Your Sexual Brain
How It Rules Your Life

What Kisses Mean
Their Surprising Power

Your Sexuality
Do You Have a Choice?

Men vs. Women
How Our Brains Differ

Love for Sale
Why Men Buy

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How deluded we are. We believe that, with our seemingly all-knowing consciousness, we are masters of our own domain (as Jerry Seinfeld so colorfully put it). In reality, as you will learn in this special issue, the imperatives and influences of sex, the sexes and sexuality all subconsciously shape our behavior in countless ways.

If you think your conscious intellect was at work in choosing your romantic partner, for instance, think again. In his feature article “Sex and the Secret Nerve,” starting on page 32, R. Douglas Fields explains how a little appreciated cranial nerve may be pulling your strings: “Many scientists believe that pheromones, those silent chemical messengers exchanged by members of the opposite sex in search of mates, relay subconscious signals to the brain through this obscure nerve.” Our kisses, too, transmit emotional messages that can cement a new relationship—or cause us to end it, as Chip Walter writes in “Affairs of the Lips,” beginning on page 48.

People make jokes about the opposing worldviews of “Mars” and “Venus.” But male and female brains really are distinct in their architecture and thinking patterns. Turn to page 40 for “His Brain, Her Brain,” by Larry Cahill, to find out how the sexes differ—and what it means. Men and women may still never understand one another, but at least now we will know why.

Choosing a partner is one thing, but how about your sexuality? Probably not, asserts Robert Epstein in “Do Gays Have a Choice?” The story begins on page 62. Same-sex preference is no biological accident of humanity, either. Find out more in “Bisexual Species,” by Emily V. Driscoll, on page 20.

Of course, if you would rather avoid all this tedious thinking about the subliminal power of sex, there is a cure. As Martin Portner relates in “The Orgasmic Mind,” starting on page 26, science has shown that sexual climax involves more than heightened arousal: it also requires that critical areas of the brain literally shut down. Sex makes empty-headed puppets of us all.
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The bonobo is one of the last large mammals to be found by science. The creature was discovered in 1929 in a Belgian colonial museum, far from its lush African habitat. A German anatomist, Ernst Schwarz, was scrutinizing a skull that had been ascribed to a juvenile chimpanzee because of its small size, when he realized that it belonged to an adult. Schwarz declared that he had stumbled on a new subspecies of chimpanzee. But soon the animal was assigned the status of an entirely distinct species within the same genus as the chimpanzee, *Pan*. The bonobo was officially classified as *Pan paniscus*, or the diminutive *Pan*. But I believe a different label might have been selected had the discoverers known then what we know now. The old taxonomic name of the chimpanzee, *Pan satyris*—which refers to the myth of apes as lustful satyrs—would have been perfect for the bonobo.

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The species is best characterized as female-centered and egalitarian and as one that substitutes sex for aggression. Whereas in most other species sexual behavior is a fairly distinct category, in the bonobo it is part and parcel of social relations—and not just between males and females. Bonobos engage in sex in virtually every partner combination (although such contact among close family members may be suppressed). And sexual interactions occur more often among bonobos than among other primates. Despite the frequency of sex, the bonobo’s rate of reproduction in the wild is about the same as that of the chimpanzee. A female gives birth to a single infant at intervals of between five and six years. So bonobos share at least one very important characteristic with our own species, namely, a partial separation between sex and reproduction.

**A Near Relative**

This finding commands attention because the bonobo shares more than 98 percent of our genetic profile, making it as close to a human as, say, a fox is to a dog. The split between the human line of ancestry and the line of the chimpanzee and the bonobo is believed to have occurred a mere eight million years ago. The subsequent divergence of the chimpanzee and the bonobo lines came much later, perhaps prompted by the chimpanzee’s need to adapt to relatively open, dry habitats.

In contrast, bonobos probably never left the protection of the trees. Their present range lies in humid forests south of the Congo River, where perhaps fewer than 10,000 bonobos survive. (Given the species’ slow rate of reproduction, the rapid destruction of its tropical habitat and the political instability of Central Africa, there is reason for much concern about its future.)

If this evolutionary scenario of ecological continuity is true, the bonobo may have undergone less transformation than either humans or chimpanzees. It could most closely resemble the common ancestor of all three modern species. Indeed, in the 1930s Harold...
J. Coolidge—the American anatomist who gave the bonobo its eventual taxonomic status—suggested that the animal might be most similar to the primate’s, because its anatomy is less specialized than is the chimpanzee’s. Bonobo body proportions have been compared with those of the australopithecines, a form of prehuman. When the apes stand or walk upright, they look as if they stepped straight out of an artist’s impression of early hominids.

Not too long ago the savanna baboon was regarded as the best living model of the human ancestor. That primate is adapted to the kinds of ecological conditions that prehumans may have faced after descending from the trees. But in the late 1970s chimpanzees, which are much more closely related to humans, became the model of choice. Traits that are observed in chimpanzees—including cooperative hunting, food sharing, tool use, power politics and primitive warfare—were absent or not as developed in baboons.

In the laboratory the apes have been able to learn sign language and to recognize themselves in a mirror, a sign of self-awareness not yet demonstrated in monkeys.

Although selecting the chimpanzee as the touchstone of hominid evolution represented a great improvement, at least one aspect of the former model did not need to be revised: male superiority remained the natural state of affairs. In both baboons and chimpanzees, males are conspicuously dominant over females; they reign supremely and often brutally. It is highly unusual for a fully grown male chimpanzee to be dominated by any female.

Enter the bonobo. Despite their common name—the pygmy chimpanzee—bonobos cannot be distinguished from the chimpanzee by size. Adult males of the smallest subspecies of chimpanzee weigh some 43 kilograms (95 pounds) and females 33 kilograms (73 pounds), about the same as bonobos. Although female bonobos are much smaller than the males, they seem to rule.

Graceful Apes

In physique, a bonobo is as different from a chimpanzee as a Concorde is from a Boeing 747. I do not wish to offend any chimpanzees, but bonobos have more style. The bonobo, with its long legs and small head atop narrow shoulders, has a more gracile build than does a chimpanzee. Bonobo lips are reddish in a black face, the ears small and the nostrils almost as wide as a gorilla’s. These primates also have a flatter, more open face with a higher forehead than the chimpanzee’s and—to top it all off—an attractive coiffure with long, fine, black hair neatly parted in the middle.

Like chimpanzees, female bonobos nurse and carry around their young for up to five years. By the age of seven the offspring reach adolescence. Wild females give birth for the first time at 13 or 14 years of age, becoming full grown by about 15. A bonobo’s longevity is...
unknown, but judging by the chimpanzee it may be older than 40 in the wild and close to 60 in captivity.

Fruit is central to the diets of both wild bonobos and chimpanzees. The former supplement with more pith from herbaceous plants, and the latter add meat. The bonobo diet contains relatively little animal protein, but bonobos do eat invertebrates and have even been seen to capture and consume monkeys. Unlike humans and chimpanzees, however, hunting in bonobos is as much a female as a male affair.

Whereas chimpanzees use a rich array of strategies to obtain foods—from cracking nuts with stone tools to fishing for ants and termites with sticks—tool use in wild bonobos seems undeveloped. (Captive bonobos use tools skillfully.) Apparently as intelligent as chimpanzees, bonobos have, however, a far more sensitive temperament. During a World War II bombing of Hella brunn, Germany, the bonobos in a nearby zoo all died of fright from the noise; the chimpanzees were unaffected.

Bonobos are also imaginative in play. I have watched captive bonobos engage in “blindman’s buff.” A bonobo covers her eyes with a banana leaf or an arm or by sticking two fingers in her eyes. Thus handicapped, she stumbles around on a climbing frame, bumping into others or almost falling. She seems to be imposing a rule on herself: “I cannot look until I lose my balance.” Other apes and monkeys also indulge in this game, but I have never seen it performed with such dedication and concentration as by bonobos.

Juvenile bonobos are playful and like to make funny faces, sometimes in long soliloquy pantomimes and at other times while tickling one another. Bonobos are, however, more controlled in expressing their emotions—whether it be joy, sorrow, excitement or anger—than are the extroverted chimpanzees. Male chimpanzees often engage in spectacular charging displays in which they show off their strength: throwing rocks, breaking branches and uprooting small trees in the process. They keep up these noisy performances for many minutes, during which most other members of the group wisely stay out of their way. Male bonobos, on the other hand, usually limit displays to a brief run while dragging a few branches behind them.

Both primates signal emotions and intentions through facial expressions and hand gestures, many of which are also present in the nonverbal communication of humans. For example, bonobos will beg by stretching out an open hand (or, sometimes, a foot) to a possessor of food and will pout their lips and make whimpering sounds if the effort is unsuccessful. But bonobos make different sounds than chimpanzees do. The renowned low-pitched, extended “huuu-huuu” pant-hooting of the latter contrasts with the rather sharp, high-pitched barking sounds of bonobos.

**Love, Not War**

My own interest in bonobos came not from an inherent fascination with their charms but from research on aggressive behavior in primates. I was particularly intrigued with the aftermath of conflict. After two chimpanzees have fought, for instance, they may come together for a hug and mouth-to-mouth kiss. Assuming that such reunions serve to restore peace and harmony, I labeled them reconciliations.

Any species that combines close bonds with a potential for conflict needs such conciliatory mechanisms. Thinking how much faster marriages would break up if people had no way of compensating for hurting one another, I set out to investigate such mechanisms in several primates, including bonobos.

Although I expected to see peacemaking in these apes, too, I was little prepared for the form it would take.

For my study, which began in 1983, I chose the San Diego Zoo. At the time, it housed the world’s largest captive bonobo colony—10 members divided into three groups. I spent entire days in front of the enclosure with a video camera, which was switched on at feeding time. As soon as a caretaker approached the enclosure with food, the males would develop erections. Even before the food was thrown into the area, the bonobos would be inviting each other for sex: males would invite females, and females would invite males and other females.

Sex, it turned out, is the key to the social life of the bonobo. The first suggestion that the sexual behavior of bonobos is different had come from observations at European zoos. Wrapping their findings in Latin, primatologists...
Eduard Tratz and Heinz Heck reported in 1954 that the chimpanzees at Hellabrunn mated *more canum* (like dogs) and bonobos *more hominum* (like people). In those days, face-to-face copulation was considered uniquely human, a cultural innovation that needed to be taught to preliterate people (hence the term “missionary position”). These early studies, written in German, were ignored by the international scientific establishment. The bonobo’s human-like sexuality needed to be rediscovered in the 1970s before it became accepted as characteristic of the species.

Bonobos become sexually aroused remarkably easily, and they express this excitement in a variety of mounting positions and genital contacts. Although chimpanzees virtually never adopt face-to-face positions, bonobos do so in one out of three copulations in the wild. Furthermore, the frontal orientation of the bonobo vulva and clitoris strongly suggest that the female genitalia are adapted for this position.

Another similarity with humans is increased female sexual receptivity. The tumescent phase of the female’s genitals, resulting in a pink swelling that signals willingness to mate, covers a much longer part of estrus in bonobos than in chimpanzees. Instead of a few days out of her cycle, the female bonobo is almost continuously sexually attractive and active [see illustration on page 10].

Perhaps the bonobo’s most typical sexual pattern, undocumented in any other primate, is genito-genital rubbing (or GG rubbing) between adult females. One female facing another clings with arms and legs to a partner that, standing on both hands and feet, lifts her off the ground. The two females then rub their genital swellings laterally together, emitting grins and squeals that probably reflect orgasmic experiences. (Laboratory experiments on stump-tailed macaques have demonstrated that women are not the only female primates capable of physiological orgasm.)

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**Social Organization of the Hominoids**

**BONOBO**

Bonobo communities are peace-loving and generally egalitarian. The strongest social bonds (blue lines) are those among females (green), although females also bond with males. The status of a male (gray) depends on the position of his mother, to whom he remains closely bonded for her entire life.

**CHIMPANZEE**

In chimpanzee groups the strongest bonds are established between the males in order to hunt and to protect their shared territory. The females live in overlapping home ranges within this territory but are not strongly bonded to other females or to any one male.

**GIBBON**

Gibbons establish monogamous, egalitarian relations, and one couple will maintain a territory to the exclusion of other pairs.

**HUMAN**

Human society is the most diverse among the primates. Males unite for cooperative ventures, whereas females also bond with those of their own sex. Monogamy, polygamy and polyandry are all in evidence.

**GORILLA**

The social organization of gorillas provides a clear example of polygamy. Usually a single male maintains a range for his family unit, which contains several females. The strongest bonds are those between the male and his females.

**ORANGUTAN**

Orangutans live solitary lives with little bonding in evidence. Male orangutans are intolerant of one another. In his prime, a single male establishes a large territory, within which live several females. Each female has her own, separate home range.
Male bonobos, too, may engage in pseudocopulation but generally perform a variation. Standing back to back, one male briefly rubs his scrotum against the buttocks of another. They also practice so-called penis-fencing, in which two males hang face to face from a branch while rubbing their erect penises together.

The diversity of erotic contacts in bonobos includes sporadic oral sex, massage of another individual’s genitals and intense tongue-kissing. Lest this imprint the impression of a pathologically oversexed species, I must add, based on hundreds of hours of watching bonobos, that their sexual activity is rather casual and relaxed. It appears to be a completely natural part of their group life. Like people, bonobos engage in sex only occasionally, not continuously. Furthermore, with the average copulation lasting 13 seconds, sexual contact in bonobos is rather quick by human standards.

That sex is connected to feeding, and even appears to make food sharing possible, has been observed not only in zoos but also in the wild. Nancy Thompson-Handler, then at Stony Brook University, saw bonobos in the Lomako Forest of the Democratic Republic of the Congo (formerly Zaire) engage in sex after they had entered trees loaded with ripe figs or when one among them had captured a prey animal, such as a small forest duiker. The flurry of sexual contacts would last for five to 10 minutes, after which the apes would settle down to consume the food.

One explanation for the sexual activity at feeding time could be that excitement over food translates into sexual arousal. This idea may be partly true. Yet another motivation is probably the real cause: competition. There are two reasons to believe sexual activity is the bonobo’s answer to avoiding conflict.

First, anything, not just food, that arouses the interest of more than one bonobo at a time tends to result in sexual contact. If two bonobos approach a cardboard box thrown into their enclosure, they will briefly mount each other before playing with the box. Such situations lead to squabbles in most other species. But bonobos are quite tolerant, perhaps because they use sex to divert attention and to diffuse tension.

Second, bonobo sex often occurs in aggressive contexts totally unrelated to food. A jealous male might chase another away from a female, after which the two males reunite and engage in scrotal rubbing. Or after a female hits a juvenile, the latter’s mother may lung at the aggressor, an action that is immediately followed by genital rubbing between the two adults.

I once observed a young male, Kako, inadvertently blocking an older, female juvenile, Leslie, from moving along a branch. First, Leslie pushed him; Kako, who was not very confident in trees, tightened his grip, grinning nervously. Next Leslie gnawed on one of his hands, presumably to loosen his grasp. Kako uttered a sharp peep and stayed put. Then Leslie rubbed her vulva against his shoulder. This gesture calmed Kako, and he moved along the branch. It seemed that Leslie had been very close to using force but instead had reassured both herself and Kako with sexual contact.

During reconciliations, bonobos use the same sexual repertoire as they do during feeding time. Based on an analysis of many such incidents, my study yielded the first solid evidence for sexual behavior as a mechanism to overcome aggression. Not that this function is absent in other animals—or in humans, for that matter—but the art of sexual reconciliation may well have reached its evolutionary peak in the bonobo. For these animals, sexual behavior is indistinguishable from social behavior. Given its peacemaking and appeasement functions, it is not surprising that sex among bonobos occurs in so many different contexts.

Dominance by bonding is evinced by female bonobos, who engage in genito-genital (GG) rubbing before eating sugarcane (a), while a bigger male displays to no avail. The females then share the food without competition (b). Only when they leave can the male get to the sugarcane (c). In male-dominated chimpanzee society the male eats first (d), while the females wait at a safe distance. After he leaves (e), carrying as many bananas as he can, the dominant female gets what is left (f). Small amounts of sugarcane and bananas are provided at some research sites in the Democratic Republic of the Congo (formerly Zaire).
partner combinations, including between juveniles and adults. The need for peaceful coexistence is obviously not restricted to adult heterosexual pairs.

Female Alliance

Apart from maintaining harmony, sex is also involved in creating the singular social structure of the bonobo. This use of sex becomes clear when studying bonobos in the wild. Field research on bonobos started only in the mid-1970s, a decade after the most important studies on wild chimpanzees had been initiated. In terms of continuity and invested (wo)manpower, the chimpanzee projects of Jane Goodall and Toshisada Nishida, both in Tanzania, are unparalleled. But bonobo research by Takayoshi Kano and others of Kyoto University began to show the same payoffs after two decades at Wamba in the Democratic Republic of the Congo.

Both bonobos and chimpanzees live in so-called fission-fusion societies. The apes move alone or in small parties of a few individuals at a time, the composition of which changes constantly. Several bonobos traveling together in the morning might meet another group in the forest, whereupon one individual from the first group wanders off with others from the second group, while those left behind forage together. All associations, except the one between mother and dependent offspring, are of a temporary character.

Initially this flexibility baffled investigators, making them wonder if these apes formed any social groups with stable membership. After years of documenting the travels of chimpanzees in the Mahale Mountains, Nishida first reported that they form large communities: all members of one community mix freely in ever changing parties, but members of different communities never gather. Later, Goodall added territoriality to this picture. That is, not only do communities not mix, but males of different chimpanzee communities engage in lethal battles.

In both bonobos and chimpanzees, males stay in their natal group, whereas females tend to migrate during adolescence. As a result, the senior males of a chimpanzee or bonobo group have known all junior males since birth, and all junior males have grown up together. Females, on the other hand, transfer to an unfamiliar and often hostile group where they may know no one. A chief difference between chimpanzee and bonobo societies is the way in which young females integrate into their new community.

On arrival in another community, young bonobo females at Wamba single out one or two senior resident females for special attention, using frequent GG rubbing and grooming to establish a relation. If the residents reciprocate, close associations are set up, and the younger female gradually becomes accepted into the group. After producing her first offspring, the young female’s position becomes more stable and central. Eventually the cycle repeats with younger immigrants, in turn, seeking a good relation with the now established female. Sex thus smooths the migrant’s entrance into the community of females, which is much more close-knit in the bonobo than in the chimpanzee.

Bonobo males remain attached to their mothers all their lives, following them through the forest and being dependent on them for protection in aggressive encounters with other males. As a result, the highest-ranking males of a bonobo community tend to be sons of important females.

What a contrast with chimpanzees! Male chimpanzees fight their own battles, often relying on the support of other males. Furthermore, adult male

(The Author)

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chimpanzees travel together in same-sex parties, grooming one another frequently. Males form a distinct social hierarchy with high levels of both competition and association. Given the need to stick together against males of neighboring communities, their bonding is not surprising: failure to form a united front might result in the loss of lives and territory. The danger of being male is reflected in the adult sex ratio of chimpanzee populations, with considerably fewer males than females.

Serious conflict between bonobo groups has been witnessed in the field, but it seems quite rare. On the contrary, reports exist of peaceable mingling, including mutual sex and grooming, between what appear to be different communities. If intergroup combat is indeed unusual, it may explain the lower rate of all-male associations. Rather than being male-bonded, bonobo society gives the impression of being female-bonded, with even adult males relying on their mothers instead of on other males. No wonder Kano calls mothers the “core” of bonobo society.

The bonding among female bonobos violates a fairly general rule, outlined by Harvard University anthropologist Richard W. Wrangham, that the sex that violates a fairly general rule, outlined by Harvard University anthropologist Richard W. Wrangham, that the sex that remains in the community strongest mutual bonds. Bonding among male chimpanzees follows naturally because they remain in the community of their birth. The same is true for female kinship bonding in Old World monkeys, such as macaques and baboons, where males are the migratory sex.

Bonobos are unique in that the migratory sex, females, strongly bond with same-sex strangers later in life. In setting up an artificial sisterhood, bonobos can be said to be secondarily bonded. (Kinship bonds are said to be primary.) Although we now know how this happens—through the use of sexual contact and grooming—we do not yet know why bonobos and chimpanzees differ in this respect.

