

Neoteny and Two-Way Sexual Selection in Human Evolution:  
David Brin - Ph.d. © April 1995 (2/89,7/93)

### **Paleo-Anthropological Speculation on the Origins of Secondary-Sexual Traits, Male Nurturing and the Child as a Sexual Image**

Much progress has been made in tracing the story of human origins, yet mysteries still shroud how we acquired such unique traits as bipedalism, concealed ovulation, and our prodigious brains. Paleo-anthropology suffers from both a dearth of hard data and a surfeit of enthusiastic opinions -- for example, drawing detailed conclusions about evolution from peculiar patterns of fat deposits in male and female anatomies. Or consider the question of why humans have lost nearly all their hair. It has been suggested that this adaptation enabled our ancestors to fill a niche unavailable to other predators -- keeping cool while chasing game under the noonday sun. Alas, this fails to explain why males (the presumed hunters) retain more ancestral hairiness than females, while children have the least of all. 1

As Herbert Spencer once commented about biological speculation -- there is nothing so tragic as a beautiful theory, foiled by an inconvenient fact. Especially in the area of human sociobiology, where evidence is scant and emotions can run high, hypotheses should be offered with good natured humility.

In that spirit I will focus on the trait of neoteny -- or the retention of childlike characteristics in mature members of a species. This process appears so amplified in humanity that we have been called the neotenous clan of apes. Humans much more closely resemble chimp or gorilla infants than adults of either species, e.g. in the smooth, vertical dome of the forehead and the relative ease of bipedality displayed by very young apes. Furthermore, even aged humans often retain a plasticity of behavior that is typically found among animals only in the young. Human emphasis on learned, rather than inherited, behavior, has been widely accepted as a chief driver of this trend, requiring our minds to remain supple and receptive for ever-longer spans.

This range of physical and mental traits may have a variety of unrelated causes and/or mechanisms, nevertheless they fall under the same overall theme of retention of childlike characteristics. (More formally, William Calvin (1991) identifies paedomorphosis ("becoming child-shaped") as juvenilization of the appearance of the end-product, without implications about the mechanism by which it came about. Neoteny has been taken by many authors to mean the slowing of some or all aspects of somatic development.)

Rather than discussing the general neotenization of our species over the last few million years, I wish to concentrate on how neoteny may have become enmeshed as part of a powerful selective cycle, going far beyond its original causes. A complex cycle of sexual selection that may have proved crucial in making human beings unique among animal species.

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Our starting point is a perceived dichotomy between adult men and women -- and thus potentially hazardous ground. Although evolutionary biology has lately been defended from a feminist perspective by Patricia Adair Gowaty (1992) and others, caution remains essential when stepping into this arena, hence I

will at times seem to belabor the obvious. Let me also emphasize that Homo sapiens appears less riven by sexual dimorphism than most species, and exceptions exist to nearly every generalization. Nevertheless, it seems clear that past and present human dimorphisms are legitimate topics for careful discussion.

While certain neotenous traits seem to be shared equally among the sexes (e.g. curiosity and plasticity of behavior), human females certainly do appear more paedomorphic in outward physical appearance than males. Although they mature at an earlier age, women do not go on to acquire the toughened skin, coarse body hair, thyroid cartilage, bony eye ridges, or deepened voices which are the common inheritance of most adult hominoids and other primates. Jones and Hill (1993) have shown that this generalization remains valid across racial, ethnic and cultural boundaries. Difference in degree of paedomorphism is one of the few truly decisive human sexual-dichotomies, used by most of us in visually distinguishing women from men.

How did this dichotomy come about? In exploring one possible explanation, we may come to see the heritage of human beings as stranger and more poignant than previously thought.

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We'll return to the subject of neoteny, but only after first covering some preliminary ground. Often, the hardest step in speculative paleo-anthropology lies in overcoming assumptions. So let us back up and begin by asking a very basic question.

### Why is it that a human female generally has to compete with other women to get a mate?

May we stipulate that women often vie over men? In one contemporary society, the United States, nearly all of the most popular magazines for women trumpet articles advising their readers how to stay competitive in what is portrayed as a desperate struggle to find and keep a mate. American women spend many times more each year on cosmetics than the nation appropriates for space research. (If we add fashion, diet food, plastic surgery, and related activities, costs compare to the defense budget.<sup>2</sup>) Granted, contemporary America is an extreme case, and even women in secure marriages work on their appearance for a complex of other cultural reasons. Still, no one can reasonably dispute that female humans often do engage in zero-sum contention over an apparently limited supply of suitable males.

Now of course men compete over women, too. But among animals this is only normal. Except for some spermatophore-donating insects, and a few fish and birds, competition between males for sexual opportunity seems almost universal.

Also nearly universal is the far calmer mate-selection process engaged in by females of most species, either accepting the victor in male-male struggles or actively choosing among candidates. This is not to say that females don't compete in nature! The struggle to raise successful offspring is deadly serious. Ethologist Sarah Blaffer Hrdy (1981) has shown that, among our primate cousins, inter-female competition for status and access to resources may seem quieter than the flashy violence of males, but it is also generally more relentless and complex. Darwin's image of females as demure, passive watchers-and-choosers greatly oversimplified a vast domain of intricate and assertive behaviors, with rivalry as much a feature of the female sex as its vaunted propensity for cooperation.<sup>3</sup>

Still, we are discussing a particular type of competition... rivalry to win a mate. And in this narrow area Darwin retains his original authority. Nature's story is nearly always about two sexes with markedly different agendas. For a male, each time he prevents one of his rivals from copulating with a female, that is one more womb which might be induced to carry forward his genetic heritage.<sup>4</sup> The same is not normally true for a female, looking at males. Once engaged in gestation, her reproductive success is unaffected by copulations taking place nearby. When there is an abundance of food, one female gets little or no direct benefit by denying any other female a chance to reproduce, or to be inseminated by the same

male. 5

So we return to our central question -- why do human females engage in rivalry over access to suitable mates?

