percent of that species dying from spontaneous liver failure in early life, or jumping off a cliff.

There are parts of Africa - usually called the sterility belt - where more than 30% of women are infertile. If I were some kind of idiot, I could go la, la, la and refuse to admit that was any kind of evolutionary anomaly. If I were Dean Hamer or any of a million theory-free (and sense-free) molecular biologists, I could look for a common sterility gene. Sheesh. If I were a dimwitted evolutionary biologist, I would come up with a theory in which these women someone are vaguely like sterile female workers among ants or bees, that they are helping their kin, helping raise their nieces and nephews - of course that's not as effective a strategy (in humans) as having and raising your own, the relatedness coefficients don't favor it, but since I would probably have been trained as a psychologist or cultural anthropologist, I would be unable to count beyond three in any event. Or, maybe people would say that I shouldn't be studying it; possibly the answer would upset people.

Anyhow, that hypothetical example is quite real, and it is caused by untreated chlamydial infections, which result in tubal scarring. That's probably the biggest cause of infertility here too, other than waiting till age 42. Almost everything that hits a lot of people and has a big impact on fitness has turned out to be caused, directly or indirectly, by infectious organisms. A metaphorical cigar for the first reader who states the obvious reason why this is the case.

Actually there are cultures in which homosexuality is unknown. True of a lot of hunter-gatherers. In fact, I don't know of any hunter-gatherers in which you find men who are preferentially homosexual. You can't find it among the Bushmen, for example. They've heard of it (among the Bantu) , but find it pretty weird.

Anyhow, I should probably shorten the way for you a little. The word 'fitness' is a technical phrase in evolutionary biology: it says how effective you are at propagating your genes, compared to the group average. Homosexual men have low fitness, around 0.20 in recent US surveys. And they aren't what you'd call rare: probably over 1%, possibly as high as 4%. That is an anomaly. You don't expect any substantial fraction - and for these purposes 1% is pretty substantial - of the population in any species to pursue a strategy that is never going to work well. Natural selection is continually pruning any gene that would cause something like that, and for that matter genes that tended to prevent exterior influences from inducing that strategy would increase.

One expects natural systems to work pretty well, because of these endless generations of pruning and refinement. And again, working means replicating - and, of course, the functions that support replication. Good, not perfect: mutations happen, almost all bad. But the mutation rate of any individual gene is always low, and natural selection keeps weeding them out: mutation-driven diseases are never common. Certainly the most common ones known are several hundred times rarer than homosexuality (which, by the way, doesn't even look particularly genetic in origin - MZ twins are 80% discordant). In fact the evolutionary cost of homosexuality is about as big as the sum total of all known mutation-driven genetic disease. It can't be caused by mutation - too common. Let me make this very clear: if one in ten thousand men were homosexual, homosexuality would not be an evolutionary anomaly. A few genetic diseases are that common. But when, say, 3 in 100 men are homosexual, it's a huge anomaly.

All these evolutionary arguments apply to populations that have been in the same environment for a long time. Put individuals somewhere new, say the surface of the Moon, and their carefully crafted adaptations will fail. Maybe something new in our environment causes homosexuality. I wouldn't say it's utterly impossible. But I doubt it, because almost all the new things in the environment are very new indeed. Most of the ways in our lives have changed have happened in the past 100 or 150 years. Go back a little farther and most people were farmers, their lives not so very different from those of farmers in Sumeria. Generally you expect important low-fitness syndromes caused by new environmental insults to be quite new - not go back thousand of years. Cigarette smoking and lung cancer is a good example. It's really only about 70 years old. But homosexuality clearly predates the machine age.

I should also make clear that failing to mate is not the real anomaly. The anomaly is failing to try. In many species, huge fractions of the young never live to grow up. Most seeds never become trees. Most males never get to mate, in some species. But they try. They pursue behavioral strategies that work on average. Some birds, in poor conditions or attacked by predators, don't make it south for the winter. But damn few fly north ! If a few percent of geese flew north for the winter, it'd be an evolutionary anomaly, in exactly the same way that human homosexuality is.