Bonobo society is, however, not only female-centered but also appears to be female-dominated. Bonobo specialists, while long suspecting such a reality, had been reluctant to make the controversial claim. But in 1992, at the 14th Congress of the International Primatological Society in Strasbourg, investigators of both captive and wild bonobos presented data that left little doubt about the issue.

Amy R. Parish, now at the University of Southern California, reported on food competition in identical groups (one adult male and two adult females) of chimpanzees and bonobos at the Stuttgart Zoo. Honey was provided in a “termite hill” from which it could be extracted by dipping sticks into a small hole. As soon as honey was made available, the male chimpanzee would make a charging display through the enclosure and claim everything for himself. Only when his appetite was satisfied would he let the females fish for honey.

In the bonobo group, it was the females that approached the honey first. After having engaged in some GG rubbing, they would feed together, taking turns with virtually no competition between them. The male might make as many charging displays as he wanted; the females were not intimidated and ignored the commotion.

Observers at the Belgian animal park of Planckendael, which currently has the most naturalistic bonobo colony, reported similar findings. If a male bonobo tried to harass a female, all females would band together to chase him off. Because females appeared more successful in dominating males when they were together than on their own, their close association and frequent genital rubbing may represent an alliance. Females may bond so as to outcompete members of the individually stronger sex.

The fact that they manage to do so not only in captivity is evident from zoologist Takeshi Furuichi’s summary of the relation between the sexes at Wamba, where bonobos are enticed out of the forest with sugarcane. “Males usually appeared at the feeding site first, but they surrendered preferred positions when the females appeared. It seemed that males appeared first not because they were dominant, but because they had to feed before the arrival of females,” Furuichi reported at Strasbourg.

Sex for Food
Occasionally, the role of sex in relation to food is taken one step further, bringing bonobos very close to humans in their behavior. It has been speculated by anthropologists—including C. Owen Lovejoy of Kent State University and Helen Fisher of Rutgers University—that sex is partially separated from reproduction in our species because it serves to cement mutually profitable relationships between men and women. The human female’s capacity to mate...
throughout her cycle and her strong sex drive allow her to exchange sex for male commitment and paternal care, thus giving rise to the nuclear family.

This arrangement is thought to be favored by natural selection because it allows women to raise more offspring than they could if they were on their own. Although bonobos clearly do not establish the exclusive heterosexual bonds characteristic of our species, their behavior does fit important elements of this model. A female bonobo shows extended receptivity and uses sex to obtain a male's favors when—usually because of youth—she is too low in social status to dominate him.

At the San Diego Zoo, I observed that if the female Loretta was in a sexually attractive state, she would not hesitate to approach the adult male Vernon if he had food. Presenting herself, she would mate with him and make high-pitched food calls while taking over his entire bundle of branches and leaves.

When Loretta had no genital swelling, she would wait until Vernon was ready to share. Primatologist Suehisa Kuroda reports similar exchanges at Wamba: “A young female approached a male, who was eating sugarcane. They copulated in short order, whereupon she took one of the two canes held by him and left.”

Despite such quid pro quo between the sexes, there are no indications that bonobos form humanlike nuclear families. The burden of raising offspring appears to rest entirely on the female’s shoulders.

Human family life implies paternal investment, which is unlikely to develop unless males can be reasonably certain that they are caring for their own, not someone else’s, offspring. Bonobo society lacks any such guarantee, but humans protect the integrity of their family units through all kinds of moral restrictions and taboos. Thus, although our species is characterized by an extraordinary interest in sex, there are no societies in which people engage in it at the drop of a hat (or a cardboard box, as the case may be). A sense of shame and a desire for domestic privacy are typical human concepts related to the evolution and cultural bolstering of the family.

Yet no degree of moralizing can make sex disappear from every realm of human life that does not relate to the nuclear family. The bonobo’s behavioral peculiarities may help us understand the role of sex and may have serious implications for models of human society. Just imagine that we had never heard of chimpanzees or baboons and had known bonobos first. We would at present most likely believe that early hominids lived in female-centered societies, in which sex served important social functions and in which warfare was rare or absent. In the end, perhaps the most successful reconstruction of our past will be based not on chimpanzees or even on bonobos but on a three-way comparison of chimpanzees, bonobos and humans.

(Further Reading)

IMMUNOLOGY

The Many Facets of the Allergic Responses
Speaker: Noah Isakov, Ph.D.

Many facets to a not so splendorous, allergoid phenomena have increased in prevalence over the past several decades. Join Dr. Isakov for the latest thoughts on:
- Allergens, asthma and other types of immune-mediated responses
- Effector mechanisms in allergic responses
- Approaches for prevention and treatment of allergy

Immune Mediated Responses: A Double-Edged Sword

While scientific speculation about the immune system dates back to the Plague of Athens in 430 BCE, the discipline of immunobiology defined itself in the 19th and 20th centuries. Refresh your picture of the immune system with Dr. Isakov, starting with discussions of:
- Introduction to immunobiology
- Basic concepts of the immune system
- Failure of host defense mechanisms

Monoclonal Antibodies and Cancer Immunotherapy

Take a look under the hood of contemporary immunotherapy. From molecular biology to medicine, monoclonal antibodies are a valuable part of the scientist's toolkit. From his view deep in the trenches of immunobiology, Dr. Isakov will offer:
- An overview of antibody molecules
- A guide to the production of monoclonal antibodies
- With specificity against a predetermined pathogen
- The scope on monoclonal antibody use in research, diagnosis, and therapy

Understanding the Roots of Cancer

Dr. Isakov will orient you to the evolving views of the genesis of cancer. Internal and external factors, oncogenes, tumor suppressor genes, cell transformation, immunosurveillance, immunoeediting, and immunotherapy are all part of the mix. Learn:
- What causes normal cells to become cancerous
- How cancer cells from a primary tumor form metastasis in remote organs
- Immune-mediated approaches for the treatment of cancer diseases

ASTROPHYSICS & COSMOLOGY

Einstein's Biggest Blunder — A Cosmic Mystery Story
Speaker: Lawrence Krauss, Ph.D.

Recent discoveries have implications for our understanding both of the future of our universe and life within it and for our understanding of fundamental physics. Join Dr. Krauss as he covers the fate of the Milky Way, what lies beyond the event horizon, and cosmic phenomena of the next 100 billion years.

The Undiscovered Country

We humans have undoubtedly questioned the origins of the cosmos for as long as we’ve walked the Earth but we've made spectacular progress in recent years. This progress forces us to discard much of what cosmology textbooks told us up until quite recently. Get the latest on competing ideas, their implications, and how they can be experimentally tested.

An Atom From Boston

Standing somewhere between natural history and biography, Dr. Krauss lays out the life history of an single atom from the beginning of the universe to the end. Life is a journey, and this atom's journey runs from nucleic physics to chemistry to cosmology, with passages through geology and biology along the way. Whether you are an atom aficionado, or more a "universe in a grain of sand" type, sit with Dr. Krauss for a refreshing look at an atom.
ARCCINO OBSERVATORY: A BEHIND-THE-SCENES TOUR

Explore the contributions and potential of radio astronomy at the celebrated Arecibo Observatory. Get an unparalleled behind-the-scenes tour of the iconic facility, and absorb an in-depth look at the unique contributions derived from Arecibo research and development.

Join us as we wind through the rainforest-blanketed karst terrain of Northern Puerto Rico. We'll get a sense of the massive physical scope of the Arecibo radio telescope. We'll boldly go where ordinary visitors are not permitted. NAIC scientists will update us about the radio astronomy, planetary radar discoveries, and climatology research at the observatory. From the monitoring of near-earth objects to cosmology, astrophysics, and global warming research, you'll gain insight into the vital activities at Arecibo.

Optional eight-hour tour includes transportation, entrance fees, and a private luncheon at the Arecibo Observatory ($175).

I thoroughly enjoyed the Bright Horizons #2 cruise and must confess that the content of the cruise and the speakers far exceeded my expectations. Of the 24 excellent lectures, and I didn't miss a single one, I found each one equally as challenging and informative as the next. You and Randal did a magnificent job of attending to every detail and I only heard compliments of the highest order from every guest. I hope to join you on a future event cruise, so please keep me on your email list.

Perry Walton

THE SPACE PROGRAM

The Future of the Space Program
Speaker: Guion S. Bluford, Jr., Ph.D.

Travel back to the future with an indepth discussion on the future of the NASA Space Program. Dr. Bluford will address the issues and opportunities ahead as space exploration matures. You'll get the big picture of the Constellation Program (with its Ariane, Orion, and Altair components) which will return humans to the moon and later take them to Mars. Come away with the insights and views on what lies ahead from Dr. Bluford, astronaut and aeronautical engineer.

The International Space Station
Join Dr. Bluford for a comprehensive survey of the International Space Station (ISS) Program. He will orient us to the history and complexities of this permanent human presence in space. From project inception to launch to ongoing development and daily living, pick up a new understanding of the logistics, function, and significance of the ISS.

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Cruise prices vary from $799 for an inside to $2,999 for a Full Suite, per person. (Cruise pricing is subject to change.) For those attending the conference, there is a $1,375 fee. Taxes and gratuities are approximately $50.

An Evening with Shuttle Astronaut Dr. Bluford
How has aeronautics affected society and vice versa? Having worked in space, what open questions does Dr. Bluford have about space exploration, and space? What are the core characteristics and qualities shared by astronauts, i.e., what is “the right stuff?” Dr. Bluford will present food for thought arising from his experiences in space (648 hours), in jet cockpits (5,200 hours), and in the field of aeronautical engineering. We'll have an out-of-this-world round of astronaut Q&A, too!

The Space Shuttle Program
Countdown to contemporary treasures - a first-hand account of life in space. Dr. Guion Bluford, a veteran of four Space Transportation System (STS) missions (STS 8, STS 61-A, STS 39, and STS 53) will present a look at the Space Shuttle Program, from its inception to the wrap up of its service in 2010. Learn about training for shuttle duty, noteworthy aspects of daily routine in space on the Discovery and Challenger, and gain a behind the scenes look at the science and technology projects executed by Shuttle astronauts.

PLANETARY SCIENCE & SOLAR SYSTEMS

Postcards from Mars
Speaker: Jim Bell, Ph.D.

The NASA Mars Explorations Rover Spirit and Opportunity landed on the Red Planet in January 2004, and have been driving, photographing, and analyzing their landing sites for the past five years. Prof. Bell has been the lead scientist in charge of the rovers' Pancam Camera imaging system since the rovers were "born" nearly a decade ago. Come along on an amazing journey of geologic exploration and learn about the ways both rovers have been utilized to discover convincing evidence that Mars was once warmer, wetter, and much more Earthlike than it is today.

Studying the Solar System in 3-D
Darin red-blue glasses and join planetary imaging expert Prof. Jim Bell on a voyage of 3-D discovery of the solar system. Stereo pictures of Mars, the Moon, Saturn, asteroids, comets, and other objects taken by astronauts and robotic space probes provide new details about the geology and history of our planetary neighbors. Learn about the ways that 3-D images are taken, and the ways that they are used by scientists and engineers interested in space exploration. Viewing the solar system in 3-D is the next best thing to being there!

Searching for Life in the Solar System and Beyond
Are we alone? The search for habitable environments and for life on other worlds is a major driving force for the exploration of the solar system. Join Prof. Bell as we explore the short list of worlds around us that may once have been (and perhaps still are, in places) habitable. Mars, Jupiter’s moon Europa, Saturn’s moons Titan and Enceladus, and perhaps other places as well. During the last decade scientists have also discovered an amazing diversity of life on our own planet, thriving in what were once considered hostile conditions. And during the same time, astronauts have discovered hundreds of planets orbiting other Sun-like stars, and some of them may be habitable as well. It’s an incredible time to search for life in the solar system and beyond!

Impact!
The solar system is teeming with millions of asteroids and comets, and occasionally they crash into the planet with catastrophic consequences. Planetary physicist Jim Bell leads a discussion about the science fact and science fiction of the role of such impacts in shaping the geology and biology of our home world. Earth has been hit in the past, with severe consequences for life on our planet. Will Earth be hit again in the future? Almost certainly. Unlike any previous species in history, however, we have the chance to understand the threat ahead of time and, perhaps, to prevent a planetary-scale catastrophe.
The orangutan is one of humankind’s closest relatives. One of the four great apes (the other three are gorillas, chimpanzees and bonobos), Pongo pygmaeus is exquisitely adapted for life in the forest canopies of the Southeast Asian islands of Borneo and Sumatra. With their long arms and hooklike hands, orangutans are adept at swinging from tree to tree in search of tropical fruits. They are among the most solitary of large primates and the only great apes found outside Africa. Orangutans are also notable for the striking size difference between males and females: the average weight of an adult male (about 90 kilograms, or 198 pounds) is more than twice that of an adult female.

An adult male orangutan is an impressive sight. The animal has a pair of wide cheek pads, called flanges, and a well-developed throat sac used for emitting loud cries known as long calls. The mature male also has long, brightly colored hair on its body and face. These are secondary sexual characteristics, the flamboyant signals that male orangutans flaunt to proclaim their fertility and fitness to the opposite sex. The features emerge during orangutan adolescence: males reach puberty at around seven to nine years of age, then spend a few years in a far from impressive “subadult” stage, during which they are about the same size as mature females. The males reach their adult size and develop secondary sexual traits by ages 12 to 14. Or at least that is what primate researchers used to think.

As stable social groups of orangutans were established in zoos, however, it became clear that an adolescent male could remain a subadult, in a state of arrested development, until his late teens. In the 1970s studies of orangutans in the rain forests of Southeast Asia by Biruté M. F. Galdikas of Simon Fraser University in British Columbia and others produced the same finding: sometimes males were arrested adolescents for a decade or more, about half their potential reproductive lives. Variability of this magnitude is fascinating—it is like finding a species in which pregnancy could last anywhere from six months to five years.

Biologists are keenly interested in studying cases of arrested development because they often shed light on the processes of growth and maturation. In some instances, the cause of arrested development is a genetic disorder; for example, a mutation in the receptor for a growth factor in humans results in a form of dwarfism. Environmental factors can also slow or halt an organism’s development. For instance, food shortages delay maturation in humans and many other animals. This response
Studies of these great apes show that some males pursue an unexpected and disquieting evolutionary strategy.

Orangutan means “man of the forest” in the Malay language. These great apes typically feed, nest, socialize and mate in the jungle canopy.
is logical from an evolutionary standpoint—if it is unclear whether you will survive another week, it makes no sense to waste calories by adding bone mass or developing secondary sexual characteristics. Gymnasts and ballet dancers who exercise to extremes and anorexics who starve themselves sometimes experience delayed onset of puberty.

Among male orangutans, though, the cause of arrested development seems to lie in the animals’ social environment. The presence of dominant adult males appears to delay the maturation of adolescent males that are in the same vicinity. Until recently, researchers believed that they were observing a stress-induced pathology—that is, the adolescent orangutans stopped developing because the adult males bullied and frightened them.

Over the past few years, however, we have conducted studies suggesting that arrested development among orangutans is not a pathology but an adaptive evolutionary strategy. The arrested adolescent males are capable of impregnating females, and by staying small and immature (in terms of secondary sexual features) they minimize the amount of food they need and lower the risk of serious conflict with adult males. But the strategy of these arrested adolescents has a disquieting aspect: they copulate forcibly with females. In other words, they rape.

Measuring Stress

The first investigations into this subject focused on groups of captive orangutans. Terry L. Maple, then at Zoo Atlanta, and other zoo biologists found that adolescent males remained developmentally arrested as long as there was a mature male in their enclosure. If the researchers removed that dominant male, the adolescents soon began to develop into adults. This kind of social regulation had been observed previously in other species. Among mandrill monkeys, for instance, socially dominant males develop dramatic secondary sexual characteristics, such as large testes and high testosterone levels, whereas subordinate males do not. In tree shrews and many rodent species, puberty is delayed in the subordinate animals.

In another example, elephant poaching in certain areas of Africa has recently produced orphaned males that grew up in a fairly unsocialized manner. When in “musth”—a male elephant’s mating period—these animals become quite aggressive and dangerous. Some zoologists have reported an effective solution: introducing older, more dominant males into the region, which results in social suppression of musth in the rogue males.

In all these cases, researchers have generally agreed that the stress of being subordinate accounts for the developmental arrest. During a typical period of stress for a mammal—say, a sprint across the savanna to escape a predator—energy is mobilized to power the muscles. As part of this process, a variety of long-term building projects in the body are inhibited, including growth, tissue repair and reproductive functions. It is the logic of triage: the animal concentrates on survival during the emergency and resumes long-term tasks later, if there is a later. But when an animal undergoes chronic stress, such as that caused by social subordination, the triaging can have adverse consequences, such as decreased growth, lower levels of sex hormones, reduced fertility and delayed puberty. In humans, severe and prolonged psychological stress can cause growth to stop in children, a rare syndrome called psychogenic dwarfism.

At first glance, adolescent male orangutans also appear to be under chronic stress. Adult male orangutans are extremely aggressive toward adolescents, particularly within the confines of a zoo. In the wild, orangutan males are dispersed and solitary, belligerently defending a large territory that encompasses several females’ territories—sort of a scattered harem. But even there adolescents are well aware of the threatening presence of a mature male. One signal is a musky odorant that adult males spread about their territories. In addition, mature male orangutans announce their presence by performing long calls; John C. Mitani of the University of Michigan at Ann Arbor has found that these resonant cries can travel for miles.

Researchers had made little effort, however, to test the hypothesis that the stress of being near a dominant male induces hormonal changes that arrest development in adolescents. In 1989 we began looking for a way to examine the hormones of arrested adolescent orangutans to determine whether these animals were indeed under chronic stress. Ide-
ally one would want to measure the levels of relevant hormones in the orangutans’ blood, but this was impossible to do, for ethical and practical reasons. So we took advantage of the fact that the average levels of various hormones in the animals’ blood are reflected in a fairly parallel fashion in their urine. Getting urine from wild animals would be immensely difficult, so we studied captive populations. Thanks to the generous help of zookeepers, curators and veterinarians at 13 zoos, we obtained more than 1,000 urine samples from 28 male orangutans, along with information on their developmental status (juvenile, arrested adolescent, developing adolescent or adult), housing, diet, medical history and growth records. In collaboration with Nancy M. Czekala of the Center for Reproduction of Endangered Species at the San Diego Zoo, we measured the levels of nine hormones, comparing animals in different developmental stages.

First we focused on growth hormone, which is crucial for normal maturation. Among the juveniles, arrested adolescents and adults, growth hormone levels in the urine were low and extremely similar, within 15 percent of one another. In contrast, adolescent males that were maturing into adults had growth hormone levels approximately three times as high. This result basically served as an internal control, showing that the external assessments of an animal’s development stage closely matched the hormonal profile relevant to growth. In other words, adolescent males going through a developmental spurt in terms of appearance—growing larger, increasing the size of their cheek flanges, and so on—were experiencing hormonal changes as well.

We then considered hormones that respond to stress. Probably the best known is adrenaline (also called epinephrine), which plays a central role in energy mobilization. Epinephrine, unfortunately, cannot be measured accurately in urine. We could, however, determine levels of another key class of stress hormones called the glucocorticoids, which can suppress growth, tissue repair and reproduction. In addition, we measured the levels of prolactin, a stress-indicative hormone that can inhibit reproduction.

This is where we got a surprise. Glucocorticoid levels did not differ among juveniles, arrested adolescents and adults. Prolactin levels did not differ either. But adolescents going through the developmental spurt had glucocorticoid and prolactin levels roughly double those of the other groups. It was not the developmentally arrested adolescents who seemed to be stressed—it was the developing adolescents.

We got another surprise when we examined reproductive hormones in these animals. As expected, adolescent males who were developing secondary sexual characteristics had hormonal profiles implying an active gonadal system. Developing males had higher levels of testosterone and luteinizing hormone (which stimulates the release of testosterone) than did the arrested adolescents. But the levels of these hormones in arrested adolescents were equivalent to those seen in adults. Moreover, arrested males had levels of follicle-stimulating hormone (FSH), which stimulates sperm maturation in males, equal to those of developing adolescents or adult males. And other investigators have found that arrested adolescents have mature functional sperm and that their testes are the same size as those of developing adolescents.