A leading hypothesis holds that humans became paragons of adaptability by emphasizing general, species-wide behavioral and mental neoteny. Further, our offspring are born nearly unformed, oraltricial, replacing reflex instinct with lessons drawn from experience and the accumulated wisdom of the tribe, channeled by only the most general of innate predispositions. This process takes a long time, during which our children are helpless as no others in the history of life on Earth.

The presumption goes that human mothers need long-term, dependable partnership to help them carry big-brained, dependent children across the hazardous, exhausting stretch from embryo to maturity. And while some human societies have used brother-sister alliances to fill this need, or communal role-sharing, the majority have left mothers primarily dependent on continued loyalty and aid from the fathers of their children.

To put this in perspective with nature at large, consider the extreme case of the elephant seal.

During each annual mating season, females congregate onshore. If food is plentiful and the beach roomy enough, there is small cause for struggle between females, so most behaviorists used to be drawn to the noisy, extravagant displays of competing males. Known as a "beach master," each bull elephant seal outweighs any female many times over. By threat, bluster, and frequent bloody fights, he drives off all male interlopers to secure a local monopoly over insemination. Females acquiesce to this situation. Indeed, should the bull be away at the far end of his territory, and a rogue male attempt mating on the sly, females will often squall for the beach master to come drive the invader out.

Why do female elephant seals prefer to share one male rather than get individual attention? Turn the question around and consider -- what does the female really need from a male? The answer is sperm, and little else. Female elephant seals, like those of most species, are generally capable of rearing their pups alone. So choice of a mate is determined solely by factors which might reflect the quality of his genes -- his heritable fitness. Is he a healthy specimen, likely to father quality offspring? Will the males he sires likely become beach masters themselves? (Of course these questions are never posed, per se. But natural selection serves up appropriate answers, just as if they had been asked.) It matters little if the bull she has chosen also impregnates scores of other females. That he is able to drive off all comers and defend a beach is testimony to potency he might pass on in his genes. Having secured impregnation, the cows depart with no apparent sentimentality. They got what they came for.

In her book, The Woman That Never Evolved, Sarah Hrdy (1981) shows that harem systems differ dramatically. Some, such as the gray langur monkey, can be much more stressful than that of elephant seals. Langur mothers don't cycle through well-timed mating seasons, but re-enter estrus when their latest child either weans or dies. Also, while a mother langur doesn't need provisioning by a mated male, she does require the security of her troop. For these reasons, the bull langur has no single rutting season. To maximize reproduction, he must "police" his harem year-round. And, since his prime period averages only a few years, it is in his Darwinian interest to see that all local females serve his reproductive needs. One bloody consequence is that a new bull, on taking over a langur troop, often kills unweaned infants so that their mothers will resume ovulating sooner.

So while female elephant seals, gorillas and reindeer can be relatively complacent with their males, females in yet other polygynous species must look on their mates warily. 6 Nevertheless, in all of these species the purely sexual aspects of selection are classically Darwinian... featuring inter-male struggle and

various degrees of female choice. Inter-female competition, while pervasive, seldom extends to jealousy over copulation itself.

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Let us assign reindeer, langurs and elephant seals to one end of a spectrum labelled harem size -- the number of "wives" a prime male in a species impregnates during his lifetime. Along the vertical axis we then chart ratio of size between adult males and adult females for each mammalian species. By plotting this chart, R.D. Alexander and others (1979) discovered a significant correlation. Species like elephant seals, where solitary bulls struggle to hold herds of breeding females, show exaggerated size differentials between the sexes. Clearly this is not in order for male to dominate female, or else females would presumably have also grown, to compensate. Rather, it is simply because a big male is better at driving off competing would-be inseminators. Successful bulls pass on the trait of largeness to their male offspring.

At the other end of the spectrum are species whose male/female size ratio is near unity, and where harem size is reduced effectively to one. Roughly four percent of mammalian species form "monogamous" pair bonds, with the rate a bit higher among primates, such as gibbons. (It is virtually the rule for birds. Chicks must grow fast to achieve flight before the seasons change. This, plus a high metabolism, means few avian young survive on the labor of one parent alone.)

Now by definition, monogamous species have approximately equal numbers of successful male and female breeders, so one might expect both to behave similarly, competing the same amount with others of the same sex. Each should be as choosy in selecting a mate, and exhibit the same degree of jealousy about copulation. But this is not the case, because most "monogamous" males are not purely monogamous in every sense of the word. Generally, these males do not give their mates so much absolute fidelity as devotion... meaning they will do anything and everything to serve and protect the nest and their offspring. But, given an opportunity to engage in outside sex without risk or harm, they will often take advantage. Such opportunistic philandering by so-called "monogamous" males was until recently hardly discussed. Now, however, we know that it plays a distinct role in the behavior patterns of most such species.