There are plenty of syndromes with comparable evolutionary cost, but almost every one is caused by an infectious organism, a parasite. Most are somatic, but some involve behavioral change. Tertiary syphilis made lots of people act odd, act in ways that detracted from fitness. If lots of people are sterile, it's infection. If lots of people go blind ( in old-fashioned surroundings), it's infection ( river blindness or trachoma) . If lots of people are deaf, it's

infection ( rubella, mainly) . If lots of people have liver failure, it's infection (hepatitis B or C) (or something fairly new like distilled alcohol). if lots of people have crappy lungs, it's tuberculosis ( or a new agent like cigarettes). That's the way things work. The big syndromes that reduce fitness are caused by infection or new environmental insults - but the greatest of these is infection.

The power of natural selection decreases with age, especially after the reproductive years, so bad stuff happening to 80 year olds is no anomaly. If homosexuality hit at 85, like Alzheimer's, it wouldn't be anomalous. But of course that is not the case. It's an evolutionary anomaly. Almost all evolutionary anomalies of comparable size are caused by infection. It's the way to bet.

Failure of key adaptations, in the absence of some kind of exterior insults, is rare. It has to be, else how could you walk and talk and say silly things? Do you realize how many different organs and biochemical systems have to work correctly in order for you to successfully have breakfast and read the comics? Hundreds, at minimum - this is why biochemistry texts are thick. If correct function of hundreds or thousands of separate biochemical mechanisms is required in order for adequate performance at an organismal level, the probability of failure of any one system is and has to be very low. And natural selection keeps that probability low. That is why geese seldom fly north for the winter. It is why a fox seldom attacks a human - unless it has rabies.

As for comparison of left-handedness and homosexuality, it will make sense the day that left-handed people have very few children, when they suffer a big reproductive disadvantage. But they don't, probably never did, so the comparison is... pointless.

I never thought homosexuality was necessarily precluded by hunter-gathering - if nothing else, you'd have to have an established causal model for homosexuality before you could say that some particular situation precluded it, and nobody does. Some argue that homosexuality is some kind of evolved strategy; presumably it would have evolved in among hunter-gatherers, since agriculture was only invented fairly recently. In that case you'd think that if anything homosexuality would be universal among hunter-gatherers, but it's not. If anything, rare.

And that fact addresses some other common statements, such as the one that homosexuality exists at about the same frequency everywhere and everywhen. If you think about that for even a moment, it's obviously baseless, because how would anyone know? It's hard enough to estimate the prevalence of homosexuality in the US today ( although it's clearly well under 10% ) ; how could anyone develop a good estimate of how common it was in medieval Germany? Or in the Indus civilization? How would anyone ever know whether it existed at all in prehistory?

About the best we can do from the historical record is to get the impression that homosexuality was common in some places and times, less common in others, not mentioned at all in some places. It's almost impossible to determine good numbers - and there is even confusion about whether what was described is really the same thing as homosexuality today.

For that matter, it doesn't even seem to have the same prevalence among people who grow up in rural or urban areas parts of the US \_today\_ .

One is a strategy that, when rare, has high fitness, higher in fact than the standard strategy. For example, among birds that build nests, a gene that made carriers big and aggressive might allow them to steal already-built nests, saving time and energy, giving them higher fitness when rare. As they became more common, there would be fewer nests to steal, fewer choice nest sites, and the advantages of thievery would decrease. At equilibrium, their fitness would be the same as that of the honest nest-builders.

There is another kind of alternative strategy which might be called making the best of a bad deal. Individuals who have had problems, suffered illness or malnutrition or some kind of bad luck, adopt a strategy that results in \_some\_ fitness, some reproduction, but never as much as the standard strategy. For example, small or sickly males of a horned beetle species don't grow horns and don't fight with the other males. They sneak around and occasionally manage to mate but do poorly compared to their big horny cousins. This kind of second-best strategy is always facultative: it is not hardwired by some particular allele, it is a reaction to circumstances. The strategies that work well when rare can be either facultative or genetically hard-wired. There are some fascinating recent examples of genetically hard-wired behavioral variants.