**Evolutionary Strategies**

These findings overturned some long-held assumptions about orangutans. Apparently, arrested adolescents are neither stressed nor reproductively suppressed. What is going on? It turns out that there is more than one way for a male orangutan to improve his chances of reproducing.

A cornerstone of modern evolutionary theory is that animal behavior has evolved not for the good of the species or the social group but to maximize the number of gene copies passed on by an individual and its close relatives. For a long time, the
A study of primates was dominated by simplistic models of how animals achieve this goal. According to these models, male behavior consists of virtually nothing but aggression and competition to gain access to females. If only one female is sexually receptive in a group with many males, this competition will result in the highest-ranking male mating with her; if two females are receptive, the males ranking first and second in the hierarchy will mate with them, and so on.

But this kind of behavior is rarely seen among social primates. Instead male primates can choose alternative strategies to maximize their reproductive success.

Why should there be alternatives? Because the seemingly logical strategy—developing powerful muscles and dramatic secondary sexual characteristics to excel at male-male competition—has some serious drawbacks. In many species, maintaining those secondary characteristics requires elevated testosterone levels, which have a variety of adverse effects on health. The aggression that comes with such a strategy is not great for health either.

Furthermore, increased body mass means greater metabolic demands and more pressure for successful food acquisition. During famines, the bigger primates are less likely to survive. For an arboreal species such as the orangutan, the heavier body of the mature male also limits which trees and branches can be accessed for food. And the development of secondary sexual characteristics makes a male more conspicuous, both to predators and to other males that view those characteristics as a challenge.

The competition between adult males and developing adolescents probably explains the elevated levels of stress hormones in the latter. In the eyes of an adult male orangutan, a developing male is soon to be a challenger, so naturally he becomes a prime target for aggression. The same pattern is seen among horses and various other social ungulates: it is not until the young males start developing secondary sexual characteristics that the unrelated dominant males begin to harass them into leaving the group. Another example comes from work by one of us (Sapolsky) with wild baboons. Some socially subordinate male baboons have much higher glucocorticoid levels than do the dominant animals, primarily because these subordinates are actively challenging the high-ranking males.

In contrast, the key impression that a developmentally arrested male communicates to an adult male is a lack of threat or challenge, because the immature male looks like a kid. Arrested male orangutans are apparently inconspicuous enough to be spared a certain amount of social stress. What is more, the “low profile” of these animals may actually give them a competitive advantage when it comes to reproduction. In many primate species, the low-ranking males are doing a fair share of the mating. Genetic paternity testing of these primates has shown that the subordinate males are quite successful in passing on their genes. This finding extends to orangutans: studies of zoo populations have proved that arrested males mate and that these matings are fertile. More recently, Sri Suci Utami Atmoko, then at Utrecht University in the Netherlands, showed that arrested adolescents fathered approximately half of the orangutan babies at her Sumatran study site.

Why are these low-ranking males taking part in so many matings? In some primate species, such as the savanna baboon, the females can decide with whom they will mate, and they frequently choose males who exhibit strong male-female affiliation and parental behavior rather than male-male competition. Even then dominant male baboons stand guard to prevent low-ranking males from mating, the females often initiate surreptitious matings—sometimes referred to as “stolen copulations”—with the subordinates. For low-ranking male baboons, the strategy of pursuing affiliative “friendships” with females is a viable one because it avoids the metabolic costs, injuries and stress of male-male competition.

But arrested male orangutans do not engage in long-term affiliative relationships with females, although an arrested male may sometimes accompany a female for several days as she roams through the forest. Furthermore, the great majority of adult female orangutans are sexually receptive only to mature males. So how do the arrested males mate? Observations

(The Authors)

ANNE NACEY MAGGIONCALDA and ROBERT M. SAPOLSKY have been studying the evolution of male orangutan reproductive strategies for more than a decade. Maggioncalda, who received a Ph.D. in biological anthropology and anatomy from Duke University in 1995, is a retired lecturer in the program in human biology at Stanford University and in the department of anatomy at the Stanford University School of Medicine. Sapolsky, who earned a Ph.D. in neuroendocrinology from the Rockefeller University in 1984, is professor of biological sciences and neurology at Stanford and a research associate at the National Museums of Kenya. His research interests include neuron death, gene therapy and the physiology of primates.
Both in the wild and in captive populations, researchers have indicated that arrested males forcibly copulate with females. Rape is an apt term for these copulations: adult females usually resist the arrested adolescents fiercely, biting the males whenever they can and emitting loud, guttural sounds (called rape grunts) that are heard only under these circumstances. Adult males sometimes rape, too, but not nearly as often as the arrested males. In a study conducted in Borneo during the early 1980s, Mitani and his field assistants observed 151 copulations by arrested males; 144 of the matings were forced.

Thus, two reproductive strategies appear to have evolved for adolescent male orangutans. If no fully mature males are nearby, the adolescent will most likely develop quickly in the hopes of attracting female attention. When adult males are present, however, a strategy of arrested development has its advantages. If the social environment changes—say, if the nearby adult males die off or migrate—the arrested males will rapidly develop secondary sexual features and change their behavior patterns. Researchers are now trying to determine exactly how the presence or absence of adult males triggers hormonal changes in the adolescents.

**Unpleasant Findings**

What are the lessons we can learn from the male orangutan? First, a situation that seems stressful from a human’s perspective may not necessarily be so. Second, the existence of alternative reproductive strategies shows that the optimal approach can vary dramatically in different social and ecological settings. There is no single blueprint for understanding the evolution of behavior. Third, although the recognition of alternative strategies built around female choice has generally met with a receptive audience among scientists, the rape-oriented strategy of arrested male orangutans is not so pleasing. But the study of primates has demonstrated time and again that the behavior of these animals is far from Disney-esque. Just consider the strategic infanticide of langur monkeys or the organized aggression—sometimes called genocide—between groups of chimpanzee males.

One must be cautious, however, in trying to gain insights into human behavior by extrapolating from animal studies. There is a temptation to leap to a wrongheaded conclusion: because forcible copulation occurs in orangutans and something similar occurs in humans, rape has a natural basis and is therefore unstoppable. This argument ignores the fact that the orangutan is the only nonhuman primate to engage in forcible copulation as a routine means of siring offspring. Furthermore, close observations of orangutan rape show that it is very different from human rape: for example, researchers have never seen a male orangutan injure a female during copulation in an apparently intentional manner. Most important, the orangutan’s physiology, life history and social structure are completely unlike those of any other primate. Orangutans have evolved a unique set of adaptations to survive in their environment, and hence it would be the height of absurdity to draw simplistic parallels between their behaviors and those of humans.


More information on orangutans is available at the Web sites of the Orangutan Foundation International (www.orangutan.org) and the Orangutan Conservancy (www.orangutan.net).
Two penguins native to Antarctica met one spring day in 1998 in a tank at the Central Park Zoo in midtown Manhattan. They perched atop stones and took turns diving in and out of the clear water below. They entwined necks, called to each other and mated. They then built a nest together to prepare for an egg. But no egg was forthcoming: Roy and Silo were both male.

Robert Gramzay, a keeper at the zoo, watched the chinstrap penguin pair roll a rock into their nest and sit on it, according to newspaper reports. Gramzay found an egg from another pair of penguins that was having difficulty hatching it and slipped it into Roy and Silo’s nest. Roy and Silo took turns warming the egg with their blubbery underbellies until, after 34 days, a female chick pecked her way into the world. Roy and Silo kept the gray, fuzzy chick warm and regurgitated food into her tiny black beak.

Like most animal species, penguins tend to pair with the opposite sex, for the obvious reason. But researchers are finding that same-sex couplings are surprisingly widespread in the animal kingdom. Roy and Silo belong to one of as many as 1,500 species of wild and captive animals that have been observed engaging in homosexual activity. Researchers have seen such same-sex goings-on in both male and female, old and young, and social and solitary.
creatures and on branches of the evolutionary tree ranging from insects to mammals.

Unlike most humans, however, individual animals generally cannot be classified as gay or straight: an animal that engages in a same-sex flirtation or partnership does not necessarily shun heterosexual encounters. Rather many species seem to have ingrained homosexual tendencies that are a regular part of their society. That is, there are probably no strictly gay critters, just bisexual ones. “Animals don’t do sexual identity. They just do sex,” says sociologist Eric Anderson of the University of Bath in England.

Nevertheless, the study of homosexual activity in diverse species may elucidate the evolutionary origins of such behavior. Researchers are now understanding, for example, that animals may engage in same-sex couplings to diffuse social tensions, to better protect their young or to maintain fecundity when opposite-sex partners are unavailable—or simply because it is fun. These observations suggest to some that bisexuality is a natural state among animals, perhaps Homo sapiens included, despite the sexual-orientation boundaries most people take for granted. “[In humans] the categories of gay and straight are socially constructed,” Anderson says.

What is more, homosexuality among some species, including penguins, appears to be far more common in captivity than in the wild. Captivity,
scientists say, may bring out gay behaviors in part because of a scarcity of opposite-sex mates. In addition, an enclosed environment boosts an animal’s stress levels, leading to a greater urge to relieve the stress. Some of the same influences may encourage what some researchers call “situational homosexuality” in humans in same-sex settings such as prisons or sports teams.

Making Peace

Modern studies of animal homosexuality date to the late 19th century with observations on insects and small animals. In 1896, for example, French entomologist Henri Gadeau de Kerville of the Society of Friends of Natural Sciences and the Museum of Rouen published a drawing of two male scarab beetles copulating. Then, during the first half of the 1900s, various investigators described homosexual behavior in baboons, garter snakes and gentoo penguins, among other species. Back then, scientists generally considered homosexual acts among animals to be abnormal. In some cases, they “treated” the animals by, say, castrating them or giving them lobotomies.

At least one early report, however, was more than descriptive, yielding insight into the possible origins of the behavior. In a 1914 lab experiment Gilbert Van Tassel Hamilton, a psychopathologist practicing in Montecito, Calif., reported that same-sex behavior in 20 Japanese macaques and two baboons occurred largely as a way of making peace with would-be foes. In the Journal of Animal Behavior Hamilton observed that females offered sex to the more dominant macaques of the same sex: “homosexual behavior is of relatively frequent occurrence in the female when she is threatened by another female, but it is rarely manifested in response to sexual hunger.” And in males, he penned, “homosexual alliances between mature and immature males may possess a defensive value for immature males, since it insures the assistance of an adult defender in the event of an attack.”

More recently, some researchers studying bonobos (close relatives of the chimpanzee) have come to similar conclusions. Bonobos seem highly promiscuous by human standards, and about half their sexual activity involves same-sex partners. Female bonobos rub one another’s genitals so often that some scientists have suggested that their genitalia evolved to facilitate this activity. The female bonobo’s clitoris is “frontally placed, perhaps because selection favored a position maximizing stimulation during the genital-genital rubbing common among females,” wrote behavioral ecologist Marlene Zuk of the University of California, Riverside, in her 2002 book Sexual Selections: What We Can and Can’t Learn about Sex from Animals. Male bonobos have been observed to

“Female homosexual encounters among bonobos help the apes get along: they resolve conflicts and promote bonding.”

FAST FACTS

Fit to Be Gay

1. Same-sex couplings are surprisingly widespread in the animal kingdom. Observers have witnessed as many as 1,500 species of wild and captive animals engaging in homosexual activity.

2. Animals may engage in homosexual acts to diffuse social tensions, to better protect their young or to maintain fecundity when opposite-sex partners are unavailable—or simply because it is fun.

3. Homosexuality among some species appears to be far more common in captivity than in the wild. Captivity may bring out gay behaviors because of a lack of opposite-sex mates and a greater need for stress relief.
mount, fondle and even perform oral sex on one another.

Such behavior seems to ease social tensions. In *Bonobo: The Forgotten Ape* (University of California Press, 1997), Emory University primatologist Frans B. M. de Waal and his co-author photographer Frans Lanting noted that “when one female has hit a juvenile and the juvenile’s mother has come to its defense, the problem may be resolved by intense [genito-genital] rubbing between the two adults.” De Waal has observed hundreds of such incidents, suggesting that these homosexual acts may be a general peacekeeping strategy. “The more homosexuality, the more peaceful the species,” asserts Petter Böckman, an academic adviser at the University of Oslo’s Museum of Natural History in Norway. “Bonobos are peaceful.”

In fact, such acts are so essential to bonobo socialization that they constitute a rite of passage for young females into adulthood. Bonobos live together in groups of about 60 in a matrarchal system. Females leave the group during adolescence and gain admission to another bonobo clan through grooming and sexual encounters with other females. These behaviors promote bonding and give the new recruits benefits such as protection and access to food.

**Defended Nest**

In some birds, males steal eggs from females and raise them in same-sex unions. This might have evolved as a strategy to increase the survival of the species. “In black swans, if two males find each other and make a nest, they’ll be very successful at nest making because they are bigger and stronger than a male and female,” Böckman says. In such cases, he observes, “having a same-sex partner will actually pay off as a sensible life strategy.”

In other instances, homosexual bonding between female parents can boost the survival of offspring when male-female pairings are not possible. In birds called oystercatchers, intense competition for male mates would leave some females single were it not for polygamous trios. In a study published in 1998 in *Nature,* zoologist Dik Heg and geneticist Rob van Treuren, both then at the University of Groningen in the Netherlands, observed that roughly 2 percent of oystercatcher breeding groups consist of two females and a male. In some of these families, Heg and van Treuren found, the females tend separate nests and fight over the male, but in others, all three birds watch over a single nest. In the latter case, the females bond by mounting each other as well as the male. The cooperative triangles produce more offspring than the competitive ones, because such nests are better tended and protected from predators.

Such arrangements point to the evolutionary fitness of stable social relationships, whatever their type. Biologist Joan E. Roughgarden of Stanford University believes that evolutionary biologists tend to adhere too strongly to Darwin’s theory of sexual selection and have thus largely overlooked the importance of bonding and friendship to animal societies and the survival of their young. “[Darwin] equated reproduction with finding a mate rather than paying attention to how the offspring are naturally reared,” Roughgarden says.

Protection of progeny, social bonding and conflict avoidance may not be the only reasons animals naturally come to same-sex relationships. Many animals do it simply “because they want to,” Böckman says. “People view animals as robots who behave as their genes say, but animals have feelings, and they react to those feelings.” He adds that “as long as they feel the urge [for sex], they’ll go for it.”

A recent finding indicates that homosexual behavior may be so common because it is rooted in an animal’s brain wiring—at least in the case of fruit flies. In a study appearing last year in *Nature Neuroscience,* neuroscientist David E. Featherstone of the University of Illinois at Chicago and his colleagues found that they could switch on homosexual leanings in fruit flies by manipulating a gene for a protein they call “genderblind,” which regulates communication between neurons that secrete and respond to the neurotransmitter glutamate.

Males that carried the mutant genderblind gene—which depressed levels of the protein by about two thirds—were uncharacteristically attracted to the chemical cues exuded by other males. As a result, these mutant males courted and attempted to copulate with other males. The finding suggests that wild fruit flies may be prewired for both heterosexual and homosexual behavior, the authors write, but that the...
genderblind protein suppresses the glutamate-based circuits that promote homosexual behavior. Such brain architecture may enable same-sex behavior to surface easily, supporting the notion that it might confer an evolutionary advantage in some circumstances.

The Captivity Effect

In some less social species, homosexual behavior is almost unheard of in wild animals but may surface in captivity. Wild koalas, which are mostly solitary, seem to be strictly heterosexual. But in a 2007 study veterinary scientist Clive J. C. Phillips of the University of Queensland in Brisbane, Australia, and his colleagues observed 43 instances of homosexual activity among female koalas living in a same-sex enclosure at the Lone Pine Koala Sanctuary. The captive females shrieked male mating calls and mated with one another, sometimes participating in multiple encounters of up to five koalas. “The behavior in captivity was certainly enhanced in terms of homosexual activity,” Phillips says.

He believes that the females acted this way in part because of stress. Animals often experience stress in enclosed habitats and may engage in homosexual behavior to relieve that tension. A lack of male partners probably also played a role, Phillips suggests. When female koalas are in heat, their ovaries release the sex hormone estrogen, which triggers mating behavior—whether or not males are present. This hardwired urge to copulate, even if expressed with a female partner, might be adaptive. “The homosexual behavior preserves sexual function,” Phillips says, enabling an animal to maintain its reproductive fitness and interest in sexual activity. In males, this benefit is even more obvious: homosexual behavior stimulates the continued production of seminal fluid.

A lack of opposite-sex partners is also thought to help explain the prevalence of homosexuality among penguins in zoos. In addition to several gay penguin couplings in the U.S., 20 same-sex penguin partnerships were formed in 2004 in zoos in Japan. Such behavior “is very rare in penguins’ natural habitats,” says animal ecologist Keisuke Ueda of Rikkyo University in Tokyo. Thus, Ueda speculates that the behavior—which included both male pairings and female couplings—arose as a result of the skewed sex ratios at zoos.

Researchers have found still other reasons for homosexual behavior in domesticated cattle—which is such a common occurrence that farmers and animal breeders have developed terms for it. “Bulling” refers to male pairs mounting, and “going boaring” is its female counterpart. For cows, the behavior is...
not just a stress reliever. It is a way to signal sexual receptivity. The females mount one another to signal their readiness to mate to the bulls—which, in captivity, may cause a breeder to know when to bring in a suitable opposite-sex partner.

Homosexual mounting is much rarer among cattle in the wild, Phillips asserts, based on his research on gaurs in Malaysia, a wild counterpart to domesticated cattle. “Cattle evolved in the forest, so a visual signal was not going to be useful for them,” he says.

Stress and the greater availability of same-sex partners may similarly contribute to the practice of homosexual acts among self-described heterosexual humans in environments such as the military, jails and sports teams. In a study published last year in the journal *Sex Roles*, Anderson found that 40 percent of 49 heterosexual former high school football players attending various U.S. universities had had at least one homosexual encounter. These ranged from kissing to oral sex to threesomes that included a woman. In team sports, homosexuality is “no big deal and it increases cohesion among members of that team,” Anderson claims. “It feels good, and [the athletes] bond.”

In stressful same-sex environments such as prisons or a war zone, heterosexuals may engage in homosexual behavior in part to relieve tension. “Homosexuality appears mostly in social species,” Böckman says. “It makes flock life easier, and jail flock life is very difficult.”

Altered Spaces

In recent decades zoo officials have tried to minimize the stresses of captivity by making their enclosures more like animals’ natural habitats. In the 1950s zoo animals lived behind bars in barren enclosures. But since the late 1970s zoo homes have become more hospitable, including more open space, more objects for animals to play with and better keepers. The Association of Zoos and Aquariums (AZA) regulates everything from cage dimensions to animal bedding. The AZA also outlines enrichment activities for captive creatures: for instance, two golden brown Amur leopards at the Staten Island Zoo regularly play with a papier-mâché zebra, an animal they have never seen in the flesh.

Researchers hope such improvements might affect animal behavior, making it more like what occurs in the wild. One possible sign of more hospitable conditions might be a rate of homosexuality more in line with that of wild members of the same species. Some people, however, contest the notion that zokeepers should prevent or discourage homosexual behavior among the animals they care for [see box on opposite page].

And whereas captivity may engender what appears to be an unnaturally high level of homosexual activity in some animal species, human same-sex environments might bring out normal tendencies that other settings tend to suppress. That is, some experts argue that humans, like some other animals, are naturally bisexual. “We should be calling humans bisexual because this idea of exclusive homosexuality is not accurate of people,” Roughgarden says. “Homosexuality is mixed in with heterosexuality across cultures and history.”