For example, the females of many bird species force prospective mates to engage in lengthy, exhausting courtship "dances" and other displays, before becoming sexually receptive. For years this was thought to involve species identification -- preventing hybrid insemination by a related species. But plumage, scent, and a thousand other simpler markers are available to accomplish the same end. Now it is thought that mating dances serve more directly pragmatic role, by culling out philanderers. Few already-mated males can afford the time and energy -- exhausting themselves in an effort at wooing -- if they already have a mate and nest elsewhere. To male birds, monogamy may not mean absolute fidelity, but it does mean having priorities. 7

Thus, even monogamous species retain dimorphisms of sexual motivation and behavior. Monogamous females must remain careful and choosy, and even "monogamous" males must still prove themselves in order to win fatherhood.

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So where do human beings fit in this spectrum? Few comparative ethologists call humanity a truly monogamous species, even by bird standards. Indeed, many men, in both behavior and avowed fantasies, lean toward the attitude of male gorillas, if not elephant seals! Our position on the male-female size ratio chart would appear to suggest that humans have a modest "natural harem size" -- between one point one and one point four -- yet some men spend their lives aiming to achieve the milestone of their bedded "hundred," or even "thousand".

Nevertheless, we also share traits with pair-bonding species. Many men and women are capable of forming tight, long-lasting and devoted associations. Moreover, our offspring are altricial, helpless, nearly

impossible for a mother to rear successfully in the wild without at least some outside aid. For a very long time any woman who chose a loyal, dependable mate almost certainly had advantages over one who failed to do so.

In summary, then --

1) It is reasonable to suggest a selected tendency in human females to prefer mating with males who offer effective, committed support, along with their sperm.

2) Given the nurturing demands to be placed on the male she chooses, one can expect female humans to prefer not to share their mates with many other women.

So far we may seem to be belaboring the obvious, but we are discussing matters all-too often associated with strong opinion and emotion, so it's best to move in careful steps.

Now ideally, given desiderata 1) and 2) above, men ought to behave like male birds, and indeed, the "best" of them do seem to follow that pattern. While such men may stray on rare occasions, they seldom do so if it seems home or family might be jeopardized. But human males show an incredible range of motivation and behavior. One does not have to reach speculatively back into the Pleistocene to illustrate the difference between mating with "bird-like" or "elk-like" men. Contemporary American society shows the calamitous consequences when women bear children fathered by the latter type, who promise anything, then depart when it's convenient. Hence we have driver number three.

3) A large fraction of human males are not (from a solemn female point of view) suitable for pair-bonding or fatherhood. High male variability probably meant that choice remained an important, even crucial, activity for our female ancestors.

Are quality males a scarce commodity? That's no problem in polygynous species, where females simply share the alphas. But such a scarcity presents severe, even desperate difficulties where females prefer pairing! Adding factor three poses the problem starkly. Human females began competing for mates because they needed the kind of competent, collaborative devotion received by female birds -- but which only a fraction of human males seem inclined or capable of delivering. Hence it is a combination of limited supply and high demand which has created the unusual situation of competition among women for successful mating.

Put in this way, it seems a prosaic, not particularly surprising conclusion to reach after so many paragraphs. And yet, the quandary of human females, and their contention for quality mates, goes far beyond the clichéd plaint of the woman nightclub comic, who bemoans (to fervent feminine applause) the scarcity of "decent men". I contend, in fact, that this dilemma has already radically shaped the flow of human development.

### **Sexual Selection in Humans**

Departing from the traditional view since Darwin, recent biological theory perceives evolution as a sequence of fairly rapid state changes that punctuate lengthy periods of relative equilibrium. There are several ways species can launch into rapid change.

-- Geographic barriers separate sub-populations, isolating divergent gene pools. Long separations result in speciation. If groups are re-united before that point, a sudden influx of stockpiled genes from the isolated reservoir can speed change within the parent stock. 9--



High attrition rates due to new environmental factors can speed adaptation. In particular, ever-changing suites of parasites seem to offer a badly-needed explanation for the existence of "heritable fitness," and even the existence of sex itself. (S.W. Gangestad, 1993.)--

Self-generated adaptation pressure occurs when a species opportunistically moves into a new niche, thereby encountering new life-threatening dangers. Thus, the novel opportunities offered by, say, taking to the trees, will be for nought unless the species soon evolves a healthy respect for arboreal snakes.--

Another way evolution can accelerate is the major exception to natural selection admitted by Darwin, and the one way species can be said to design themselves. Sexual Selection. The bird of paradise and mandrill are vivid examples of what can happen when female choice of "quality" males becomes tied not just to the male's robustness or fidelity, but to some outward and apparently arbitrary physical display -- e.g. length of plumage or vividness of color.

We will not go into the details of this process, or the ongoing debate over whether or not such traits advertise health or heritable fitness. (Thornhill & Gangestad, 1993). Sexual selection in humans is discussed by Gangestad (1993), where it applies to matters of simple, first-order self interest optimization by human females (the presumed choosers).

What has long escaped discussion are the second-order effects, where "runaway" sexual selection may have resulted in human traits that are as exaggerated as any bird's tail. Nor has there been much investigation of females as objects of sexual-selection, rather than simply as classical selectors.