Now homosexuality of course does not look like either kind of behavioral strategy, because it is not efficient at propagating genes either directly \_or\_ indirectly\_. It looks like a flight from reproductive fitness. Homosexuality in its basics has no resemblance to known variant behavioral strategies in other species. There are variant males that imitate females, but those mimics \_mate\_ In fact, biologists call them 'sneaky fuckers', but that seldom gets into the journals. There are, in a few species, some individuals who either temporarily (wolves, meerkats, some birds) or permanently (ants, bees, termites - no known mammals, I think) refrain from reproducing and help raise other's offspring. But homosexual men don't do that. For it to work as a strategy, they'd have to do it a lot; it'd have to be as common and strong a behavior as mother love. No such strong nurturing pattern exists. It wouldn't work if it did exist, because the relationship coefficients are too low.

It is not enough that some homosexual men, once in a great while, do something nice for their nephews. For homosexuality to work as a strategy, it'd have to happen all the time. That is not the case here and no one has ever heard reported a culture where it was.

Brain damage can do some pretty amazing things. For example,

Case report. A 31-year-old woman had intractable temporal lobe epilepsy (TLE) since childhood. Her seizures began with orgasm-like euphoric erotic feeling usually followed by complex partial seizures (CPS). MRI demonstrated a right-sided mesiotemporal sclerosis proved also by histopathology.

The bastards cured her.

What makes you think the distribution is uniform? It's not. Boys who grow up in urban areas are something like three times more likely to be homosexual than those who grow up in rural areas. The stats for schizophrenia are quite similar.

Your idea that identical twins would end up with identical fates when exposed to an infectious disease is often not the case. Concordance for polio among identical twins is 36%. You know they both had to be exposed. Exactly how this works is unknown. We do know that the vast majority, at least 99%, of people who contract polio do not get paralyzed. The polio virus is really an intestinal bug, but sometimes it wanders into the motor nerves and causes trouble. MZ twins are more likely to be concordant than DZ twins (6% concordance for DZ) (also true of homosexuality) but most are still not concordant. MZ twins are concordant about half the time for TB

I think that this low concordance between identical twins is the norm for a number of diseases that are rare consequences of a common pathogen. Most stomach cancer used to be caused by *H. pylori* infections, but it only happens in around 1% of infections. MZ twins have about 27% concordance for stomach cancer, even though probably both are infected. Bell's palsy is caused by herpes simplex, but almost everyone has herpes simplex and only a few ever develop Bell's palsy. I don't have the numbers but I bet MZ twins are usually discordant.

Try to remember that there are a fair number, perhaps even a large number, of pathogens that everyone, or nearly everyone, gets. There are serious diseases that are rare consequences of those common infections. Everybody gets herpes simplex, and sometimes it reappears as Bell's palsy. Until very recently everyone got chickenpox - and once in a while that shows up again late in life as shingles. It can also show up again as Ramsay-Hunt syndrome, which is a lot like Bell's palsy. Everybody - and I mean everybody, everywhere, - gets Epstein-Barr: and it causes at least a third of Hodgkin's and non-Hodgkin's lymphoma (also nasopharyngeal cancer in China, Burkitt's lymphoma in Africa). There is also an odd pattern in that no one ever seems to get multiple sclerosis or lupus unless they are seropositive for EB. Everyone gets some kind of papilloma virus, and it is beginning to look as if that is a necessary step in basal skin cancer, the most common and least serious cancer. Everyone gets human herpesvirus 6 and 7; we don't yet know much about what they do, but they hang around for life. For none of these are there 'hot spots'. I could also list tens of respiratory viruses that everyone gets - RSV, influenza, parainfluenza, etc. etc. etc. Harkening back to narcolepsy, there are all kinds of signs that damage to the hypothalamic nucleus is triggered by some infection, which starts some kind of autoimmune attack (as in rheumatic fever); 99% of narcoleptics have a particular HLA type that only ~25% of the general population has. And as everyone knows, identical twins are usually discordant for narcolepsy. So..., I'm trying to break this to you gently - but what you say about hot spots and twins either resisting or succumbing together - it ain't necessarily so. Gregory Cochran