Even Silo the penguin, who had been coupled with Roy for six years, displayed this malleability of sexual orientation. One spring day in 2004 a female chinstrap penguin named Scrappy—a transplant from SeaWorld in San Diego—caught his eye, and he abruptly left Roy for her. Meanwhile Roy and Silo’s “daughter,” Tango, carried on in the tradition of her fathers. Her chosen mate: a female named Tazuni. M

(Further Reading)

She did not often have such strong emotions. But she suddenly felt powerless against her passion and the desire to throw herself into the arms of the cousin whom she saw at a family funeral. “It can only be because of that patch,” said Gretchen (not her real name), a participant in a multinational trial of a testosterone patch designed to treat hypoactive sexual desire disorder, in which a woman is devoid of libido. Testosterone, a hormone ordinarily produced by the ovaries, is linked to female sexual function, and the women in this 2005 study had undergone operations to remove their ovaries.

After 12 weeks of the trial, Gretchen had felt her sexual desire return. Touching herself unleashed erotic sensations and vivid sexual fantasies. Eventually she could make love to her husband again and experienced an orgasm for the first time in almost three years. But that improvement was not because of testosterone, it turned out. Gretchen was among the half of the women who had received a placebo patch—with no testosterone in it at all.

Achieving sexual climax requires a complex conspiracy of sensory and psychological signals—and the eventual silencing of critical brain areas.

The Orgasmic Mind

By Martin Portner
Gretchen’s experience underlines the complexity of sexual arousal. Far from being a simple issue of hormones, sexual desire and orgasm are subject to various influences on the brain and nervous system, which controls the sex glands and genitals. And many of those influences are environmental. Recent research, for example, shows that visual stimuli spur sexual stirrings in women, as they do in men. Gretchen’s desire may have been invigorated by conversations or thoughts about sex she had as a result of taking part in the trial. Such stimuli may help relieve inhibitions or simply whet a person’s appetite for sex.

Achieving orgasm, brain-imaging studies show, involves more than heightened arousal. It requires a release of inhibitions and control in which the brain’s center of vigilance shuts down in males; in females, various areas of the brain involved in controlling thoughts and emotions become silent. The brain’s pleasure centers tend to light up brightly in the brain scans of both sexes, especially in those of males. The reward system creates an incentive to seek more sexual encounters, with clear benefits for the survival of the species. When the drive for sex dissipates, as it did with Gretchen, people can reignite the spark with tactics that target the mind.

**Sex in Circles**

Biologists identified sex hormones such as estrogen and testosterone in the 1920s and 1930s, and the first studies of human sexuality appeared in the 1940s. In 1948 biologist Alfred Kinsey of Indiana University introduced his first report on human sexual practices, *Sexual Behavior in the Human Male*, which was followed, in 1953, by *Sexual Behavior in the Human Female*. These highly controversial books opened up a new dialogue about human sexuality. They not only broached topics—such as masturbation, homosexuality and orgasm—that many people considered taboo but also revealed the surprising frequency with which people were coupling and engaging in sexual relations of countless varieties.

Kinsey thus debuted sex as a science, paving the way for others to dig below statistics into the realm of biology. In 1966 gynecologist William Masters and psychologist Virginia Johnson—who originally hailed from Washington University before founding their own research institute in St. Louis—described for the first time the sexual response cycle (how the body responds to sexual stimulation), based on observations of 382 women and 312 men undergoing some 10,000 such cycles. The cycle begins with excitation, as blood rushes to the penis in men, and as the clitoris, vulva and vagina enlarge and grow moist in women. Gradually, people reach a plateau, in which they are fully aroused but not yet orgasmic. After reaching orgasm, they enter the resolution phase, in which the tissues return to the pre-excitatory stage.

In the 1970s psychiatrist Helen Singer Kaplan of the Human Sexuality Program at Weill Medical College of Cornell University added a critical element to this cycle—desire—based on her experience as a sex therapist. In her three-stage model, desire precedes sexual excitation, which is then followed by orgasm. Because desire is mainly psychological, Kaplan emphasized the importance of the mind in the sexual experience and the destructive forces of anxiety, defensiveness and failure of communication.

In the late 1980s gynecologist Rosemary Basson of the University of British Columbia proposed a more circular sexual cycle, which, despite the term, had been described as a largely linear progression in previous work. Basson suggested that desire might both lead to genital stimulation and be invigorated by it. Countering the idea that orgasm is the pinnacle...
of the experience, she placed it as a mere spot on the circle, asserting that a person could feel sexually satisfied at any of the stages leading up to an orgasm, which thus does not have to be the ultimate goal of sexual activity.

**Dissecting Desire**

Given the importance of desire in this cycle, researchers have long wanted to identify its key ingredients. Conventional wisdom casts the male triggers in simplistic sensory terms, with tactile and visual stimuli being particularly enticing. Men are drawn to visual erotica, explaining the lure of magazines such as *Playboy*. Meanwhile female desire is supposedly fueled by a richer cognitive and emotional texture. “Women experience desire as a result of the context in which they are inserted—whether they feel comfortable with themselves and the partner, feel safe and perceive a true bond with the partner,” opines urologist Jennifer Berman of the Female Sexual Medicine Center at the University of California, Los Angeles.

Yet sexual imagery devoid of emotional connections can arouse women just as it can men, a 2007 study shows. Psychologist Meredith Chivers, then at the Center for Addiction and Mental Health in Toronto, and her colleagues gauged the degree of sexual arousal in about 100 women and men, both homosexual and heterosexual, while they watched erotic film clips. The clips depicted same-sex intercourse, solitary masturbation or nude exercise—performed by men and women—as well as male-female intercourse and mating between bonobos (close ape relatives of the chimpanzee).

The researchers found that although nude exercise genitaly aroused all the onlookers the least and intercourse excited them the most, the type of actor was more important for the men than for the women. Heterosexual women’s level of arousal increased along with the intensity of the sexual activity largely irrespective of who or what was engaged in it. In fact, these women were genitaly excited by male and female actors equally and also responded physically to bonobo copulation. (Gay women, however, were more particular; they did not react sexually to men masturbating or exercising naked.)

The men, by contrast, were physically titillated mainly by their preferred category of sexual partner—that is, females for straight men and males for gay men—and were not excited by bonobo copulation. The results, the researchers say, suggest that women are not only aroused by a variety of types of sexual imagery but are more flexible than men in their sexual interests and preferences.

When it comes to orgasm, simple sensations as well as higher-level mental processes probably also play a role in both sexes. Although Kinsey characterized orgasm in purely physical terms, psychologist Barry R. Komisaruk of Rutgers University has defined the experience as more multifaceted. In their book *The Science of Orgasm* (Johns Hopkins University Press, 2006), Komisaruk, endocrinologist Carlos Beyer-Flores of the Tlaxcala Laboratory in Mexico and Rutgers sexologist Beverly Whipple describe orgasm as maximal excitation generated by a gradual summing of responses from the body’s sensory receptors, combined with complex cognitive and emotional forces. Similarly, psychologist Kent Berridge of the University of Michigan at Ann Arbor has described sexual pleasure as a kind of “gloss”
that the brain’s emotional hub, the limbic system, applies over the primary sensations.

The relative weights of sensory and emotional influences on orgasm may differ between the sexes, perhaps because of its diverging evolutionary origins. Orgasm in men is directly tied to reproduction through ejaculation, whereas female orgasm has a less obvious evolutionary role. Orgasm in a woman might physically aid in the retention of sperm, or it may play a subtler social function, such as facilitating bonding with her mate. If female orgasm evolved primarily for social reasons, it might elicit more complex thoughts and feelings in women than it does in men.

**Forgetting Fear**

But does it? Researchers are trying to crack this riddle by probing changes in brain activity during orgasm in both men and women. Neuroscientist Gert Holstege of the University of Groningen in the Netherlands and his colleagues attempted to solve the male side of the equation by asking the female partners of 11 men to stimulate their partner’s penis until he ejaculated while they scanned his brain using positron-emission tomography (PET). During ejaculation, the researchers saw extraordinary activation of the ventral tegmental area (VTA), a major hub of the brain’s reward circuitry; the intensity of this response is comparable to that induced by heroin. “Because ejaculation introduces sperm into the female reproductive tract, it would be critical for reproduction of the species to favor ejaculation as a most rewarding behavior,” the researchers wrote in 2003 in the *Journal of Neuroscience*.

The scientists also saw heightened activity in brain regions involved in memory-related imagery and in vision itself, perhaps because the volunteers used visual imagery to hasten orgasm. The anterior part of the cerebellum also switched into high gear. The cerebellum has long been labeled the coordinator of motor behaviors but has more recently revealed its role in emotional processing. Thus, the cerebellum could be the seat of the emotional components of orgasm in men, perhaps helping to coordinate those emotions with planned behaviors. The amygdala, the brain’s center of vigilance and sometimes fear, showed a decline in activity at ejaculation, a probable sign of decreasing vigilance during sexual performance.

To find out whether orgasm looks similar in the female brain, Holstege’s team asked the male partners of 12 women to stimulate their partner’s clitoris—the site whose excitation most easily leads to orgasm—again inside a PET scanner. Not surprisingly, the team reported in 2006, clitoral stimulation by itself led to activation in areas of the brain involved in receiving and perceiving sensory signals from that part of the body and in describing a body sensation—for instance, labeling it “sexual.”

But when a woman reached orgasm, something unexpected happened: much of her brain went silent. Some of the most muted neurons sat in the left lateral orbitofrontal cortex, which may govern self-control over basic desires such as sex. Decreased activity there, the researchers suggest, might correspond to a release of tension and inhibition. The scientists also saw a dip in excitation in the dorso.medial prefrontal cortex, which has an apparent role in moral reasoning and social judgment—a change that may be tied to a suspension of judgment and reflection.

Brain activity fell in the amygdala, too, suggesting a depression of vigilance similar to that seen in men, who generally showed far less deactivation in their brain during orgasm than their female counterparts did. “Fear and anxiety need to be avoided
at all costs if a woman wishes to have an orgasm; we knew that, but now we can see it happening in the depths of the brain,” Holstege says. He went so far as to declare at the 2005 meeting of the European Society for Human Reproduction and Development: “At the moment of orgasm, women do not have any emotional feelings.”

But that lack of emotion may not apply to all orgasms in women. Komisaruk, Whipple and their colleagues studied the patterns of brain activation that occur during orgasm in five women with spinal cord injuries that left them without sensation in their lower extremities. These women were able to achieve a “deep,” or nonclitoral, orgasm through mechanical stimulation (using a laboratory device) of the vagina and cervix. But contrary to Holstege’s results, Komisaruk’s team found that orgasm was accompanied by a general activation of the limbic system, the brain’s seat of emotion.

Among the activated limbic regions were the amygdala and the hypothalamus, which produces oxytocin, the putative love and bonding hormone whose levels jump fourfold at orgasm. The researchers also found heightened activity in the nucleus accumbens, a critical part of the brain’s reward circuitry that may mediate orgasmic pleasure in women. In addition, they saw unusual activity in the anterior cingulate cortex and the insula, two brain areas that Rutgers anthropologist Helen Fisher has found come to life during the later stages of love relationships. Such activity may connect a female’s sexual pleasure with the emotional bond she feels with her partner.

Pleasure Pill?

Disentangling the connections among orgasm, reproduction and love may someday yield better medications and psychotherapies for sexual problems. As Gretchen’s case illustrates, the answer is usually not as simple as a hormone boost. Instead her improvement was probably the result of the activation or inactivation of relevant parts of her brain by social triggers she encountered while participating in an experiment whose purpose centered on female sexual arousal. Indeed, many sex therapies revolve around opening the mind to new ways of thinking about sex or about your sexual partner [see box on this page].

Companies are also working on medications that act on the nervous system to stimulate desire. One such experimental compound is a peptide called bremelanotide, which is under development by Palatin Technologies in Cranbury, N.J. It blocks certain receptors in the brain that are involved in regulating basic drives such as eating and sex. In human studies, bremelanotide has prompted spontaneous erections in men and boosted sexual arousal and desire in women, but the U.S. Food and Drug Administration has held up its progress out of concern over side effects such as rising blood pressure.

Continued scientific dissection of the experience of orgasm may lead to new pharmaceutical and psychological avenues for enhancing the experience. Yet overanalyzing this moment of intense pleasure might also put a damper on the fun. That is what the science tells us anyway. —M.P.

Domestic Bliss

Is the pursuit of sexual gratification vital to the health of an established relationship? In her book Mating in Captivity (HarperCollins, 2006), New York–based psychotherapist Esther Perel emphasizes the importance of eroticism and orgasm in a marriage. She chronicles the typical dissolution of a couple’s sex life when the love bond becomes politically correct and excessively domesticated. To avoid sexual staleness, Perel advocates unusual strategies such as cultivating separateness—developing different interests and groups of friends from those of your partner, for example—instead of closeness, as a way of making your partner more mysterious and exciting. She also suggests looking for creative ways to let fantasy and even a little craziness thrive within the confines of a long-term relationship.

Other psychologists, however, advise against placing too much emphasis on orgasm in a mature relationship. In her book Peace between the Sheets (Frog Books, 2003), couples therapist Marnia Robinson suggests that the journey to orgasm renders us prisoners to dopamine, a neurotransmitter secreted in the brain’s reward centers. After all, dopamine underlies other addictive behaviors, from gambling to drug abuse. In Robinson’s view, partners should mutually unite in pleasure, without the sexual relationship necessarily having to be crowned by orgasm.

(Further Reading)

We stood around the body planning our autopsy strategy. A scalpel, we realized, was not going to be the appropriate implement for this corpse, so we made our decision. It took all three of us to muscle the slippery black bulk of the pilot whale into the screaming blur of the band-saw blade.

The whale had died of natural causes, after a distinguished military tenure conducting deep-sea operations for the U.S. Navy, which sends marine mammals to places where humans cannot safely go. In death, it was going to perform one more service—provide us with information about its magnificent brain. The navy had invited researchers at the Scripps Institution of Oceanography in La Jolla, Calif., to come to its base in San Diego in the mid-1980s, and I had joined them. Dressed like fishmongers in black rubber smocks and boots, anatomist Leo S. Demski, visiting from the University of Kentucky, veterinarian Sam H. Ridgway of the Naval Oceans Systems Center and I sought to unravel a scientific mystery. It was imperative that we learn whether the whale had a certain cranial nerve—for reasons that will soon become apparent.

Every picture of the human brain you have seen is wrong. Something is missing, and the omission is not trivial. The dirty little secret is a tiny, relatively unstudied nerve sprouting from the base of the brain whose function is only now becoming clear: subliminal sexual attraction. Many scientists believe that pheromones, those silent chemical messages exchanged by members of the opposite sex in search of mates, relay subconscious signals to the brain through this obscure nerve. Others are skeptical. How can a little-studied nerve be involved in activities with such important implica-
Mysterious Nerve

Cranial nerves emerge from the floor of the brain in pairs; each pair is numbered from the front of the brain (closest to the forehead) to the back (near the spinal cord). Cranial nerve zero (also called the terminal nerve) is not in typical textbooks. Anatomists historically missed the thin nerve, perhaps because it is often inadvertently pulled off along with the tough membranes that wrap the brain.

Cranial nerve 0
(Terminal nerve)

1
2
3
4
5
6
7
8
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10
11
12

face. Cranial nerves emerge from the floor of the brain in pairs, like a multilegged centipede. As medical students know, each nerve pair is numbered in sequence from the front of the brain (closest to the forehead) to the back (near the spinal cord).

Cranial nerve one is the olfactory nerve. All scents enter our brain through this nerve. Next, immediately behind the olfactory nerve, is cranial nerve two, the optic nerve. The optic nerve connects the eyes to the brain. The pairs continue in sequence to the 12th cranial nerve, which extends from the tongue and enters the brain near the spinal cord. Each pair was carefully identified, numbered and studied in detail. Then, in the late 1800s, neuroanatomists had their tidy understanding of cranial nerves attacked, so to speak, by a shark.

In 1878 German scientist Gustav Fritsch noticed a slender cranial nerve entering the brain of a shark just ahead of all the known nerves. No one had noticed it before. Even today countless anatomy students dissect dogfish sharks, but few detect the nerve because it is still not in the textbooks.

The discovery put anatomists in a predicament. Because it was located in front of the olfactory nerve, the new nerve should have been named cranial nerve one. But renumbering all the cranial nerves at this point was impossible, because their identities were deeply entrenched in the medical vocabulary. The solution was to christen this new find “nerve zero,” the “terminal nerve.” Most people forgot about it altogether. It just did not fit within the 12-nerve curriculum. And anyway, all five senses were accounted for by the other cranial nerves. How important could this little nerve be?

It would have been easier to overlook this inconvenient discovery if nerve zero were present only in sharks. But over the next century anatomists found the wispy nerve springing from the brain just in front of the olfactory nerve in almost all vertebrates (animals with backbones). To their chagrin, they found the nerve in humans, too, in 1913. Usually it is ripped away during dissection when the tough membranes that wrap the brain are peeled off, but if one knows where to look and is especially careful, the little nerve is always there. What is its purpose?

One clue comes from how it is connected in the brain. Like the olfactory nerve, nerve zero sends its endings to the nose. Perhaps, some researchers argue, this nerve is simply a frayed strand of the olfactory nerve and not a separate cranial nerve at all. The dead pilot whale, my colleagues and I realized, was a perfect opportunity to examine that notion by looking directly to an example from nature.
Whales and dolphins are unique in having a blowhole on the top of their head. Whales evolved from aquatic mammals that breathed through nostrils in the front of the face. Over the course of millions of years of evolution the nostrils gradually migrated to the top of their head. In the process, whales and dolphins gave up the sense of smell, and they lost their olfactory nerve. We realized that if nerve zero were also involved in the sense of smell—as just a twig branching off of the olfactory nerve—it, too, would have been abandoned in the evolutionary exchange of nostrils for blowhole. But if, as we suspected, nerve zero did something else, it might still be present in whales.

Before I relate the results of our autopsy, you must have a look at some of the evidence that raised our suspicions that nerve zero connects the sense of smell to sex.

Smell and Pheromones

Smell is the most ancient of all the senses—even the lowly bacterium must discern the difference between nutritious and noxious substances by sniffing (detecting chemicals in) its environs. Humans, who have a weak sense of smell compared with most mammals, nonetheless have 347 different types of sensory neurons in the olfactory epithelium, where cells for smell reside in the nose. Each one detects a different type of odor, and all the varied aromas and stenches we know result from mixtures of responses of these 347 types of receptor cells. In comparison, every color we see results from signal combinations of only three types of sensory neurons in the retina (red-, green- or blue-sensitive cones), vision’s sensing layer at the back of the eyes.

Animals rely heavily on the sense of smell and other nonverbal cues for communication. From frenzied June beetles to tomcats pursuing a queen in heat, pheromones are important for selecting mates and stimulating reproduction throughout the animal kingdom. A stallion curls its upper lip and inhales deeply to snuffle pheromones from a mare in heat, a behavior called flehming. Many animals also rely on the sense of smell to determine sex, social rank, territories, reproductive status and even identity of specific individuals, such as their own mates or offspring.

In humans, mate selection and sexual reproduction are far more complex, but there are indications that people do exchange such secret pheromone messages. Pheromones differ in two important ways from the chemicals that excite our sense of smell. For a smell to waft a distance from its source, the odor-producing molecules must be very small and volatile (able to float great distances in the air). Not so for pheromones, which can be large molecules passed between the noses of individuals during intimate contact, such as kissing.

Second, not all pheromones have an odor. If pheromones were to excite nerve endings that convey their signals directly to brain regions controlling sexual reproduction, bypassing the cerebral cortex where consciousness arises, they could act like an unseen olfactory cupid—putting a romantic twinkle in the eye of a certain member of the opposite sex—and we would never know it.

As it turns out, nerve zero’s connections in the brain leave open that very possibility. To explain how requires a more detailed look at the circuitry for the sense of smell and for a special structure in the nose of many animals that detects pheromones, called the vomeronasal organ.

The olfactory nerve connects sense cells in our nose to the olfactory bulb inside our skull. This neural bulb is a massive relay point containing a nest of synapses. Raw incoming sensory information from the 347 kinds of odor receptors is first sorted here, then processed to analyze and discriminate among the universe of odors. The signals next pass to the olfactory cortex for finer discrimination and conscious perception of the odor.