In "runaway" sexual selection, the selected trait becomes more embedded and exaggerated with each passing generation, requiring the next wave of the selected sex (usually males) to compete from a new plateau, which amplifies the trait even more, and so on. Even if the degree of exaggeration threatens the viability of the species at large -- e.g. the titanic antlers of the extinct Irish elk -- this may not abate the driving competition among individuals for reproductive success. 9 bThe models of R. A. Fisher (1958) long ago showed that evolution of a sexually selected trait, and the preference for it, can strongly correlate, with both accelerating in tandem.

Why is it nearly universally males of species who become burdened with huge antlers, giant tail feathers, or other garish exaggerations? A mistake of teleology might claim this is only fair, since females carry the major costs of reproduction, and a larger share of the risk. A more valid explanation lies in the fact that females in these species have a dictatorial veto over which males get to breed. Males wind up being selected to satisfy any criteria females get in the habit of using.

But now let us return to the situation among humans. We have seen that Homo sapiens has a queer arrangement in which both sexes must compete for partners, and both, in turn, must choose. The stage is set for trait-runaway by sexual selection to take place in an unusual two way mode -- acting not only on males, but on females as well.

Human runaway sexual selection? At first glance we would seem too sensible a species for anything like that. We don't appear to have been saddled with burdensome exaggerations like antlers or bright tails. Or have we?

Consider the greatest exaggeration of them all... our powerful, out-sized brains. Not only do large infant craniums put human mothers in great stress while giving birth, the brains within strike some biologists as extremely perplexing. In their cups, philosophical anthropologists can sometimes be heard wondering why humans "overshot" the mental capacity we needed in order to become masters of the planet -- in other words, competent hunter-gatherers with stone tools and fire. That was enough to remove a lot of

environmental stress, and should have led to a period of equilibrium. Instead, change only accelerated, until in short order we produced encephalization capable of conceiving mathematics, spacecraft design, and music more precise than any bird or whale could ever produce.

One possible solution to the problem of overshoot is that, quite simply, men and women might once have found the trait of intelligence "sexy" in each other. Brains, then, would be our equivalent of peacocks' tails... except in our case selectivity was shared by both sexes, and in turn both sexes shared in the amplified trait.

Are there other possible pivots of sexual selection? While watching out for cultural interference, consider, what do contemporary men and women say they want in the opposite sex? David Buss (1994), a University of Michigan psychologist, conducted a survey of 10,000 people in 37 cultures on six continents, concerning the traits people find attractive in the opposite sex. Oversimplifying somewhat the results of Buss and others 10 -- those attributes listed as most desirable fit the priorities discussed in section one. Women tend to rank first kindness, intelligence, and self-confidence. Also rated highly were accomplishment, reputation, health, vigor, reliability, and sense of humor. Physical handsomeness, while appreciated, is usually not among the highest mate-choice desiderata, except when the topic is extramarital affairs. Youth is not a major consideration.

Again oversimplifying, men seem to evaluate women in two stages. Stage one begins and ends with physical attractiveness -- manifested in terms of health, youth, and secondary sexual characteristics. These alone are generally enough to give rise to at least mild sexual fantasization. A whole new domain opens however, when men contemplate marriage or committed alliance, at which point some men contemplate the very same traits listed in the previous paragraph -- the sorts of things that might help determine a woman's suitability as a long-term partner and ally. The mere existence of stage two in human males is actually quite remarkable, as mammals go -- a strong sign of men's movement toward a more monogamous reproductive strategy, in which his choice is as nearly important to him as a woman's is to her. As we have seen though, this applies only to some men.

But let's go back and consider a man's stage one. Health and youth, as prime triggers of initial male arousal, make Darwinian sense. For while sperm is cheap, it makes little sense to deposit any where it will do no good. On selfish-gene terms, a male will be attracted to copulate with a female young and healthy enough to be fecund. 11

But what of those pronounced secondary female sexual characteristics which make up the third trigger of male arousal? Here we see strong indications that women have been competing with each other for quite some time, and a degree of "runaway" has indeed taken hold to dramatically alter their form and destiny.

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One exaggerated female secondary sex characteristic is large breasts. Back in the 1960s, some anthropologists proposed that the "purpose" of these enlarged glands -- often far greater than needed to produce milk for nursing infants -- was to attract males to desire copulation. Some even suggested that breasts mimic the twin globes of the buttocks, and became adaptive as a way to entice males to mount face to face. This hypothesis has major flaws.

1) We now know a sub-species of chimpanzee, the bonobo, or pygmy chimp, which routinely mates face to face without any such adaptation. So do orangutans.

2) Anyone thinking that a typical male, once already aroused, needs enticement to mount simply does not understand males, period.

Anyway, the problem for human females was never to get males to copulate, but to get them to desire

more than just one copulation ... to willingly offer partnership lasting beyond the blush of youthful fecundity. Exaggerated breasts do nothing to enhance this, at least not directly. I will soon propose that their evolution was much more convoluted than that. 12

But first, let us return at last to another secondary characteristic, one with far more influence than large breasts, or even youth and beauty, over a man's willingness to consider a woman a possible mate. After all, tastes toward those attributes vary considerably, among societies and from era to era. Even hourglass figures, which Devendra Singh (1993) finds to be desired across cultural boundaries, only serve as an anchoring mean around which considerable variation in desirability is seen.

We have already mentioned this other trait, which is an obligate attraction-trigger, in that its absence can be a nearly universal turn-off of male desire. This trait is some degree of neoteny of physical appearance -- or paedomorphism. Consider the obvious. Failure to retain certain childlike body attributes can be extremely prejudicial to a woman's opportunity to breed. Give or take a shadow, here or there, we know that most human males simply will not be attracted to copulate with, or pair bond to, women possessing beards! Nor are bony eye ridges, thick necks, or basso voices considered feminine. In their presence, even monumental breasts or perfect hourglass figures will not compensate.