I was explaining what reproductive fitness means. Dwarfism was an example, one where the fitness is similar to that of homosexual men. Obviously, if there were a gene causing homosexuality, it would tend to become rare in the same way as dwarfism, barring improbably large side advantages. But natural selection makes hopeless life strategies, strategies that can never work well from an evolutionary standpoint, rare. It eliminates genes that cause such ineffective strategies, it multiplies ones that prevent. Natural selection

optimizes; it makes things work, terribly complicated things. They often work with great precision. Human homosexuality has an evolutionary impact similar to a hypothetical case in which a few percent of Canadian geese go north for the winter: that doesn't happen. It wouldn't work. Any pattern like that is an anomaly; it's odd. A rich person ( who could feed a zillion kids) using artificial contraception in a way that leaves no descendants is not an anomaly in this sense. [Why? GOOD MIDTERM QUESTION.HCH]

[FOLLOWING APPARENTLY ABOUT IDEA THAT GAY MALES ARE HELPERS AT THE NEST]

This is only the umpteenth time I've run into particular mistake: to be fair, the others weren't in this forum. First, it is important to mention that nobody sees homosexual men among hunter-gatherers, the groups whose way of life is thought to most closely resemble the general evolutionary past of the human race.

Second, this idea that homosexual men somehow paid their evolutionary way by helping others in the tribe raise children is bullshit, because they don't do any such thing in any society. If they were something like worker bees, if helping others raise their kids were their particular evolutionary strategy, they would have a strong impulse in that direction, and they'd do it a lot. They would always have done it, they'd practically always be doing it. . It'd be as obvious as mother love - but it doesn't exist.

Third, how on Earth would homosexuality help? Being neuter might - it works for bees, but how is strong same-sex interest going to help anyone provide for kids in the tribe? It's a distraction, a time consuming distraction. Obviously, a guy who spent most of his time investing in his sister's kids and screwed the occasional interested chick would have a far superior reproductive strategy. Homosexuality neither makes babies nor brings in the bacon.

Fourth, it wouldn't work if they did do it: the relationship coefficients are wrong. In order for a gene causing altruistic behavior ( behavior that costs the doer and benefits others) to be favored by natural selection, it has to satisfy Hamilton's inequality:  $sum\ of\ rb > c$ ,  $r$  is the relatedness coefficient,  $b$  is the benefit to the other individual, and  $c$  is the cost to the doer, all measured in terms of fitness. Someone who has and raises two kids to maturity breaks even, in a genetic sense.  $r$  is 0.5 for your own kid, 0.25 for a nephew or niece. In order for a homosexual man to break even, he'd have to cause four more nephews/nieces to survive to maturity than would have without his efforts; he has to be better at making kids grow up than a mother - and, in order to fit our observations, must do so in a way that has never been noticed by anyone. Those non-reproductive females among wolves are usually the children of the male and female alphas. They are helping to raise their brothers and sisters ( where  $r = 0.5$ ). When they get the chance, later in life, they breed. This is harder to do in humans, because our childhood is so long. By the time that one grows, up, Mom's reproductive period is usually over. Anyhow, homosexual men don't do this: they don't hang around and help raise extra brothers and sisters. And if they did, how would homosexuality help them do it?