For many animals that rely on pheromones for sexual communication, the key place for sensing these chemicals is a specialized area inside the vomeronasal organ. This organ, in turn, is connected to a tiny “accessory” olfactory bulb, next to the main olfactory bulb involved in the sense of smell. From there, nerves connect to areas of the brain involved in sexual arousal (such as the amygdala) rather than to the olfactory cortex. In rodents, for example, stimulating the vomeronasal organ with pheromones can release a flood of sex hormones into the blood.

Acting through the vomeronasal organ, phero-
Pheromones influence the frequency of estrus and stimulate sexual behavior and ovulation in animals. The wrong pheromones can even terminate a pregnancy. In 1959 Hilda M. Bruce of the National Institute for Medical Research in London reported that an embryo will not implant in the uterus of a recently mated female mouse if she is exposed to the smell of urine from an unfamiliar male. Instead the embryo will be aborted, and the female will return to estrus. In contrast, the smell of urine from her mate does not prevent implantation and pregnancy.

In research published in 2006, Nobel laureate Linda Buck and her colleague Stephen Liberles, both then at the Fred Hutchinson Cancer Research Center in Seattle, identified 15 members of a new family of receptor proteins. These receptors, found in the mouse nose, exist on the surface of sense cells that detect pheromones, lending credence to the idea of a separate pathway for pheromones in mammals. These cells are different from the receptors that detect odors. Each of the newly discovered TAARs (trace amine-associated receptors) responds selectively to specific nitrogen-containing molecules in mouse urine. The concentration of one of these chemicals increases in mouse—and human—urine under the stresses associated with mating behavior, such as those involving dominance and submission. Two of the TAARs are excited by compounds found exclusively in the urine of male mice, but only after puberty, also suggesting a sex link. Incidentally, behavioral researchers had previously identified one of these compounds and found that it accelerated the onset of puberty in female mice.

We now have an understanding of pheromones in mice that extends from molecules to sexual behavior, but what about pheromones in humans? Intriguingly, Buck found that humans have the genes to make at least six of the same pheromone receptors present in mice.

**Nerve Zero’s Role**

Although some scientists claim to have detected an operational vomeronasal organ in humans as well, most believe that it appears to be vestigial. As is the case with gill slits, we possess vomeronasal organs only during our fetal lives, after which they atrophy. So if pheromones are sending sexual signals to human brains, they are not relying on the vomeronasal organ to relay them. Instead nerve zero might be stepping into the breach.

Consider the following anatomical features of nerve zero. Like its olfactory cousin, nerve zero has its endings in the nasal cavity, but remember that it sends its nerve fibers to the hot-button sex regions of the brain: the medial and lateral septal nuclei and preoptic areas. These regions of the brain are concerned with the “nuts and bolts” of reproduction. They control release of sex hormones and other ir-

Pilot whale brains lost the olfactory nerve during evolution but retained nerve zero—an important clue to its function.
resistible urges such as thirst and hunger. The septal nucleus can act on and be influenced by the amygdala, hippocampus and hypothalamus. Damage to the septal nuclei causes behavioral changes in sexual behavior, feeding, drinking and rage reactions. Thus, in connecting the nose to the reproductive centers of the brain, nerve zero completely bypasses the olfactory bulb.

Cutting the olfactory nerve or removing the vomeronasal organ will disrupt normal mating behavior in rodents, suggesting that the olfactory nerve transmits pheromone messages from the vomeronasal organ. But in the past few years, researchers have come to understand that nerve zero also sends fibers to the vomeronasal organ—and that nerve zero’s fibers run extremely close to the fibers of the olfactory nerve. As a result, in experiments in which the olfactory nerve was deliberately severed, investigators may have inadvertently cut through nerve zero as well.

In 1987 neuroscientist Celeste Wirsig, then at Baylor College, carefully severed the nerve zero of male hamsters, leaving the olfactory nerve unscathed (as shown by the fact that hamsters with a severed nerve zero could find a hidden cookie just as fast as control animals could). The hamsters with a severed nerve zero failed to mate.

Similarly, in 1980 neuroscientists observed that electrically stimulating the olfactory nerve could trigger sexual responses in fish and other animals. But could this sexual behavior actually result from a stimulated nerve zero, which runs close to the olfactory nerve for most of its length? Neuroanatomists R. Glenn Northcutt, then at the University of Michigan at Ann Arbor (now at the University of California, San Diego), and Demski, then at Kentucky (now at the New College of Florida), suspected as much. They also knew that on their way to the brain, some fibers in nerve zero took an unexpected side trip and sent branches to the retinas of the eyes. This may seem odd until you realize that for most plants and animals, reproduction is seasonal—and day length is the most accurate way to gauge time of year. Many scientists suspect that a nerve involved in mating and reproduction might also connect to the retina to keep a constant check on the calendar.

Regardless of function, this place was where nerve zero and the olfactory nerve parted company, so Northcutt and Demski were able to apply a mild electric shock to goldfish nerve zero fibers in this site without stimulating the olfactory nerve at the same time. When they did, the male goldfish responded instantly by releasing sperm.

So in addition to the anatomical evidence that nerve zero connected the nose to parts of the brain controlling sexual reproduction, strong physiological evidence now existed that—in fish at least—nerve zero might be a sensory system for responding to sex pheromones and regulating reproductive behavior. Another lead pointing to a sexual role for nerve zero would come from my own research, again on a creature from the sea.

In 1985, while studying nerve zero of a stingray using the electron microscope, I saw something peculiar: many of its axons (nerve fibers) were stuffed with what looked like minuscule black spheres. They turned out to be peptide hormones packed tightly together like pellets in a shotgun shell. And at the tips of some of these nerves I observed the release of these hormones and their uptake by tiny blood vessels—suggesting that nerve zero may in fact be a neurosecretory organ, meaning that it regulates reproduction by releasing hormones in much the same way as the pituitary gland does. This new clue that the terminal nerve released sex hormones, together with the knowledge that it connected the nose to parts of the brain controlling sexual reproduction, triangulated on one conclusion: pheromones.

Yet skeptical scientists have credited arousal exclusively to the olfactory nerve, still arguing that nerve zero is not a separate cranial nerve at all but simply a frayed strand of the olfactory nerve. So
When Demski and I heard that a pilot whale had just died at the San Diego Naval Base, we jumped at the chance to examine it. This animal could show us whether nerve zero was truly autonomous and might even help illuminate its function.

**Whale of a Find**

Back in the lab at Scripps, Demski reached into a plastic bucket with gloved hands and withdrew the pilot whale’s brain that we had removed from the immense carcass. It was about the size of a soccer ball and resembled a human brain, except that its cerebral cortex had tighter and more numerous convolutions—almost kinky in comparison to the wavy folds of a human cortex.

After turning over the whale brain for a look at its underside, we were struck by the strangeness of seeing a mammalian brain devoid of its olfactory nerves. (Remember that whales lost their sense of smell in exchange for blowholes.) Demski carefully peeled away the membranes from the area in which we expected to find a pair of nerve zeros, assuming they had not been lost along with the olfactory nerves. With the surprise of unwrapping a present, we found them: two slender white nerves headed toward the whale’s blowhole.

Our postmortem on the pilot whale had proved that nerve zero was a distinct neural entity, not just a fragment of the olfactory nerve. And for whales and dolphins, which had sacrificed their sense of...
smell and the olfactory nerves that made it possible, whatever nerve zero did was too precious to survival for evolution to abandon.

Despite the intriguing findings, nerve zero’s role in the sexual behavior of humans remains unclear. Recent research in mice has revealed the presence of certain sensory neurons that are not associated with the vomeronasal organ but that respond to pheromone stimulation. Even without a functioning vomeronasal organ, our noses may nonetheless contain sensory neurons capable of responding to pheromones.

How much of this labor is split between the olfactory nerve and nerve zero is not yet worked out. Obviously, nerve zero is doing something different with the information it is receiving from the nose, because it does not connect to the olfactory bulb where smells are analyzed. Moreover, it connects to parts of the brain controlling reproduction, and it releases a powerful sex hormone (GnRH) into the blood.

Nerve zero develops very early in embryos, and studies show that all the neurons in the forebrain that produce GnRH use the fetal nerve zero as a pathway to migrate along to find their proper place in the brain. When this embryonic pathway is disrupted, Kallmann’s syndrome is the result. This disorder not only impairs people’s sense of smell, it leaves them unable to mature sexually beyond puberty. Undoubtedly, nerve zero has other functions in addition to reproduction—most cranial nerves transmit sensory and motor (related to body movement) traffic. Electrical impulses have been detected traveling out from the brain through nerve zero, but what the outgoing messages do is puzzling.

One of the most intriguing things about the story of nerve zero is the suggestion that signals in the environment control our brain and behavior. This notion clashes with our passionate belief in free will, but the evidence continues to mount.

A recent study by Denise Chen and her colleagues at Rice University found that people performed better on cognitive tests while sniffing sweat collected from individuals who had been watching a scary movie than they did while smelling the sweat of people who had been watching a happy movie. The test takers said they could not tell the difference between the two types of sweat, but they were more cautious and accurate while inhaling the sweat of fearful moviegoers. In many animals stress and fear produce lifesaving chemical warning signals—humans, it seems, are no different.

Functional magnetic resonance imaging is also providing a fascinating window into pheromone stimulation of the human brain. A study by Valerie Treyer and her colleagues at University Hospital Zurich revealed that an odorless pheromone extracted from swine sweat (5a-Androst-16-en-3-one) stimulates neural activity in the same “pleasure/reward” region of the human brain activated by smelling roses—something to keep in mind the next time your guy shows up with an expectant smile and a fist full of flowers.

Many animals have specialized scent glands for releasing pheromones, but so do people. The dark area surrounding a mother’s nipple, called the areola, warms suddenly at the sound of a crying infant, and pheromones are released from the bumpy skin glands that ring the area. A team led by Benoist Schaal of the French National Center for Scientific Research found that these pheromones speed the time it takes a newborn infant to locate the breast and begin suckling. Infants of mothers who are blessed with more of these scent glands latch on faster and gain weight quicker than infants born to women with fewer glands.

Nerve zero undermines not only our confidence in free will but also our faith in our own senses. New research on animals shows that impulses from nerve zero change how the environment is perceived. Neuropeptides released from the endings of nerve zero in the nose modify the sense of smell by adjusting the sensitivity of olfactory neurons. In the same way, fibers from nerve zero that enter the retina of a fish’s eye alter processing of visual information in response to olfactory signals stimulating the nerve. In fish, at least, nerve zero may provide a biological basis for the adage that “love is blind.” M
It turns out that male and female brains differ quite a bit in architecture and activity. Research into these variations could lead to sex-specific treatments for disorders such as depression and schizophrenia.

BY LARRY CAHILL

On a gray day in mid-January of 2005, Lawrence Summers, then president of Harvard University, suggested that innate differences between the male and female brain might be one factor underlying the relative scarcity of women in science fields. His remarks reignited a debate that has been smoldering for a century, ever since some scientists sizing up the brains of both sexes began using their main finding—that female brains tend to be smaller—to bolster the view that women are intellectually inferior to men.

To date, no one has uncovered any evidence that anatomical disparities might render women incapable of achieving academic distinction in math, physics or engineering [see box on page 47]. And the brains of men and women have been shown to be quite clearly similar in many ways. Nevertheless, over the past decade or so investigators have documented an astonishing array of structural, chemical and functional...
variations in the brains of males and females.

These inequities are not just interesting idiosyncrasies that might explain why more men than women enjoy the Three Stooges. They raise the possibility that we might need to develop sex-specific treatments for a host of conditions, including depression, addiction, schizophrenia and post-traumatic stress disorder (PTSD). Furthermore, the differences imply that researchers exploring the structure and function of the brain must take into account the sex of their subjects when analyzing their data—and include both women and men in future studies or risk obtaining misleading results.

Sculpting the Brain

Not so long ago neuroscientists believed that sex differences in the brain were limited mainly to those regions responsible for mating behavior. In a 1966 Scientific American article entitled “Sex Differences in the Brain,” Seymour Levine of Stanford University described how sex hormones help to direct divergent reproductive behaviors in rats—with males engaging in mounting and females arching their backs and raising their rumps to attract suitors. Levine mentioned only one brain region in his review: the hypothalamus, a small structure at the base of the brain that is involved in regulating hormone production and controlling basic behaviors such as eating, drinking and sex. A generation of neuroscientists
Several intriguing behavioral studies add to the evidence that some sex differences in the brain arise before a baby draws its first breath.

and functional magnetic resonance imaging (fMRI), which can peer into the brains of living subjects.

These imaging experiments reveal that anatomical variations occur in an assortment of regions throughout the brain. Jill M. Goldstein of Harvard Medical School and her colleagues, for example, used MRI to measure the sizes of many cortical and subcortical areas. Among other things, these investigators found that parts of the frontal cortex, the seat of many higher cognitive functions, are bulkier in women than in men, as are parts of the limbic cortex, which is involved in emotional responses. In men, on the other hand, parts of the parietal cortex, which is involved in space perception, are bigger than in women, as is the amygdala, an almond-shaped structure that responds to emotionally arousing information—to anything that gets the heart pumping and the adrenaline flowing. These size differences, as well as others mentioned throughout the article, are relative: they refer to the overall volume of the structure relative to the overall volume of the brain.

Differences in the size of brain structures are generally thought to reflect their relative importance to the animal. For example, primates rely more on vision than olfaction; for rats, the opposite is true. As a result, primate brains maintain proportionately larger regions devoted to vision, and rats devote more space to olfaction. So the existence of widespread anatomical disparities between men and women suggests that sex does influence the way the brain works.

Other investigations are finding anatomical sex differences at the cellular level. For example, Sandra Witelson and her colleagues at McMaster University discovered that women possess a greater density of neurons in parts of the temporal lobe cortex associated with language processing and comprehension. On counting the neurons in postmortem samples, the researchers found that of the six layers present in the cortex, two show more neurons per unit volume in females than in males. Similar findings were subsequently reported for the frontal lobe. With such information in hand, neuroscientists can now explore whether sex differences in neuron number correlate with differences in cognitive abilities—examining, for example, whether the boost in density in the female auditory cortex relates to women’s enhanced performance on tests of verbal fluency.

Such anatomical diversity may be caused in large part by the activity of the sex hormones that bathe the fetal brain. These steroids help to direct the organization and wiring of the brain during development and influence the structure and neuronal density of various regions. Interestingly, the brain areas that Goldstein found to differ between men and women are ones that in animals contain the highest number of sex hormone receptors during development. This correlation between brain region size in adults and sex steroid action in utero suggests that at least some sex differences in cognitive function do not result from cultural influences or the hormonal changes associated with puberty—they are there from birth.

Inborn Inclinations

Several intriguing behavioral studies add to the evidence that some sex differences in the brain arise before a baby draws its first breath. Through the years, many researchers have demonstrated that when selecting toys, young boys and girls part ways. Boys tend to gravitate toward balls or toy cars, whereas girls more typically reach for a doll. But no one could really say whether those preferences are dictated by culture or by innate brain biology.

To address this question, Melissa Hines, then at City University London,
and Gerianne M. Alexander of Texas A&M University turned to monkeys, one of our closest animal cousins. The researchers presented a group of vervet monkeys with a selection of toys, including rag dolls, trucks and some gender-neutral items such as picture books. They found that male monkeys spent more time playing with the “masculine” toys than their female counterparts did, and female monkeys spent more time interacting with the items typically preferred by girls. Both sexes spent equal time monkeying with the picture books and other gender-neutral toys.

Because vervet monkeys are unlikely to be swayed by the social pressures of human culture, the results imply that toy preferences in children result at least in part from innate biological differences. This divergence, and indeed all the anatomical sex differences in the brain, presumably arose as a result of selective pressures during evolution. In the case of the toy study, males—both human and primate—prefer toys that can be propelled through space and that promote rough-and-tumble play. These qualities, it seems reasonable to speculate, might relate to the behaviors useful for hunting and for securing a mate. Similarly, one might also hypothesize that females, on the other hand, select toys that allow them to hone the skills they will one day need to nurture their young.

Simon Baron-Cohen and his associates at the University of Cambridge took a different but equally creative approach to addressing the influence of nature versus nurture regarding sex differences. Many researchers have described disparities in how “people-centered” male and female infants are. For example, Baron-Cohen and his then student Svetlana Lutchmaya found that one-year-old girls spend more time looking at their mothers than boys of the same age do. And when these babies are presented with a choice of films to watch, the girls look longer at a film of a face, whereas boys lean toward a film featuring cars.

Of course, these preferences might be attributable to differences in the way adults handle or play with boys and girls. To eliminate this possibility, Baron-Cohen and his students went a step further. They took their video camera to a maternity ward to examine the preferences of babies that were only one day old. The infants saw either the friendly face of a live female student or a mobile that matched the color, size and shape of the student’s face and included a scrambled mix of her facial features. To avoid any bias, the experimenters were unaware of each baby’s sex during testing. When they watched the tapes, they found that the girls spent more time looking at the student, whereas the boys spent more time looking at the mechanical object. This difference in social interest was evident on day one of life—implying again that we come out of the womb with some cognitive sex differences built in.

Under Stress

In many cases, sex differences in the brain’s chemistry and construction influence how males and females respond to the environment or react to, and remember, stressful events. Take, for example, the amygdala. Goldstein and others have reported that the amygdala is larger in men than in women. And in rats, the neurons in this region make many more interconnections in males than in females.
Wired Preferences?

Vervet monkeys observed by Gerianne M. Alexander of Texas A&M University and Melissa Hines, then at City University London, displayed toy preferences that fit the stereotypes of human boys and girls: the males (top) spent more time in contact with trucks, for example, whereas the females (bottom) engaged more with dolls (graphs). Such patterns imply that the choices made by human children may stem in part from their neural wiring and not strictly from their upbringing.

To assess whether male and female amygdalae respond differently to stress, Katharina Braun and her co-workers at Otto von Guericke University in Magdeburg, Germany, briefly removed a litter of degu pups from their mother. For these social South American rodents, which live in large colonies like prairie dogs do, even temporary separation can be quite upsetting. The researchers then measured the concentration of serotonin receptors in various brain regions. Serotonin is a neurotransmitter, or signaling molecule, that is key for mediating emotional behavior. (Prozac, for example, acts by increasing serotonin function.)

The workers allowed the pups to hear their mother’s call during the period of separation and found that this auditory input increased the serotonin receptor concentration in the males’ amygdala yet decreased the concentration of these same receptors in females. Although it is difficult to extrapolate from this study to human behavior, the results hint that if something similar occurs in children, separation anxiety might differentially affect the emotional well-being of male and female infants. Experiments such as these are necessary if we are to understand why, for instance, anxiety disorders are far more prevalent in girls than in boys.

Another brain region now known to diverge in the sexes anatomically and in its response to stress is the hippocampus, a structure crucial for memory storage and for spatial mapping of the physical environment. Imaging consistently demonstrates that the hippocampus is larger in women than in men. These anatomical differences might well relate somehow to differences in the way males and females navigate. Many studies suggest that men are more likely to navigate by estimating distance in space and orientation (“dead reckoning”), whereas women are more likely to navigate by monitoring landmarks. Interestingly, a similar sex difference exists in rats. Male rats are more likely to navigate mazes using directional and positional information, whereas female rats are more likely to navigate the same mazes using available landmarks.

Even the neurons in the hippocampus behave differently in males and females, at least in how they react to learning experiences. For example, Janice M. Juraska and her associates at the University of Illinois have shown that placing rats in an “enriched environment”—cages filled with toys and with fellow rodents to promote social interactions—produced dissimilar effects on the structure of hippocampal neurons in male and female rats. In females, the experience enhanced the “bushiness” of the branches in the cells’ dendritic trees—the many-armed structures that receive signals from other nerve cells. This change presumably reflects an increase in neuronal connections, which in turn is thought to be involved with the laying down of memories. In males, however, the complex environment either had no effect on the dendritic trees or pruned them slightly.

Benefits of Stress?

But male rats sometimes learn better in the face of stress. Tracey J. Shors of Rutgers University and her collaborators have found that a brief exposure to a series of one-second tail shocks enhanced performance of a learned task and increased the density of dendritic connections to other neurons in male rats yet impaired performance and decreased connection density in female rats. Findings such as these have interesting social implications. The more we discover about how brain mechanisms of learning differ between the sexes, the more we may need to consider how optimal learning environments potentially differ for boys and girls.