If any trait is a likely candidate to have "run away" with women, as they competed and were chosen by men, it is very likely to be outward physical neoteny. There are several reasons why this makes evolutionary sense.

i)

We were already headed in that direction. As stated earlier, humankind needed to become neotenous in order to retain into adulthood our child-like, flexible brains and personalities. This was especially crucial for the acquisition of language. With juvenilization already under way in some areas -- in neural wiring and behavior -- it is reasonable to suggest the trend might become the focus of sexual selection, taken in additional directions by one sex, under strong selection pressure from the other.

ii)

Neoteny is a general fall-back variable. We are not the only species to go neotenous. Under our selective influence, most breeds of dogs now show substantial neoteny over a wide range of independent attributes, from physical form to behavior. In fact, juvenilization may be looked at as nature's way of allowing a species to back out of an evolutionary corner and try again, starting with a fresher, more plastic set of traits. 13

iii)

Neoteny is directly correlated with the very trait human females needed to attract in males. Consider the strange situation... human females were in competition with each other for mating, so they started developing external traits to attract males. But the problem was not simply to attract a male to desire copulation (which is trivial) but to attract the right type of male. In other words, the type of male given to protective or nurturing impulses.

Men are not langur monkeys. But even if infanticide played a role in our past behavior, there was also the countervailing tendency of tenderness to children. Studies by Robinson, Lockard and Adams (1979) showed that an infant's face -- especially smiling -- causes pleasure response at an involuntary level in many adult men, as well as large majorities of women. Countless tales of heroism by firemen and others who have risked their lives for the children of strangers show that this trait is well advanced, if not



universally distributed among human males.

It is not at all preposterous, then, to suppose that when runaway sexual selection occurred in human females, it took off down a path that caused the external juvenilization of women... and that this was adaptive because it helped engender feelings of tenderness and protectiveness in some males. Tenderness which, in turn, might have been reinforced by female choosiness, so that trait was genetically rewarded in males.

The result may have been a cycle which continued round and round, accelerating with every loop... producing with each new generation females who were marginally more neotenous and choosy, as well as males who were marginally more likely to care what happens to their lovers and offspring. Such a cycle would have been self-feeding, self-reinforcing, and exceedingly powerful. 14

### **The Effects of Two-Way Human Sexual Selection**

Not only are human females compelled to compete for mates, something uncommon in most species. They appear also to have been the sex most changed (at least in outward appearance) by runaway sexual selection in Homo sapiens, making women the least primate-looking of all higher primates. In comparison, males have been left relatively untouched. 15

Moreover, there is a predictable and tragic consequence to the development of neoteny as an emblem of adult female attractiveness. Consider it this way. Sexual selection requires two partners in order to work, first the sex under competitive stress (normally males, but in this case women) among whom a certain fraction are "chosen". If some trait has a high correlation with reproductive success, the prevalence of that trait will increase in the next generation. And true runaway will accelerate even faster if the choosers change as well -- becoming ever more critical and demanding of that trait. So if paedomorphism was women's runaway trait, there's every reason to picture men growing ever more attracted to paedomorphism in women, at a matching pace. Obvious enough, so far.

But paedomorphism means resemblance to children! Consider the bizarre dilemma, then. In order to attract quality mates -- protector types -- women began taking on the external features of the objects of the protective impulse -- children. This was rewarded, presumably, with reproductive success. But it also meant that men began associating with sexual desirability the very outward traits which are most directly associated with childhood!

The calamitous sickness of sex with pre-pubescents is one of the nastier features of our species. It is denounced by the majority, yet persists at low levels in all cultures, posing a dilemma for those contemplating a better tomorrow for our descendants. But now we might suggest one possible explanation of the origin of this dysfunction. It may derive, at least in part, as an aberrant offshoot from the two-way cycle of runaway sexual selection just described. If ever there was proof that evolution is not planned, this is it. An undergraduate could have predicted the tragic consequences.

Fecundity, health, neoteny... these are superficial signs which human males came to associate with feminine sexual attractiveness. Unfortunately, this boat-load of attributes was without a tiller, headed on a collision course with the best interests of the very children the whole game is about in the first place! What was needed was an emergency adaptation to help sane human males tell children apart from adult, fecund women. It is at this point, I contend, that human females developed a secondary set of exaggerated physical traits, not to elicit sex from males but in order to help high-end males across this tragic trap. One of the most pronounced of these secondary traits was the ballooning of women's breasts.

A male does not need the stimulation of breasts simply to desire copulation. But amplified breasts, along

with the waist-pelvis flair, do add to a suite of characteristics which give a normal adult male permission to admit his arousal, even to himself. They are not so much signals to indicate fecund femaleness as indicators of female adulthood. Healthy men are probably protected from sexual impulses toward children by a set of interrupt switches. These switches are by now so well developed that most men are scarcely aware of the beginnings of arousal by borderline pubescents... and feel shame when that arousal even momentarily reaches consciousness. 16 It is the unfortunate failure of such switches that provokes some to behave aberrantly. Likewise, it was the successful introduction of those switches that caused the majority of men to need more than just health and neoteny to experience the full flux of desire.