Probably the most important lesson learned in biology over the past 40 years is that natural selection is strongest at the individual level and that behavior should be analyzed

keeping that in mind. This had not oozed much into the popular mind. Homosexual men have a lot fewer children than average: that is a fact, and it is not exactly surprising. I think that this nonsensical crap about the evolutionary 'function' of human homosexuality originated with Jim Weinrich and was then uncritically mentioned by the notoriously numerically challenged E. O. Wilson in a book. Jim can't count, but I can.

[SOMEONE POSTED]

> Is it not likely that human sexuality is in fact a bell curve, with "strict homosexual" on >one end and "strict heterosexual" on the other end, and the majority of the people falling >somewhere in between? (With the caveat that sexual preference and sexual practice are >not necessarily the same thing.

No, it is not likely. Sheesh. That would make exactly as much sense as a bell curve of food preferences ranging from steak at the left to granite at the right, in which people in the middle liked steak and rocks equally well. Is an even split between a behavior that works and one that never does what you expect from biology? Do you expect half the geese to fly north for the winter?

[MORE RANT IN RESPONSE TO DISCUSSION]

rb > c isn't my equation. William D. Hamilton figured it out, he who was the greatest theoretical biologist of the 20th century. There are whole fields based on this one paper laying out the theory of of kin selection, of which that is the key equation. It's one of the most cited papers in the biological literature. You are approximately in the position of a guy in 1942, who, when confronted with the special theory of relativity, developed in 1905, denounces it as silly; and makes obvious the fact that he has never even heard of it To be fair, kin selection is not all that obvious (at least, until pointed out).. There is in fact an extensive literature on how, and to what extent, individual animals determine the relatedness of conspecifics they meet. Most of the time it is simple proximity; the average relatedness of near neighbors is higher than the global average, in fact often very high. Sometimes animals clearly remember who is who; know who their sibs are, for example. Interesting enough a number of animals appear able to smell their way to determination of relatedness, probably through detection of olfactory HLA clues in mammals.

To be even fairer, there are of course academic disciplines with thousands of professors that don't actually have any content at all. I mean, there was nothing, literally nothing, to Freudian psychiatry, but it was everywhere at one time. However, it never got any results, never really explained anything. Kin selection theory explains just fine. It has played an essential part in explaining the origin of eusociality (as in ants, bees, and termites). Hamilton predicted eusociality in aphids, which was only discovered later. It has explained patterns of family investment in many species. It has explained puzzling phenomena like obligatory siblicide in some birds. It has been used to explain levels and patterns of conflict between parents and offspring ( the kid is 100% related to himself, only 50% to mom or a full sibling). It has been used to (by David Haig) explain the ultimate origin of genetic imprinting, in at least some cases, particularly things like igfr2.

I have heard the help-through-college another time. again citing a single case. This gets old, but in order for homosexuality to pay its evolutionary way, homosexual men would have to \_on average\_ do things that greatly helped their close relatives' reproductive success. They would have to spend tremendous amounts of effort, a huge fraction of their time (probably well over 100%) doing things that helped their kin - as mothers do and have always done. But this does not happen, College is a silly example, since of course on average it \_reduces\_ reproductive success.

I don't know your educational background. But when I get interested in a new field, I don't just loftily assume that my first thoughts will trump all the work in that area that has ever been done, even without bothering to learn anything about the state of the art. I bothered to memorize Vogel and Motulsky's book on human genetics, read Hamilton's original papers, read Maynard Smith's \_Evolution and the Theory of Games\_, dug through Crow and Kimura's book on population genetics, read hundreds of papers, mostly goofy, on homosexuality. etc. etc. etc - just for starters. A good background in mathematical physics didn't hurt. I got up to the point where people occasionally ask me to give invited talks to the Human Behavior and Evolution Society, review and author papers on human genetics for PNAS; it is not that I know everything - who does ? - but I know enough to be occasionally useful. But you don't. Nor are you every likely to: anyone who thinks that a single case of aid to a nephew is actually comparable to the universal, strong, impossible to ignore pattern of mothers feeding and raising and protecting their offspring isn't a good thinker.

Grgeory Cochran