Although the hippocampus of the female rat can show a decrement in response to acute stress, it appears to be more resilient than its male counterpart in the face of chronic stress. Cheryl D. Conrad and her co-workers at Arizona State University restrained rats in a mesh cage for six hours—a situation that the rodents found disturbing. The researchers then assessed how vulnerable the rodents’ hippocampal neurons were to killing by a neurotoxin—a standard measure of the effect of stress on these cells. They noted that chronic restraint rendered the males’ hippocampal cells more susceptible to the toxin but had no effect on the females’ vulnerability. These findings and others...
suggest that in terms of brain damage, females may be better equipped to tolerate chronic stress than males are.

Extending the work on how the brain handles and remembers stressful events, my colleagues and I have found contrasts in the way men and women lay down memories of emotionally arousing incidents—a process known from animal research to involve activation of the amygdala. In one of our first experiments with human subjects, we showed volunteers a series of graphically violent films while we measured their brain activity using PET. A few weeks later we gave them a quiz to see what they remembered.

We discovered that the number of disturbing films they could recall correlated with how active their amygdala had been during the viewing. Subsequent work from our laboratory and others confirmed this general finding. But then I noticed something strange. The amygdala activation in some studies involved only the right hemisphere, and in others, only the left hemisphere. It was then I realized that the experiments in which the right amygdala lit up involved only men; those in which the left amygdala was fired up involved women. Since then, three subsequent studies—two from our group and one from John Gabrieli and Turhan Canli, both then at Stanford, and their collaborators—have confirmed this difference in how the brains of men and women handle emotional memories.

The realization that male and female brains were processing the same emotionally arousing material into memory differently led us to wonder what this disparity might mean. To address this question, we turned to a century-old theory stating that the right hemisphere is biased toward processing the central aspects of a situation, whereas the left hemisphere tends to be involved in the finer details. If that conception is true, we reasoned, a drug that dampens the activity of the amygdala should impair a man’s ability to recall the gist of an emotional story (by hampering the right amygdala) but should hinder a woman’s ability to come up with the precise details (by hampering the left amygdala).

Propranolol is such a drug. This so-called beta blocker quiets the activity of adrenaline and its cousin noradrenaline and, in so doing, dampens the activation of the amygdala and weakens recall of emotionally arousing memories. We gave this drug to men and women before they viewed a short slide show about a young boy caught in a terrible accident while walking with his mother. One week later we tested their memory. The results showed that propranolol made it harder for men to remember the more holistic aspects, or gist, of the story—

![The Stressed Hippocampus](image)

The hippocampus in male rats reacts differently to both acute and chronic stress than does the same structure in females.

**ACUTE STRESS**

Short-term stress caused the density of dendritic “spines” in hippocampal neurons to increase in males but to decrease in females (micrographs and graph) studied by Tracey J. Shors of Rutgers University and her colleagues. The spines are the sites where dendrites receive excitatory signals from other neurons. Because the hippocampus is involved in learning and memory, the results raise the possibility that short-term stress induces anatomical changes that facilitate learning in males but reduce it in females.

**CHRONIC STRESS**

Long-lasting stress, in contrast, may leave the male hippocampus more vulnerable to harm. When Cheryl D. Conrad, J. L. Jackson and L. S. Wise, all at Arizona State University, exposed chronically stressed rats to a nerve toxin, males, but not females, suffered more damage than same-sex controls did. The micrographs below are from stressed subjects.
The Amygdala and Emotional Memory

In research by the author and his collaborators, the amygdala, crucial for memory of emotional events, reacted differently in men and women who viewed emotionally arousing slides, such as of a decaying animal. Men who reported strong responses showed greatest activity in the right hemisphere amygdala (left scan and schematic) and the most accurate recall two weeks later, whereas the women who felt most worked up and showed the best recall displayed greatest activity in the left amygdala (right panel). Further studies by the team suggest that the hemispheric sex differences in amygdala activity cause women to be more likely to retain details of an emotional event and men more likely to remember its gist.

that the boy had been run over by a car, for example. In women, propranolol did the converse, impairing their memory for peripheral details—that the boy had been carrying a soccer ball.

In more recent investigations, we found that we can detect a hemispheric difference between the sexes in response to emotional material almost immediately. Volunteers shown emotionally unpleasant photographs react within 300 milliseconds—a response that shows up as a spike on a recording of the brain’s electrical activity. With Antonella Gasbarri and others at the University of L’Aquila in Italy, we have found that in men, this quick spike, termed a P300 response, is more exaggerated when recorded over the right hemisphere; in women, it is larger when recorded over the left. Hence, sex-related hemispheric disparities in how the brain processes emotional images begin within 300 milliseconds—long before people have had much, if any, chance to consciously interpret what they have seen.

These discoveries might have ramifications for the treatment of PTSD.

Previous research by Gustav Schelling and his associates at Ludwig Maximilian University in Germany had established that drugs such as propranolol diminish memory for traumatic situations when administered as part of the usual therapies in an intensive care unit. Prompted by our findings, they found that, at least in such units, beta blockers reduce memory for traumatic events in women but not in men. Even in intensive care, then, physicians may need to consider the sex of patients when meting out their medications.

Sex and Mental Disorders

PTSD is not the only psychological disturbance that appears to play out differently in women and men. A PET study by Mirko Diksic and his colleagues at McGill University showed that serotonin production was a remarkable 52 percent higher on average in men than in women, which might help clarify why women are more prone to depression—a disorder commonly treated with drugs that boost the concentration of serotonin.

A similar situation might prevail in addiction. In this case, the neurotransmitter in question is dopamine—a chemical involved in the feelings of pleasure associated with drugs of abuse. Studying rats, Jill B. Becker and her fellow investigators at the University of Michigan at Ann Arbor discovered that in females, estrogen boosted the release of dopamine in brain regions important for regulating drug-seeking behavior. Furthermore, the hormone had long-lasting effects, making the female rats more likely to pursue cocaine weeks af-

PET scans, such as those above made by Mirko Diksic and his colleagues at McGill University, reveal that the brains of males produce serotonin at a faster rate than those of females. Serotonin influences mood, so the finding may help make sense of the observation that more women than men suffer depression.
ter last receiving the drug. Such differences in susceptibility—particularly to stimulants such as cocaine and amphetamine—could explain why women might be more vulnerable to the effects of these drugs and why they tend to progress more rapidly from initial use to dependence than men do.

Certain brain abnormalities underlying schizophrenia appear to differ in men and women as well. Ruben Gur, Raquel Gur and their colleagues at the University of Pennsylvania have spent years investigating sex-related differences in brain anatomy and function. In one project, they measured the size of the orbitofrontal cortex, a region involved in regulating emotions, and compared it with the size of the amygdala, implicated more in producing emotional reactions. The investigators found that women possess a significantly larger orbitofrontal-to-amygdala ratio (OAR) than men do. One can speculate from these findings that women might on average prove more sensitive to these reactions. The investigators found that women possess a significantly larger orbitofrontal-to-amygdala ratio (OAR) than men do. One can speculate from these findings that women might on average prove more capable of controlling their emotional reactions.

In additional experiments, the researchers discovered that this balance appears to be altered in schizophrenia, though not identically for men and women. Women with schizophrenia have a decreased OAR relative to their healthy peers, as might be expected. But men, oddly, have an increased OAR relative to healthy men. These findings remain puzzling, but, at the least, they imply that schizophrenia is a somewhat different disease in men and women and that treatment of the disorder might need to be tailored to the sex of the patient.

In a comprehensive 2001 report on sex differences in human health, the prestigious National Academy of Sciences asserted that “sex matters. Sex, that is, being male or female, is an important basic human variable that should be considered when designing and analyzing studies in all areas and at all levels of biomedical and health-related research.”

Neuroscientists are still far from identifying all the sex-related variations in the brain and pinpointing their influences on cognition and propensity for brain-related disorders. Nevertheless, the research conducted to date certainly demonstrates that differences extend far beyond the hypothalamus and mating behavior. Researchers and clinicians are not always clear on the best way to go forward in deciphering the full influences of sex on the brain, behavior and responses to medications. But growing numbers now agree that going back to assuming we can evaluate one sex and learn equally about both is no longer an option.
Affairs of the Lips

By Chip Walter

Researchers are revealing hidden complexities behind the simple act of kissing, which relays powerful messages to your brain, body and partner.

When passion takes a grip, a kiss locks two humans together in an exchange of scents, tastes, textures, secrets and emotions. We kiss furtively, lasciviously, gently, shyly, hungrily and exuberantly. We kiss in broad daylight and in the dead of night. We give ceremonial kisses, affectionate kisses, Hollywood air kisses, kisses of death and, at least in fairy tales, pecks that revive princesses.

Lips may have evolved first for food and later applied themselves to speech, but in kissing they satisfy different kinds of hungers. In the body, a kiss triggers a cascade of neural messages and chemicals that transmit tactile sensations, sexual excitement, feelings of closeness, motivation and even euphoria.
Not all the messages are internal. After all, kissing is a communal affair. The fusion of two bodies dispatches communiqués to your partner as powerful as the data you stream to yourself. Kisses can convey important information about the status and future of a relationship. So much, in fact, that, according to recent research, if a first kiss goes bad, it can stop an otherwise promising relationship dead in its tracks.

Some scientists believe that the fusing of lips evolved because it facilitates mate selection. “Kissing,” said evolutionary psychologist Gordon G. Gallup, Jr., of the University at Albany, State University of New York, in a September 2007 interview with the BBC, “involves a very complicated exchange of information—olfactory information, tactile information and postural types of adjustments that may tap into underlying evolved and unconscious mechanisms that enable people to make determinations … about the degree to which they are genetically incompatible.” Kissing may even reveal the extent to which a partner is willing to commit to raising children, a central issue in long-term relationships and one that is crucial to the survival of our species.

Satisfying Hunger

Whatever else is going on when we kiss, our evolutionary history is embedded within this tender, tempestuous act. In the 1960s British zoologist and author Desmond Morris first proposed that kissing might have evolved from the practice in which primate mothers chewed food for their young and then fed them mouth to mouth, lips puckered. Chimpanzees feed in this manner, so our hominid ancestors probably did, too. Pressing out-turned lips against lips may have then later developed as a way to comfort hungry children when food was scarce and, in time, to express love and affection in general. The human species might eventually have taken these proto-parental kisses down other roads until we came up with the more passionate varieties we have today.

Silent chemical messengers called pheromones could have sped the evolution of the intimate kiss. Many animals and plants use pheromones to communicate with other members of the same species. Insects, in particular, are known to emit pheromones to signal alarm, for example, the presence of a food trail, or sexual attraction.

Whether humans sense pheromones is controversial. Unlike rats and pigs, people are not known to have a specialized pheromone detector, or vomeronasal organ, between their nose and mouth. Nevertheless, biologist Sarah Woodley of Duquesne University suggests that we might be able to sense pheromones with our nose. And chemical communication could explain such curious findings as a tendency of the menstrual cycles of female dormitory mates to synchronize or the attraction of women to the scents of T-shirts worn by men whose immune systems are genetically compatible with theirs. Human pheromones could include androstenol, a chemical component of male sweat that may boost sexual arousal in women, and female vaginal hormones called copulins that some researchers have found raise testosterone levels and increase sexual appetite in men.

If pheromones do play a role in human courtship and procreation, then kissing would be an ex-
tremely effective way to pass them from one person to another. The behavior may have evolved because it helps humans find a suitable mate—making love, or at least attraction, quite literally blind.

We might also have inherited the intimate kiss from our primate ancestors. Bonobos, which are genetically very similar to us (although we are not their direct descendants), are a particularly passionate bunch, for example. Emory University primatologist Frans B. M. de Waal recalls a zookeeper who accepted what he thought would be a friendly kiss from one of the bonobos, until he felt the ape’s tongue in his mouth!

Good Chemistry

Since kissing evolved, the act seems to have become addictive. Human lips enjoy the slimmest layer of skin on the human body, and the lips are among the most densely populated with sensory neurons of any body region. When we kiss, these neurons, along with those in the tongue and mouth, rocket messages to the brain and body, setting off delightful sensations, intense emotions and physical reactions.

Of the 12 or 13 cranial nerves that affect cerebral function, five are at work when we kiss, shuttling messages from our lips, tongue, cheeks and nose to a brain that snatches information about the temperature, taste, smell and movements of the entire affair. Some of that information arrives in the somatosensory cortex, a swath of tissue on the surface of the brain that represents tactile information in a map of the body. In that map, the lips loom large because the size of each represented body region is proportional to the density of its nerve endings [see illustration on page 53].

Kissing unleashes a cocktail of chemicals that govern human stress, motivation, social bonding and sexual stimulation. In a recent study, psychologist Wendy L. Hill and her student Carey A. Wilson of Lafayette College compared the levels of two key hormones in 15 college male-female couples before and after they kissed and before and after they talked while holding hands. One hormone, oxytocin, is involved in social bonding, and the other, cortisol, plays a role in stress. Hill and Wilson predicted that kissing would boost levels of oxytocin, which also influences social recognition, male and female orgasm, and childbirth. They expected this effect to be particularly pronounced in the study’s females, who reported higher levels of intimacy in their relationships. They also forecast a dip in cortisol, because kissing is presumably a stress reliever.

But the researchers were surprised to find that oxytocin levels rose only in the males, whereas it decreased in the females, after either kissing or talking while holding hands. They concluded that females must require more than a kiss to feel emotionally connected or sexually excited during physical contact. Females might, for example, need a more romantic atmosphere than the experimental setting provided, the authors speculate. The study, which Hill and Wilson reported in November 2007 at the annual meeting of the Society for Neuroscience, revealed that cortisol levels declined for both sexes no matter the form of intimacy, a hint that stress does in fact drop when we kiss.

To the extent that kissing is linked to love, the act may similarly boost brain chemicals associated with pleasure, euphoria and a motivation to connect with a certain someone. In 2005 anthropologist Helen Fisher of Rutgers University and her colleagues reported scanning the brains of 17 individuals as they gazed at pictures of people with whom they were deeply in love. The researchers found an unusual flurry of activity in two brain regions that govern pleasure, motivation and reward: the right ventral tegmental area [see illustration on next page] and the right caudate nucleus. Addictive drugs such as cocaine similarly stimulate these reward centers, through the release of the neurotransmitter dopamine. Love, it seems, is a kind of drug for us humans.

Kissing has other primal effects on us as well. Visceral marching orders boost pulse and blood pressure. The pupils dilate, breathing deepens and rational thought retreats, as desire suppresses both prudence and self-consciousness. For their part, the

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participants are probably too enthralled to care. As poet e. e. cummings once observed: “Kisses are a better fate / than wisdom.”

**Litmus Test**

Although a kiss may not be wise, it can be pivotal to a relationship. “One dance,” Alex “Hitch” Hitchens says to his client and friend in the 2005 movie *Hitch*, “one look, one kiss, that’s all we get … one shot, to make the difference between ‘happily ever after’ and, ‘Oh? He’s just some guy I went to some thing with once.’”

Can a kiss be that powerful? Some research indicates it can be. In a recent survey Gallup and his colleagues found that 59 percent of 58 men and 66 percent of 122 women admitted there had been times when they were attracted to someone only to find that their interest evaporated after their first kiss. The “bad” kisses had no particular flaws; they simply did not feel right—and they ended the romantic relationship then and there—a kiss of death for that coupling.

The reason a kiss carries such weight, Gallup theorizes, is that it conveys subconscious information about the genetic compatibility of a prospective mate. His hypothesis is consistent with the idea that kissing evolved as a courtship strategy because it helps us rate potential partners.

From a Darwinian perspective, sexual selection is the key to passing on your genes. For us humans, mate choice often involves falling in love. Fisher wrote in her 2005 paper that this “attraction mechanism” in humans “evolved to enable individuals to focus their mating energy on specific others, thereby conserving energy and facilitating mate choice—a primary aspect of reproduction.”

According to Gallup’s new findings, kissing may play a crucial role in the progression of a partnership but one that differs between men and women. In a study published in September 2007 Gallup and his colleagues surveyed 1,041 college undergraduates of both sexes about kissing. For most of the men, a deep kiss was largely a way of advancing to the next level sexually. But women were generally looking to take the relationship to the next stage emotionally, assessing not simply whether the other person would make a first-rate source of DNA but also whether he would be a good long-term partner.

“Females use [kissing] … to provide information about the level of commitment if they happen to be in a continuing relationship,” Gallup told the BBC. The locking of lips is thus a kind of emotional barometer: the more enthusiastic it is, the healthier the relationship.

Because women need to invest more energy in producing children and have a shorter biological window in which to reproduce, they need to be pickier about whom they choose for a partner—and they cannot afford to get it wrong. So, at least for women, a passionate kiss may help them choose a mate who is not only good at fathering children but also committed enough to stick around and raise them.

That said, kissing is probably not strictly necessary from an evolutionary point of view. Most other animals do not neck and still manage to produce plenty of offspring. Not even all humans kiss. At the turn of the 20th century Danish scientist Kristoffer Nyrop described Finnish tribes whose members bathed together but considered kissing indecent. In 1897 French anthropologist Paul d’Enjouy reported that the Chinese regard mouth-to-mouth kissing to be as horrifying as many people deem cannibalism.
to be. In Mongolia some fathers do not kiss their sons. (They smell their heads instead.)

In fact, up to 10 percent of humanity does not kiss lips, according to human ethology pioneer Irenäus Eibl-Eibesfeldt, now head of the Max-Planck-Society Film Archive of Human Ethology in Andechs, Germany, writing in his 1970 book, Love and Hate: The Natural History of Behavior Patterns. Fisher published a similar figure in 1992. Their findings suggest that some 650 million members of the human species have not undertaken the art of osculation, the scientific term for kissing; that is more than the population of any nation on earth except for China and India.

Lopsided Love

For those cultures that do kiss, however, osculation conveys additional hidden messages. Psychologist Onur Güntürkün of the Ruhr-University of Bochum in Germany surveyed 124 couples kissing in public places in the U.S., Germany and Turkey and found that the partners tilted their heads to the right twice as often as to the left before their lips touched. Right-handedness cannot explain this tendency, because being right-handed is four times more common than is the act of kissing on the right. Instead Güntürkün suspects that right-tilted kissing results from a general preference that develops at the end of gestation and in infancy. This “behavioral asymmetry” is related to the lateralization of brain functions such as speech and spatial awareness.

Nurture may also influence our tendency to tilt to the right. Studies show that as many as 80 percent of mothers, whether right-handed or left-handed, cradle their infants on their left side. Infants cradled, face up, on the left must turn to the right to nurse or nuzzle. As a result, most of us may have learned to associate warmth and security with turning to the right.

Some scientists have proposed that those who tilt their heads to the left when they kiss may be showing less warmth and love than those who tilt to the right. In one theory, tilting right exposes the left cheek, which is controlled by the right, more emotional half of the brain. But a 2006 study by naturalist Julian G. Greenwood and his colleagues at Stranmillis University College in Belfast, Northern Ireland, counters this notion. The researchers found that 77 percent of 240 undergraduate students leaned right when kissing a doll on the cheek or lips. Tilting to the right with the doll, an impulsive act, was nearly as prevalent among subjects as it was among 125 couples observed osculating in Belfast; they tilted right 80 percent of the time. The conclusion: right-kissing probably results from a motor preference, as Güntürkün hypothesized, rather than an emotional one.

Despite all these observations, a kiss continues to resist complete scientific dissection. Close scrutiny of couples has illuminated new complexities woven throughout this simplest and most natural of acts—and the quest to unmask the secrets of passion and love is not likely to end soon. But romance gives up its mysteries grudgingly. And in some ways, we seem to like it that way. M

(Further Reading)


The Truth about

The hype is huge, and the findings are disturbing—
Online Dating
but the future of online dating looks good

By Robert Epstein
About two years ago I arranged to meet for coffee with a woman I had corresponded with online. I arrived early and sat at a table in a conspicuous spot. After a few minutes, a woman came to my table, sat down and said with a big smile, “Hi, I’m Chris!”