So women were off again, down the steep slope of competition. All else being equal, the desirable males were more attuned to women with fully developed breasts than to those whose glands were sufficient for nursing, but compact as a chimp's. Today, in order to help win the desperate game, North American women spend the annual budget of some small nations "correcting" a physical condition which has nothing to do with any illness or incapacity to nourish their young. Breast augmentation joins other types of cosmetic surgery -- procedures designed to restore the appearance of health and neoteny. It is a sign not only of the stresses faced by women naturally, but how these have been amplified and exaggerated by contemporary society.

In this context, one might be tempted by an unusual interpretation of the "Venus-Ishtar" stone figurines found in neolithic sites -- depicting female forms with exaggerated breasts and hourglass figures. Perhaps they were portable and artificial permission cues, serving much the same function as the milder forms of pornography do today, allowing solitary males to release pent-up physiological tension that accumulates behind a dam of inhibitions that pre-date any religious stricture.

Notwithstanding such speculative asides, we are drawn to one unmistakable conclusion. In the strange story of humanity, it is the female who has been forced to wear the equivalent of bright, garish plumage, even though she is still the one with the most exhausting task in reproduction, and still the one with the most to lose. This combination is without known parallel in nature.

We are a strange clan, indeed.

### **Social Implications**

One could be bloody-minded and suggest the present quandary will take care of itself, since presumably the children of "reindeer" men will be less successful than those whose fathers help nurture them. It has been said that the archaic term, illegitimacy, could be applied to a deadly plague sweeping the United States in the late Twentieth Century -- one that correlates more closely with childhood poverty, death and disability than any other group of causes, including accidents and infectious agents. If failure of men to assist in the raising of their children has such consequences, it might eventually result in the genetic rewarding of male nurturance, so that men equilibrate about a new "best" strategy, centered closer to shared child care. 17 Alas, in the context of a modern and compassionate society, this laissez-faire approach is callous, slow, and no solution at all.

Certainly we should put even greater effort into social conditioning, to try altering the ratio of "storks" to "reindeer" among human males. No doubt education can change the proportionate distribution of types. Unfortunately, those who expect a complete panacea out of socialization are likely to be disappointed. What good will it do to exhort boys not to act like elk, if they see elk-style men having success?

A better remedy might be to help women and girls learn to judge better -- to tell apart the various types of men -- and to distinguish a sincere promise from mere words aimed at an immediate end. In other words, use the tools of science to help young female Homo sapiens do what most females of other

species do -- choose as well as they can, despite the complexities of modern context. For many, this could make the difference between a successful, happy life and eventual abandonment in poverty. Indeed, the pages of most womens' magazines seem obsessed with exactly this effort -- floundering chaotically toward alchemical prescriptions for choice-directed happiness. This effort currently receives virtually no support from feminist intellectuals, who consider the approach ideologically anathema, holding that womanshould not base her happiness on marriage or successful mate-choice, even though such success, when achieved, demonstrably leverages improved lives for women and children in all contexts and at all social levels, and furthermore that same success can be perfectly compatible with actualization in career and other areas of life. In other words, a woman who chooses a mate well isalso more likely to succeed in areas beyond home and marriage.

Even if a program teaching girls to make wise choices were implemented and highly effective, there would still be a rub; for so long as the goal is "one man for each woman" the rules of a zero-sum game continue to apply. There will be winners and losers, and the spectacle of females fiercely competing for quality mates will continue.

Finally, humanity may soon have the power to plan and execute alterations to its own genetic heritage. It's conceivable that a few prunings of DNA might excise the worst ancient reproductive behaviors, while retaining desirable protective drives. Brin (1992) describes how amazonogenesis might be added to the suite of impressive capabilities of the human womb, effectively ending male social dominance. Such programs would demand careful thought, and the wisdom to put them into effect only by consensus... a task almost as daunting politically as scientifically.

None of this implies the situation for human beings is hopeless. Through a combination of methods we might improve matters to the point where we are merely uncomfortable, instead of painfully confused. But one realization clearly emerges out of this discussion -- there is no design possible for a human utopia. Whatever society we put together will at best be a network of compromises.

## Remarks

It happens all too often that this sort of speculative essay is taken too seriously, by both authors and all-too easily persuaded (or outraged) readers. Evolutionary paleo-sociobiology is a subject which, for lack of solid facts, is all too prone to emotional, egotistical or wishful posturing. It is well to recall that one can only go so far by spinning reasonable-sounding scenarios. Those I have presented here are mere conjectures. I claim nothing more.

Secondly, open discussion can only do good here. Once people of good will, both men and women, are better aware of the hand dealt them by evolution, they must almost certainly grow better at playing it.

And there is an up side in this odd tale of runaway selection, as expressed movingly by Sarah Hrdy (1981, p.14)

...it will be well to keep in mind a central paradox of the human condition -- that our species possesses the capacity to carry sexual inequality to its greatest known extremes, but we also possess the potential to realize an unusual social equality between the sexes...

For all its tragic implications, this cycle of mutual selection has meant that both genders experience much the same range of emotions during their lifetimes. True, men and women seem at times to concentrate on different priorities, which come into sad conflict in our present culture. But standing back, one can say without any doubt that both girls and boys grow up knowing what it's like to feel the fear and excitement of initiating an encounter, as well as being the one to evaluate or choose, to accept or refuse. In most

species these activities are strictly reserved for one sex or the other, but men and women both experience rejection, and each knows all the happy and aggravating phases of bonding. This may help women and men empathize with each other to a degree I would suspect is unprecedented between the sexes in nature, where males and females have little experience of each others' ways. Those who perceive only the gulf between men and women should take note.

Finally, although we may have stumbled about blindly in our million years of feverish adaptation, and while we now find ourselves boxed in, with little hope for anything like utopia, there is no cause for shame. If we are awkward and uneven in our adaptations, it is because we are a people still in rapid flux. One cannot hope or expect that a species will be perfectly at peace with itself when it is still in furious transition from what it once was, toward what it eventually may become. The first species ever to have some control or choice about that destiny.

Compassion is the trait we may be most proud of. Ironically, it can have come from nowhere else than the bizarre story of our ancestors' competition for reproductive success.

## Notes

1. Joseph Carroll suggests that the discovery of fire may have been a driver for both hairlessness and the acquisition of clothing. "Removable fur has obvious advantages if you are experimenting with fire." (Personal correspondence.) This might also explain why the smell of burning hair is so repugnant to most people.

2. Ironies abound. Are nine-hundred dollar toilet seats worse than facial creams whose ingredients cost five cents, but which are sold at the equivalent of five thousand dollars a gallon? One cosmetics company executive explained, "We don't sell products. We sell hope."

3. Dr. James Moore, of UCSD, tells of female grey langur monkeys inciting males into battle over them. The female role certainly needn't be passive. It remains, however, nearly universally selective.

4. Even where males don't battle directly over matings, competition exists. Male chimpanzees often take turns mating with females in estrus. But they also have huge testicles, producing vast amounts of sperm. Reproductive advantage apparently goes to the male who produces enough to overwhelm his rivals' contributions. Male gorillas, who practice close harem-tending, have testes that are minuscule, by comparison.

5. Exceptions include red phalaropes and jacanas, species of birds in which the nurturing parent is the *male*, who is left alone with the egg while the female goes off in search of yet another male. Among phalaropes it is the female who is larger and brightly feathered, and who performs elaborate mating rituals to prove her worth to the selective male. The "choosy" sex is generally that with the most to lose from a bad call.

6. Hrdy has shown that philandering by females can be adaptive in stress-filled situations such as the langur monkey troop. Females often evade the chief bull to mate with promising young male outsiders who stand a chance of ousting him. This apparently helps confuse those outsider males over paternity, causing them to refrain from infanticide when and if they do take over. Such an adaptive path might have been followed by human females, explaining both concealed estrus and the ability to engage in subtle sexual deception. In any event, this mode of female philandering is distinct from the issue we are discussing -- how women were trapped into having to compete for the ability to reproduce at all.

7. A stereotype appears to have some basis, then. The spectrum of males ranges from langurs and reindeer (animal Don Juans?) all the way to swans and storks (Jimmy Carters?) ... from committed polygamists all the way to those who are almost completely reliable -- who are tempted, but then ponder home and say, "I guess not." \*\*\*

8. For "variability" we might replace "volatility" or even "instability." To illustrate this, from 1960 to 1986, the proportion of women attending University of California Medical Schools rose from under five percent to forty percent. Over the same period, the female population of Californiaprisons also started around five percent... and stayed there. Clearly women are learning assertiveness, but being selective about applying it. Males' former near monopoly on violent crime has not shifted, despite all recent changes in the stressful lives of American women.

This is not to say that men are automatically bad guys. Rather they appear to show a degree of variability that is exaggerated even among primates. Consider why this high variability makes sense. First, humanity's recent rate of evolution appears to have been rapid, and Darwin showed that selection acts on variability. Among males, especially, a successful sport can pass on new, adaptive traits generously, while omitted male "failures" have little consequence. If this argument smacks of "group selection", careful re-phrasing can put the same idea in context of "selfish genes." Finally, the twin forces of sexual selection and change of reproductive strategy, have very probably contributed to making human males unstable, variable, and perhaps a little "crazy".

8b. RENUMBER NOTES. INSERT ILLEGITIMACY-PLAGUE QUOTE.

9. Prof. William Calvin of the University of Washington contends that the ice ages acted on humans as a genetic "pump." During boom times, populations of competent, versatile northerners would have expanded in relative isolation. When the ice returned, these groups only partly died back, but also would migrate south, infusing new traits into the (larger) parent population.

9 b. An analogy would be if human females found the "wild, romantic drifter" type of male irresistible, despite the harm such types do to society's ability to maintain subtle networks of interdependence. Naturally, this could never happen; it is just a hypothetical situation.

10. This generalization appears to hold particularly well for women who report a low frequency of sexual relations, especially extra-marital affairs. Gangestad (1993) accounts for this in an interesting way, presenting a theory of tradeoffs between a male's "investment potential" (IP) and his "heritable fitness" (HF). When women are not looking for a permanent mate, or have complete independence from any need for outside resource assistance, there appears to be a tendency to seek males on the basis of outward physical traits associated with genetic superiority (HF). In other words, when women need men only for seed, their attitude may swing toward that of elephant seal females. Throughout most of human history, however, a life-or-death need for loyal help (IP) probably helped drive the more prevalent attitudes reported by Buss.