But Chris was not the woman in the online photographs. This wasn’t a question of an age discrepancy or a new hairdo. She was a completely different woman. Chris was in marketing, you see, and to her it was simply a good strategy to post photographs that would draw in as many “customers” as possible. I never said a word about the photographs. I just enjoyed our conversation and the refreshments. A few weeks later I noticed that Chris had replaced the photographs with those of yet another woman.

In the U.S. alone, tens of millions of people are trying to find dates or spouses online every day. How accurate are the ads they find? And just how successful is online dating compared with conventional dating? These and other questions have recently stimulated a small explosion of studies by social scientists. The research is quickly revealing many surprising things about the new world of online dating, and some of the findings could be of great value to the millions who now look to the Internet to find love.

Deception at Light Speed

Experiences such as the one I had with Chris are multiplying by the thousands: some people online lie quite drastically about their age, marital or parental status, appearance, income or profession. There are even Web sites, such as www.DontDateHimGirl.com, where people go to gripe, and a few lawsuits have been filed against online services by disgruntled

On the Internet, nobody knows you’re a dog: in one study, about 20 percent of online daters admitted to deception, and respondents also said that 90 percent of other people lied.
suitors. Just how bad is deception in online dating?

To put this issue in context, bear in mind that deception has always played at least a small role in courting. One could even argue that deception is a necessary part of wooing a potential partner (“Yes, I love sports!”) and even of forming successful long-term relationships (“No, that dress doesn’t make you look fat at all!”).

But cyberspace introduces a host of new possibilities. Survey research conducted by media researcher Jeana Frost, then at Boston University and the Massachusetts Institute of Technology, suggests that about 20 percent of online daters admit to deception. If you ask them how many other people are lying, however—an interviewing tactic that probably gets closer to the truth—that number jumps to 90 percent.

Because self-reported data can be unreliable, especially those from people asked to confess bad things about themselves, several researchers have sought objective ways to quantify online deception. For example, psychologist Jeffrey Hancock of Cornell University and communications professor Nicole Ellison of Michigan State University bring people into a lab, where they measure height and weight and then check the numbers against those in their online profiles. The preliminary data suggest that, on average, online profiles shave off about five pounds and add perhaps an inch in height. According to Ellison, although deception is “fairly common, the lies are of a very small magnitude.” On the other hand, she says that the shorter and heavier people are, the bigger the lies.

In another attempt to collect objective data on deception, economists Guenter Hitsch and Ali Hortacsu, both at the University of Chicago, and psychologist Dan Ariely of M.I.T. compared the heights and weights of online daters with the same statistics obtained from national census data. Like Hancock and Ellison, they found that online height is exaggerated by only an inch or so for both men and women but that women appear to understate their weight more and more as they get older: by five pounds when they are in their 20s, 17 pounds in their 30s and 19 pounds in their 40s.

For men, the major areas of deception are educational level, income, height, age and marital status; at least 13 percent of online male suitors are thought to be married. For women, the major areas of deception are weight, physical appearance and age. All of the relevant research shows the importance of physical appearance for both sexes, and online daters interpret the absence of photographs negatively. According to one recent survey, men’s profiles without photographs draw one-fourth the response of those with photographs, and women’s profiles without photographs draw only one-sixth the response of those with photographs.

If you are a Garrison Keillor fan, you have prob-

(Online daters often regret telling the truth, feeling that too much honesty creates a bad impression.)

ably heard about the fictional Lake Wobegon on public radio, where “all the women are strong, all the men are good-looking, and all the children are above average.” In the online dating community, similar rules apply: in one study, only 1 percent of online daters listed their appearance as “less than average.”

Rationale for Falsehoods

Why so much inaccuracy? One theory, formulated in the late 1980s and early 1990s by Sara Kiesler and her colleagues at Carnegie Mellon University, suggests that by its very nature “computer-mediated communication” is disinhibiting, causing people to say just about anything they feel like saying. Because people typically use screen names rather than real ones, their ramblings are anonymous and hence not subject to social norms. There are also no physical cues or consequences—no visible communication gestures, raised eyebrows, grimaces, and so on—to keep people’s behavior in check. As a result, online daters tend to construct what Ellison and her colleagues Jennifer Gibbs of Rutgers University and Rebecca Heino of Georgetown University call an “ideal self” rather than a real one. A study published recently by Ellison and her colleagues even suggests that online daters often regret it when they do tell the truth, feeling that too much honesty, especially about negative attributes, creates a bad impression.

There are also straightforward, practical reasons for lying. One recent study showed that men claiming incomes exceeding $250,000 got 151 percent more replies than men claiming incomes less than $50,000, for example. Many women are quite
Ten Commandments for Online Lovers

BE VAGUE. The more information you provide, the poorer the impression you will create, shows research by psychologist Michael I. Norton of Harvard University, media researcher Jeanne Frost, then at Boston University and the Massachusetts Institute of Technology, and psychologist Dan Ariely of M.I.T. People mistake vagueness for attractiveness, filling in the missing details in ways that suit their own desires.

BE ENTHUSIASTIC. When psychologist Larry D. Rosen of California State University, Dominguez Hills, asked women to choose between men who sent neutral e-mails (“I like my job”) versus enthusiastic e-mails (“I love my job!”), three quarters of the women said they preferred the latter.

HAVE COFFEE. If you think there is some potential for a relationship, move swiftly to arrange a brief, safe, face-to-face encounter. The volumes of information you get in such a meeting in just a few minutes quickly override any other impressions you might have formed in multiple e-mails or even phone calls.

DON’T PAY. Avoid high month-to-month fees—or any fees, for that matter—by looking for free membership deals or joining one of the gratis social-networking sites. Beware the “pay to respond” sites that allow you to sign up without paying but then charge you before you can respond to any e-mails.

FORGET THE TESTS. Until scientifically validated, predictive tests are available online, don’t waste your time or money on sites offering to find your soul mate through testing. At this point, no one knows how to do such matching, no matter what the hype. And even if such tests do appear someday, remember the problem of “false negatives”: the test might mistakenly steer you away from your perfect mate.

DON’T GET HOOKED. The online dating environment is so huge that one can easily spend hours every day sending out e-mails, replying to those received and searching profiles. Unfortunately, almost none of that activity leads to a relationship or even to a phone call. Try to limit your online dating activities to no more than a few minutes a day—and don’t forget about the real-world alternatives: join a club or take classes.

BE HONEST. Although a certain amount of deception is normal in any dating experience, dishonesty ultimately backfires. It is important to present yourself in the best possible light, but do not get carried away.

MAKE CONTACT. Research by communications expert Andrew Fiore of the University of California, Berkeley, shows that the best predictor of how many e-mails people receive is how many they send. If you really want to find someone, don’t just sit there. Initiate contact and also respond to the interesting messages you receive.

INVOLVE YOUR FRIENDS. Look for online services that allow friends and family members to come online with you—preferably free of charge—and let them help you find your mate. To be healthy, dating should never be done in social isolation.

BE PATIENT. With advertisements making extravagant promises and millions of people available to you at the click of a mouse, your expectations are bound to be high. But online dating is a slow, frustrating experience for most people. Expect to spend at least three to six months, and possibly much longer, finding someone with whom you are compatible. —R.E.

To take Robert Epstein’s test of relationship skills, go to http://myloveskills.com; to visit his home page, go to http://drrobertepstein.com

open about listing much younger ages, often stating in the text of their profiles that they have listed a younger age to make sure they turn up in searches. (Because men often use age cutoffs in their searches, women who list ages above that cutoff will never be seen.)

My research assistant Rachel Greenberg and I have examined the age issue by plotting a histogram of the ages of 1,000 men and 1,000 women selected at random from the national database of Match.com, arguably now the largest of the online matchmaking services. (The company’s Web site claims to have 15 million current members, with 20,000 people joining every day.) We speculated that from age 29 on—the point at which people in our culture tend to become sensitive about growing older—we might see some distinctive patterns in the distribution of ages [see box on page 60]. For men, a small spike appeared in the distribution at 32 and a large one at 36. The number of men calling themselves 36 was dramatically higher than the average frequency of men between the ages of 37 and 41.

For women, we found three clear age spikes at 29, 35 and 44. The difference between the number of women claiming to be 29 and the average frequency of women claiming to be between ages 30 and 34 was nearly eight times larger than we would expect by chance. Apparently women at certain ages are
reluctant to reveal those ages—and certain numerical ages are especially appealing, presumably because our culture attaches less stigma to those ages.

**Tests That Fail**

I have been a researcher for about 30 years and a test designer for nearly half those years. When I see extravagant ads for online tests that promise to find people a soul mate, I find myself asking, “How on earth could such a test exist?”

The truth is, it doesn’t.

For a psychometric evaluation to be taken seriously by scientists, the test itself needs to clear two hurdles. It needs to be shown to be reliable—which means, roughly, that you can count on it to produce stable results. And it needs to be shown to be a valid measure of what it is supposed to be measuring. With a test that matches people up, such validity would be established by showing that the resulting romantic pairings are actually successful.

Criteria for establishing test reliability are quite rigorous. Once relevant data are collected, the results are typically submitted to the scientific community for scrutiny. A peer-reviewed report (one vetted by other knowledgeable researchers in the field) is ultimately published in an academic journal.

Several online services are now built entirely around claims that they have powerful, effective, “scientific” matchmaking tests—most notably eHarmony.com, promoted by clinical psychologist Neil Warren; PerfectMatch.com, promoted by sociologist Pepper Schwartz of the University of Washington; and Chemistry.com (a recent spin-off of Match), promoted by anthropologist Helen Fisher of Rutgers. But not one of the tests they offer has ever been subjected to the type of outside scientific verification that I have described.

Why would a major company such as eHarmony, which claims to have attracted 20 million members since its inception, not subject its “scientific, 29-dimension” test to a scientific validation process? In 2004 eHarmony personnel did present a paper at a national convention claiming that married couples who met through eHarmony were happier than couples who met by other means. Typically such a paper would then be submitted for possible publication in a peer-reviewed journal. But this paper has still not been published, possibly because of its obvious flaws—the most problematic being that the eHarmony couples in the study were newlyweds (married an average of 6 months), whereas the couples in the control group (who had met by other means) were way past the honeymoon period (married an average of 2.1 years). (Personnel at eHarmony, including its founder, Neil Warren, did not respond to requests to be interviewed for this article.)

eHarmony claims that, on average, 236 of its members marry every day in the U.S. as a result of its services. But that figure is not as impressive as it might sound. In 2005, using eHarmony’s own published statistics, a team of credible authorities—among them Philip Zimbardo, a former president of the American Psychological Association—published evidence that eHarmony’s claims were grossly exaggerated.

It is easy to get hooked by the online world, but face-to-face meetings are the real test.

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Suspicious spikes in ages in a random sample of 1,000 female and 1,000 male profiles from Match.com suggest that online daters lie about their ages. The curve for males has a small spike at age 32 and a larger one at age 36. The number of men claiming to be 36 is 84 percent higher than the average frequency of men claiming to be between ages 37 and 41—a difference more than seven times larger than could be expected by chance. For women, three clear spikes occur at ages 29, 35 and 44. The difference between the number of women claiming to be 29 and the average frequency of women claiming to be between the ages of 30 and 34 is nearly eight times larger than could be expected by chance. The difference between the number of women claiming to be 35 and the average frequency of women claiming to be between ages 36 and 43 is more than five times larger than could be expected by chance. —R.E.
bership figures results from the fact that while a large company such as Match might advertise that it has 15 million members, less than a million are actually paying customers. The others have full profiles online—an important marketing draw—but cannot respond to e-mails. This is one of several reasons, according to McDermott, why many paying members get frustrated by a lack of response to their e-mails; the vast majority of people in the profiles simply cannot respond.

One of my greatest concerns about online dating has to do with what I call “the click problem.” We already have a commitment problem in America, one of several reasons why roughly half of first marriages and about two thirds of second marriages here end in divorce. Online dating probably is making things worse.

No matter what Hollywood tells us, long-term relationships take patience, skill and effort. In cyberspace, unfortunately, the bar is so long and the action so quick that few people are willing to put up with even the slightest imperfection in a potential mate. If someone is the wrong height or wears the wrong shoes or makes the wrong kind of joke, he or she is often dismissed instantly. After all, it is a simple matter to go back and click, with tens of thousands of potential mates ready to fill the void.

Virtual Dating and More

These many problems notwithstanding, the future of online dating and matchmaking looks bright. Interest is growing quickly, and intense competition will force rapid changes in the kinds of services that are offered. In 2001 online dating was a $40-million business; by 2008 that figure was expected to reach $600 million, with more than 800 businesses vying for every dollar.

The online dating model is already developing. Phase one—the Long Bar—is exemplified by companies such as Match, True and Yahoo! Personals. Phase two—the Long Test—is the bread and butter of companies like eHarmony and PerfectMatch. But phase three is already well under way.

Engage, for example, allows members to bring friends and family with them online, all of whom can prowl the profiles, checking people out and matching them up. Members can also rate the politeness of their dates, as well as the accuracy of the profiles. This is the new “community” approach to online matching—a naturalistic, social corrective for the deception that plagues cyberspace. The community approach is also evident in the sprawling new social-networking sites such as Facebook, Friendster and MySpace; MySpace alone has more than 100 million members. Although the social-networking sites appeal mainly to young users and are not strictly dating sites, they bring the community back into whatever dating is generated there. On mega dating sites such as eHarmony and Match, dating is done in complete social isolation, a matter of great concern to Ellison and other researchers in this area.

And the next step in online dating—“virtual dating”—is already being developed. Using special software developed by the M.I.T. Media Lab, researchers Frost, Ariely and Harvard University’s Michael I. Norton reported that people who had had a chance to interact with each other (by computer only) on a virtual tour of a museum subsequently had more successful face-to-face meetings than people who had viewed only profiles. One major bonus: virtual dating takes care of the safety concerns that prevent many people from meeting in person.

Take this just a small step forward: people meeting and chatting in a romantic virtual cafe on the Champs-Élysées in Paris—seeing and hearing each other online as they interact in this beautiful setting. Andrew Fiore, a doctoral candidate at the University of California, Berkeley, who studies online dating, suggests that in a few years we will even be able to add physiological signs to the experience—the sound of your date’s heartbeat, perhaps?

Add community-based matchmaking to enriched virtual dating, and we have turned the Internet into the greatest yenta the world has ever known.
Do Gays Have a Choice?

Science offers a clear and surprising answer to a controversial question

By Robert Epstein

On a typical summer Saturday morning Matt Avery and his wife, Sheila (not their real names), cook breakfast with their two sons, ages five and eight. Then they get organized with towels, goggles and water wings and load the family into the car for an afternoon at the pool. “Weekends are all about family time,” Matt says.

Matt and Sheila have been happily married for 11 years. “She’s my soul mate,” Matt says. “I wouldn’t trade my life for the world.”

But some people would claim that Matt’s life is based on an illusion—that he could not possibly be a dedicated husband and father. Why? Because Matt used to be gay.

According to the National Gay and Lesbian Task Force and at least a few experts, gays do not have a choice about their sexual orientation. If a man or a woman is born gay, he or she will always be gay. Because Matt was gay for most of his young adulthood (ages 17 to 24), the thinking goes, he must still be gay today. Pressured by a homomisic society—a society that dislikes and shuns gays—Matt has simply run back inside the closet. Gay activists favor this per-
The public disclosure by James McGreevey, who announced at an August 2004 press conference that he was resigning as governor of New Jersey, seems to support this view. With his beautiful wife at his side, McGreevey revealed that he was about to be sued by another male for sexual harassment. His announcement suggested, at least to some, that he had always been gay and that his two marriages and two children were somehow less than valid.

Does this perspective have merit? Or are religious conservatives correct in asserting that homosexuality is entirely a matter of choice? A wealth of scientific evidence provides an answer. It turns out that sexual orientation is virtually never a black-and-white matter. Rather it exists on a continuum, with both genes and environment determining where people end up.

Biblical Proportions

It is difficult for most people to think objectively about homosexuality, in large part because biases against it are literally of biblical proportions. According to the book of Leviticus, homosexuality—at least when practiced by males—is prohibited, punishable by death. Thousands of American pulpits to this day repeat the old biblical injunctions, which fuel discomfort with homosexuality at every layer of our society.

Until recent decades, prejudice against homosexuality has persisted even in the mental health professions. In the 1970s most therapists still held that homosexuality was a psychological disorder, akin to a disease. In the 1968 edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM)—the indispensable diagnostic tool used by therapists—homosexuality appeared in the section on sexual deviations as an instance of an aberration in which sexual interests are “directed primarily toward objects other than people of the opposite sex.”

It was largely gays themselves—understandably tired of being viewed as freaks of nature—who began to assert that their orientation was not pathological. A defining moment came on June 27, 1969, after a police raid on a gay bar in Greenwich Village in New York City provoked a riot. Crowds continued to gather at the site for another five days, protesting discrimination and preaching gay rights. Now called the Stonewall Riots (named after the Stonewall Inn, which was at the center of the melee), they galvanized the modern gay-rights movement in America and initiated a shift toward greater cultural acceptance of homosexuality.

A mere four years later, in 1973, the nomenclature committee of the American Psychiatric Association (APA) set about reassessing the profession’s dark characterization of homosexuality. Leading the charge was psychiatrist Robert L. Spitzer of Columbia University. As a result of his committee’s recommendation, the term “homosexuality” disappeared from the next edition of the DSM. That hardly settled the matter, however. In a poll of psychiatrists conducted soon after the APA’s leadership voted to make the change, 37 percent said they opposed the change, and some accused the APA of “sacrificing scientific principles” in the service of “civil rights”—in other words, of giving in to pressure.

Changing “Truths”

Matt Avery had no doubt about his orientation when he first became sexually active in his teens. During college in the early 1980s, he worked at a gay bar and had hundreds of sexual partners. He also had a four-year relationship with a man. Matt considered himself “feminine.” “I was 140

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**FAST FACTS**

**Sexual Orientation**

1. Some people who once considered themselves homosexuals are able to live happily as heterosexuals.

2. Sexual orientation falls along a continuum: some are exclusively attracted to members of the opposite sex; others, to the same sex; and many are somewhere in the middle.

3. Social pressure can push those in the middle toward heterosexuality. But because genes play a role, people with strong same-sex attractions probably cannot change their orientation.
pounds, had long fingernails, a blond ponytail and wore an earring,” he reminisces. “I was a sight to be seen.”

But when he was 24, his partner returned from a weekend retreat with some incredible news. Being gay, his partner said, “wasn’t a truth” for him. Matt was distraught. “My whole life,” he says, “was defined by whomever I was with—whomever I could use to make up for my own faults.” After their sexual relationship ended, they stayed roommates and friends. But then, Matt says, “he started dating this woman.” This change was another blow, especially because Matt was still seeing multiple men at the time. He was shaken but also curious. “One day,” he recalls, “I decided homosexuality might not be a truth for me either, and I went on a date with a woman. It was pretty good.”

Within two or three years he found himself involved exclusively with women. He made the shift without therapy and without the influence of religious groups. He was supported, he says, by friends who helped him deal with “issues involving my father.” They helped him learn to be comfortable with his masculinity. Matt got to the point where even his sexual fantasies about men disappeared. In that respect, he probably became straighter than many heterosexuals. Although Matt made the switch without professional assistance, others—sometimes under tremendous social pressure from family members or religious groups—seek out “reparative” therapists to help them become straight.

Floyd Godfrey—himself formerly gay—has been a reparative therapist in Arizona for nine years. His office has five clinicians, and they see 30 to 40 clients a week, many of whom are men struggling to overcome homosexual tendencies. Godfrey says they come because they are depressed, anxious and unhappy. “They feel out of place,” he says. “They don’t feel like one of the guys. When people feel like they don’t fit in, that can produce depression.”

Some, he says, are young men whose fathers were abusive or neglectful. “Their dad was never available for them to bond with. Or sometimes mom was controlling or overprotective. The bottom line,” Godfrey says, “is that there was a disruption during childhood of the bond that normally develops between father and son.” Deficient upbringing, Godfrey claims, can sometimes lead to same-sex attractions.