11 A woman's fertile period is much narrower than a man's time as a potential father. This biological fact bodes poorly for those hoping propaganda alone might end the youth-fetishism of American males. While "good" men who have bonded to their wives can love them and continue to find them arousing until senescence -- and "age-ism" can, indeed, be ameliorated by good upbringing and consciousness-raising -- it is nevertheless almost certainly wired-in for the outward emblems of fecundity -- youth and health -- to be arousing to men. Like it or not, this is part of the foundation from which all future attempts at improved socialization and mitigation must commence.

12. I choose to concentrate on breasts here because the case is clearer. Regarding other pronounced



female traits -- e.g. broadened pelvises and narrow waists -- runaway sexual selection may have been a contributing factor. For instance, Devendra Singh (1993) finds that a ratio between waist and hip circumference of 3:4 is seen as attractive in women of almost any culture, despite wide variability in taste concerning overall "plumpness." Thornhill and Gangestad (1993) contend that estrogen causes exaggerated fat deposits in the gluteal-femoral region (thighs and buttocks) while testosterone causes deposit in the abdominal region. This ties in with their theory that human sexual selection is based on choosing mates whose appearance shows averageness plus symmetry, modified by those features exaggerated by testosterone in men and estrogen in women. Those hormones, in turn are involved in hypo-active immune systems, so such exaggerations would advertise that here is a healthy individual who has parasite resistance to spare. Alas, by that standard, beer bellies and male pattern baldness should also be deemed attractive in males, as well as violent, irrational behavior.

In any event, sexual selection cannot have driven the widening of the female pelvic girdle any faster than the punishment of horrible death inflicted during a difficult childbirth, as the cranial size of human infants expanded prodigiously. With all of this complications in mind, the decision to focus on breasts seems clear-cut.

13. Consider a leap of speculation. It might be proposed that, since it is males who are the usual crucibles of sexual selection, it is the male in most species who also starts out with an intrinsically broader range of variability... or ways to misread the blueprint. It is, after all, upon minor excursions from the old floor plan that sexual selection must act. While this variability guarantees a higher failure rate, and even occasional monsters, it also offers great rewards to the successful sport or variant. Thus a modest degree of instability may be inbuilt in males. On the other hand, the female reproductive pattern in most species is conservative, no female is likely to profit enough from wild excursions from the norm to make the risk worthwhile.

But what if, suddenly, it is females who must compete, subjected to the tyranny of external choice? Then their very stability in following the species plan may turn into a disadvantage, robbing individuals of the sort of variability upon which a successful runaway leader depends. But there is always neoteny. Given that women were doomed to be swept into a (more typically male) runaway race of change and adaptation against each other, neoteny may have been the easiest path to take. This is, of course, an extremely tentative extrapolation.

14. Indeed, the drive toward female paedomorphism may have added synergistically to the brain-behavior neoteny trend discussed before... possibly helping to make us the mental giants of Earth.

15. Note that this dichotomy is particularly pronounced in the so-called Caucasoid races. In some other groups, males seem to differ less from females in hirsuteness and exaggeration of female breasts is less pronounced. Nevertheless, women of all races appear visually less apelike than their brothers.

16. Evolution is not planned. In order for my scenario to take place, we need a plausible cost to males, of not following the road I describe. Clearly sex with children is unprofitable, a waste of sperm and distraction. Moreover, once human life span lengthened enough for parents to expand their supervisory role, there would have been a drive for moms and dads to forbid other males to sexually assault their children. If this were enforced severely, one could imagine men developing a hesitancy about mating with any female lacking adulthood cues.

17. Almost no human society is known that did not exhibit the practice of polygyny, in one form or another. But natural hunter gatherer societies appear to have varied widely in the criteria used for selecting "chiefs" -- (defined as those males invested with both tribal authority and accompanying reproductive advantages). In some clans, protector types seem to have been chosen, with active

participation in this selection by female councils. In others, more brutal types prevailed simply on the basis of fighting ability, and females lacked any voice in determining who would become a chief and have multiple wives. Note that the difference among native tribes was not whether there was polygyny by alpha males, but who set the criteria for its implementation. (Among the Cherokee, a chief could not choose his second wife. When the first wife felt ready, she would select someone she could get along with, and he had at best a veto. Also, family-abandonment was a major crime.) These two archetypal patterns appear to have rewarded profoundly different male personality traits, both of which persist today.

If we call serial-monogamy a sequential form of polygyny, the rate in supposedly monogamous contemporary America is clearly much higher than it was in most aboriginal tribes. It is left to the reader to decide which category of male is having the most reproductive success today -- the "user" type, or faithful "dad" types. Despite greater death rates associated with the "inseminate-and-leave" strategy, it clearly produces a lot of offspring... and will continue doing so until our "tribe" changes its partly-polygamous mating practices, or at least re-defines its implied criteria for choosing "chiefs".

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### About the Author

As a scientist, David Brin acquired his Ph.D. from the University of California, taught university physics and writing courses, and has participated in interdisciplinary activities at UCLA's Center for the Study of Evolution and the Origin of Life. As a *New York Times* bestselling author, Brin has won Hugo, Nebula, & Locus Awards for his novels and short stories, including The Postman, Earth and Glory Season. He

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### **Misc not now used**

Dian Fossey (1984) documented infanticide among gorillas. Fascinating work on North American antelope (see Nat.Hist.4/89) shows that styles of polygyny can change with circumstances within a single generation of a species, shifting over several years from a territorial-based system (males covering all females within a defended range) to a harem system, in which a male defends his rights to several specific females, wherever they might go. This variability of style within an overall theme is reminiscent of what we see in human societies.

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