Let us set aside the obvious question for the moment—whether the therapy works—and consider a more basic issue. Why is it called “reparative”? Doesn’t this term presume that homosexuality is somehow invalid—that gays are like broken washing machines that need to be repaired? In other words, isn’t this therapy a retrenchment to the old disease model of homosexuality that Spitzer and his colleagues dispatched more than 30 years ago?

It seems so. Those deeply entrenched notions
As for the claim that homosexuality is the result of poor parenting, there is no scientific evidence.

Affect even the way we talk about homosexuality. Even the common term “sexual preference” reflects bias, suggesting that orientation is entirely a matter of choice. As for the claim made by Godfrey and others that homosexuality is the result of poor parenting, there is simply no legitimate scientific evidence to support it. Whereas it is true that some homosexuals had poor relationships with their fathers when they were growing up, it is impossible to say whether those fathers produced homosexual tendencies in their sons by rejecting them or, instead, whether some fathers simply tend to shun boys who are effeminate at the outset.

As for the effectiveness of reparative therapy—referred to by some as reorientation therapy—initial studies such as a small one published in 2002 by New York psychologists Ariel Shidlo and Michael Schroeder suggested that such therapy worked poorly or only occasionally.

In a landmark study published in the Archives of...
Switching Sides?

Robert L. Spitzer was an ardent Trotskyite in his youth, and his father was a Maoist. At one point, he was even the vice president of the NAACP chapter at Cornell University. Maybe his background explains why, in 1972, when the psychiatrist first witnessed a gay protest at a psychology convention, it was he who approached the protesters, not the other way around. He saw social injustice, and he wanted to help.

He told the protesters he was a member of the nomenclature committee revising the Diagnostic and Statistical Manual of Mental Disorders (DSM) for the American Psychiatric Association and that he would ask its members to allow gay activists to present their views. Ultimately, the committee recommended that the term “homosexuality” be eliminated from the DSM. The governing board of the APA then voted 13 to 0 (with two abstentions) to accept the recommendation—an extraordinary leap for gay rights in America.

Today Spitzer, now at Columbia University, explains that neither he nor his committee ever meant to suggest that homosexuality was normal or healthy; such a conclusion would be “very wrong.” “Just because something is not a mental disorder doesn’t mean it’s normal,” Spitzer explains.

What is more, Spitzer says, the committee was careful to preserve a category of dysfunction—still in the DSM today—that allowed unhappy gays to seek change. “Distress” over one’s sexual orientation is still listed as a disorder. As a practical matter, he says, this category applies only to gays, not to heterosexuals. “I don’t think there are heterosexuals,” Spitzer states, “who wish they only were attracted to the same sex.”

There was “tremendous opposition” to removing “homosexuality” from the DSM. How, then, does he account for that unanimous vote? “I think the leadership at that time decided, ‘We gotta do this whether we like it or not. We gotta stop the gays from breaking up our meetings. We gotta help them out, and this makes sense.’” He adds: “It helped gays feel better and get treated better. Scientifically it may not have been correct, but socially it sure was.”

In 1999 Spitzer entered the sexuality fray again—this time approaching a group of self-proclaimed ex-gays who were protesting at a convention. That event led to his controversial recent study, which suggests that some homosexuals can turn straight [see main text].

Formerly a hero to gays, Spitzer is now the reluctant darling of the Christian right, and his new research has been labeled “despicable” by a colleague at Columbia. Spitzer sees no contradictions in his actions: “I think of myself as a guy who loves controversy, loves to be where the action is—and I did some courageous things.”

—R.E.

Sexual Behavior in October 2003, however, Spitzer interviewed 200 men and women who once considered themselves homosexuals but who had lived their lives as heterosexuals for at least five years. Most of the participants had undergone some form of reorientation therapy. In addition to determining whether such therapy actually worked, Spitzer wanted to know just how dramatically people could alter their orientation. To his surprise, most of his subjects not only reported living long-term (more than 10 years) as heterosexuals, they also declared they had experienced “changes in sexual attraction, fantasy and desire” consistent with heterosexuality. The changes were clear for both sexes.

Not everyone who sets out to change his or her sexual orientation is successful in doing so, however. How can we understand these dynamics—why many people want to change, why some can, and why some appear unable to do so?

Continuity Rules

At the heart of the controversy about homosexuality are some microscopically small objects: the strands of proteins that make up our genes. Two genetic issues are relevant to our understanding of homosexuality. First, do genes play any role in sexual orientation? And second, if genes do help determine orientation, do they actually create two distinct types of orientation—gay and straight, as most people believe—or do they create a continuum of orientation?

A variety of studies suggest that genes play at least some role in homosexuality. Although no one study is entirely conclusive, studies of twins raised together, twins raised apart and family trees suggest—at least for males—that the more genes one
shares with a homosexual relative, the more likely it is that one will be homosexual—the hallmark of a genetic characteristic. But more interesting for our purposes is the question of a continuum. Sometimes, as with eye color, genes create discrete characteristics. But with many attributes, such as height and head width, genes create continuities. Whereas most people believe that “straight” and “gay” are discrete categories, there is strong evidence that they are not—and this fact has important implications for the way we understand the various controversies surrounding homosexuality.

Ever since the late 1940s, when biologist Alfred Kinsey published his extensive reports on sexual practices in the U.S., it has been clear, as Kinsey put it, that people “do not represent two discrete populations, heterosexual and homosexual. The living world is a continuum in each and every one of its aspects.” A recent position statement by the APA, the American Academy of Pediatrics and eight other national organizations agrees that “sexual orientation falls along a continuum.” In other words, sexual attraction is simply not a black-and-white matter, and the labels “straight” and “gay” do not capture the complexities.

For obvious evolutionary reasons, most people are strongly inclined to prefer opposite-sex partners, because such relationships produce children who continue the human race. But a few—probably between 3 and 7 percent of the population—are exclusively attracted to members of the same sex, and many are in the middle. If a person’s genes place him or her toward one end of what I call the Sexual Orientation Continuum, he or she almost certainly can never become homosexual [see illustration at left]. If the genes place the person at the other end of the curve, he or she almost certainly cannot become straight—or at least not a happy straight. But if an individual is somewhere in between, environment can be a major influence, especially when the person is young. Because society strongly favors the straight life, in the vast majority of cases the shift will be toward heterosexuality.

The way sexuality plays out is eerily similar to the process by which people become left- or right-handed. It may sound contrary to common sense, but scientific studies suggest that genes play a relatively small role in handedness; its heritability—an estimate of what proportion of a trait’s variability can be accounted for by genes—is only about 0.32, compared with, say, 0.84 for height and 0.95 for head width. Then why is more than 90 percent of the population right-handed? It is because of that cultural “push” working again. Subtle and not so subtle influences make children favor their right hand, and the flexibility they probably had when they were young is simply lost as they grow up. Although they can still use the left hand, their handedness becomes so well established that they would find it difficult, if not impossible, to become left-handed.

Preliminary studies by psychologist J. Michael Bailey of Northwestern University, Michael King of University College London and others suggest that the heritability of homosexuality is not much higher than that of handedness—perhaps in the range 0.25 to 0.50 or so for males and somewhat lower for females. This finding raises an intriguing question: If people were raised in a truly orientation-neutral culture, what sexual orientation would they express? Although it is unlikely that half of us would end up gay, without societal pressure it is clear that a much larger proportion of the population would express homosexuality than we see now.

Matt’s Choice

As for Matt, it is likely that he, like most or all people who change sexual orientation, was not near an extreme end of the continuum to begin with. It is unreasonable to say that he has been returned to a “natural” state; however, with strong social support, he has simply chosen a new path for himself—one that his genes made possible but that is almost certainly not possible for every gay person. Someday I suspect that psychobiological re-
How Gay Are You?

To see where you fall on the Sexual Orientation Continuum, take this simple quiz, which is designed to produce a statistically correct distribution along the lines of the continuum shown in the illustration on the opposite page. For a more accurate picture of your sexual orientation, including an estimate of how much flexibility you have in expressing your orientation, take the author’s full test at http://MySexualOrientation.com

How strongly are you attracted to members of the opposite sex?
___ 0 = VERY STRONGLY
___ 1 = MODERATELY
___ 2 = NOT AT ALL

Have you ever felt sexually attracted to a member of the same sex?
___ 0 = NO
___ 1 = YES

Have you ever had a dream about a sexual encounter with a member of the same sex?
___ 0 = NO
___ 1 = YES

Have you ever had a waking fantasy about a sexual encounter with a member of the same sex?
___ 0 = NO
___ 1 = YES

Have you ever voluntarily had sexual contact (such as kissing or petting) with a member of the same sex?
___ 0 = NO
___ 1 = YES

How frequent are your same-sex fantasies or dreams?
___ 0 = NEVER HAD THEM
___ 1 = RARE OR OCCASIONAL
___ 2 = FREQUENT

Have you ever felt sexually aroused when you’ve had any exposure to two people of your same sex having a sexual encounter (through gossip, a video or some other means)?
___ 0 = NO
___ 1 = YES

Would you be willing to have sexual relations with someone of the same sex?
___ 0 = NO
___ 1 = MAYBE
___ 2 = YES

How frequent are your same-sex encounters?
___ 0 = NEVER HAD THEM
___ 1 = RARE OR OCCASIONAL
___ 2 = FREQUENT

Now add up the numbers and see where you stand:
0–1: Exclusively heterosexual
2–3: Predominantly heterosexual
4–5: Predominantly heterosexual, with homosexual tendencies
6–7: Equally heterosexual and homosexual
8–9: Predominantly homosexual, with heterosexual tendencies
10–11: Predominantly homosexual
12–13: Exclusively homosexual

search will allow us to find precise physical correlates of sexual orientation: genes, neural structures or perhaps more subtle physical characteristics. But no advances in science will ever completely resolve the moral and philosophical issues that Matt’s conversion raises.

Do gays have a choice? Because of the enormous pressures pushing all of us toward the straight end of the Sexual Orientation Continuum from the time we are very young, it is reasonable to assume that most of the people who currently live as homosexuals were probably close to the gay end of the continuum to begin with; in other words, they probably have strong genetic tendencies toward homosexuality. Even though the evidence is clear that some gays can switch their sexual orientation, the vast majority probably cannot—or at least not comfortably. If you doubt that—and assuming that you are right-handed—try eating with your left hand for a day or two, and good luck with your soup. M

(Further Reading)

Arthur is an alleged john, a man who patronizes prostitutes. After his arrest on September 5, 2008, a photograph of this 41-year-old appeared on the Web site of the Chicago Police Department. Arthur (not his real name) was far from the only person so branded on this Internet portal. Samuel, 59, and José, 34 (whose names were also changed to protect their privacy), were on this online pillory for a month after their September 5 arrests.

The apprehensions of Arthur, Samuel, José and many others represent the huge demand among males for prostitutes. In the U.S., police officers detained about 78,000 people in 2007 for prostitution-related crimes, according to the Federal Bureau of Investigation. Experts believe that about 10 percent of these arrests are of the sex patrons, almost all of whom are men.

Overall, an estimated 16 percent of men pay for sex in the U.S., according to a 2005 report by social work professor Sven-Axel Månsson.
of Malmö University in Sweden. And a study published in 2000 of 998 street prostitutes and 83 call girls in Los Angeles led by sociologist Janet Lever of California State University, Los Angeles, suggests that 28 percent of men who patronize prostitutes and nearly half of those who employ call girls buy sex regularly, with the rest being occasional customers.

The proportion of patrons seems to vary considerably by country and by study. Månsson reported that 14 percent of Dutch men have bought sex as compared with nearly 40 percent of men in Spain. (Prostitution is legal in both countries.) And according to HYDRA, a Berlin-based organization that provides legal advice and other aid to prostitutes, up to three quarters of men in Germany, which also has legalized prostitution, have paid for sexual services. Meanwhile other estimates for Germany put the proportion far lower, at about one fifth. In Thailand, where prostitution is illegal but socially accepted, one study suggested that a whopping 95 percent of men have slept with a prostitute.

Whatever the numbers, the behavior is prevalent enough that psychologists cannot easily write it off as pathological. Rather men’s motives for buying sex are hotly contested among researchers. Some believe the practice serves as a salve for common psychological afflictions, such as an unfulfilled appetite for sex, love or romance. Others paint a dimmer portrait of johns, believing they are typically driven by chauvinistic motives, such as a desire to dominate and control women. A similar debate rages among experts about the morality of prostitution itself [see box on page 73].

Basic Instinct

Of course, the simplest explanation for men buying sex is that they like it. After all, people are generally willing to pay for activities they enjoy as much as they do sex. On the other hand, a man can usually get sex for free in the context of an ordinary intimate relationship. So why pay good money for it, especially given the social and health risks of having sex with a prostitute? Are all johns so unappealing that they cannot get sex any other way?

Most researchers do not think so. Johns come from all socioeconomic classes, according to culture researcher Sabine Grenz of the University of Gothenburg in Sweden. They may be stockbrokers, truck drivers, teachers, priests or law-enforcement officials. Many are married with children. “There are no social characteristics that basically distinguish johns from other men,” says Grenz, who published her interviews with a large number of johns in a 2005 book.

Nor are these men defined by obvious personality problems. In a survey published in 1994 psychologist Dieter Kleiber
of the Free University of Berlin had some 600 johns fill out the Freiburg Personality Inventory and found no particular abnormalities. The only correlations he found applied to risk taking and unprotected sex. For example, the men who demanded sex without condoms tended to score higher on ag-

gression, and married and well-to-do customers practiced unprotected sex more frequently than others did. “The more secure and orderly a man’s life is, the more he believes in his own invulnerability,” Kleiber concludes.

The research underscores the diversity of the men who pay for sex. Accordingly, these individuals seek prostitutes for varied reasons. Some of them may indeed be driven purely by sexual impulse. In a study of johns sponsored by the Rosa Luxemburg Foundation, sociologist Udo Gerheim of Bremen, Germany, found that many of these men are either sexually frustrated (because they are not getting satisfying sex elsewhere) or hedonists who want to live out their erotic fantasies in a red-light setting.

Representatives of HYDRA similarly say that men go to prostitutes to appease a sexual appetite. Many men feel freer to experiment within the context of commercial sex than with their wives or girlfriends, enabling them to expand their sexual range and to experience greater sexual fulfillment.

Yet some researchers have identified emotional and psychological motivations among the men who purchase sex. Gerheim spotted a type of romantic john who imagines that he is having a genuine relationship with a prostitute based on mutual trust. Kleiber also saw a romantic streak in many of his interviewees. These men, Kleiber explains, seem to be pursuing the ideal of love in a fee-for-service setting.

When Kleiber and his colleagues asked johns to characterize their prostitutes, most rated them as “charming” and “open.” Some also said these women were “intelligent” and “witty.” Many of the men painted a picture of a perfect...

FAST FACTS

Purchasing Power

1» In the U.S., police officers detained about 78,000 people in 2007 for prostitution-related crimes, according to the Federal Bureau of Investigation. Only about 10 percent of these arrests are of the sex patrons, who almost exclusively are men.

2» A considerable proportion of men worldwide buy sex from female prostitutes, with most estimates of lifetime prevalence ranging from 7 to 39 percent, depending on the country and study. Many experts argue that it is a male appetite—and not the choices of prostitutes—that fundamentally drives the sex trade.

3» Men’s motives for buying sex are hotly contested among researchers. Some believe the practice serves as a salve for common psychological afflictions, such as an unfulfilled craving for sex or romance. Others, meanwhile, paint a dimmer portrait of johns, believing they are driven by chauvinistic motives, such as a desire to dominate and control women.
An Oppressive Act or a Harmless Game?

Although prostitution, as a business or behavior, is generally frowned on in the U.S. as immoral in principle, philosophers may assign deeper meaning to the practice of buying and selling sex. These theorists, however, disagree dramatically about what that meaning is. Whereas some believe prostitution is a manifestation of the tendency of men to exploit women, others contend that the behavior more likely reflects the repression of sexual impulses by monogamous societies. Here are arguments from both sides of the street:

Critics of prostitution see it as a patriarchal act in which the goal of the john is to subjugate and exploit women. They view the contractual regulation of sexual acts between men and women as fundamentally illegitimate—and not only in the context of prostitution. When men enter into marriage contracts, they are often using their financial power to gain unlimited access to female bodies. Even if forcing a partner to engage in sex is legally considered rape, as long as women are in an economically inferior position many experts, such as philosopher Christine Overall of Queen’s University in Ontario, see an element of force in sex between married partners as well as between a john and a prostitute.

Supporters of prostitution see it as a type of harmless sexual play that enables experimentation by both parties: one person may like oral sex, whereas another prefers bondage or cross-dressing. Prostitution is simply role-playing for a fee. For instance, philosopher Andrea Günter, who wrote a chapter in a 1994 book about prostitution, believes our sexual desires have to be suppressed to meet the requirements of a monogamous society. Human beings buy sex, she says, because of the difficulty of engaging in sexual intercourse outside established couples relationships. Sexual services are aimed primarily at men not because men want to dominate women but because of the oppressive cultural myth of the chaste woman. Some advocates for this view, such as sociologist Sabine Kleinhämmes, who authored a 1988 volume on the subject, believe that a utopian society would seek not to eliminate prostitution but rather to offer a comparable service for women.

—N.W.

Prostitutes “offer the men emotional involvement, psychic stability and empathy,” one researcher observes.

sex workers generally accept their customers unconditionally and offer intimacy on demand, whatever their true feelings, says gender researcher Gunda Schumann, who co-authored a 1980 book on the psychology of prostitution. “They offer the men emotional involvement, psychic stability and empathy,” she observes. In this view, ordinary men buy sex to deal with their psychological insecurities as well as their sexual needs.

The idea that sex with a prostitute can be therapeutic dates back thousands of years. In the Epic of Gilgamesh, a poem from ancient Mesopotamia, Enkidu—a friend of the king who is half wild—is civilized by having sex with a whore. The tale portrays the prostitute as sacred because she

(The Author)

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Prostitution Laws around the World

The legality of prostitution varies from country to country. Here is a sampling of international policies relating to prostitution.

- **Illegal**
  Prostitution and related crimes such as pimping and brothel ownership are banned. Providers of sexual services and their customers can be prosecuted.
  
  **Examples:** China, Cuba, Egypt, India, Iran, Japan, Kenya, the Philippines, Romania, Rwanda, Saudi Arabia, South Africa, South Korea, Sweden (where selling sex is not a crime, but buying sex is), Taiwan, U.S. (with the exception of Nevada and, at press time, Rhode Island)

- **Legal with Restrictions**
  Prostitution is either legal or not specifically criminal. Brothel ownership and pimping, however, are prosecuted in these countries, some of which also regulate prostitution, requiring, for example, the female professionals to register with the state and undergo regular health examinations.
  
  **Examples:** Argentina, Austria (also regulated), Belgium, Brazil, Canada, Denmark, England, Ethiopia, France, Iceland, Israel, Italy, Mexico (also regulated), Norway, Peru, Senegal (also regulated), Singapore (also regulated), Switzerland

- **Legal and Regulated**
  Prostitution and related services are permitted, typically with controls such as a ban on forced prostitution and age limits, registration and regular health examinations for prostitutes.
  
  **Examples:** Germany, Greece, the Netherlands, New Zealand, Turkey

SOURCE: ProCon.org
sacrifices herself to the man to cleanse him of destructive inner forces.

“Material” Girls

Other researchers disagree that prostitutes serve as a balm for the woes of essentially normal men. Sociologist Julia O’Connell Davidson of the University of Nottingham in England characterizes johns as necrophiliacs who commit their acts on socially “dead” women. These are men, she says, whose sexual desire is switched on by not having to care about the prostitute as a human being—the opposite of the intimacy hypothesis.

“What turns the john on is the woman’s powerlessness,” O’Connell Davidson concludes. Sex with a prostitute, she says, is more about seeking revenge on women or exerting control over them than about a quest for intimacy and romance.

In a speech he gave to the European Parliament in 2006, Månsson pointed out that johns frequently speak about sex “as a consumer product rather than an expression of intimate relations.” One man, he reported, compared sex with a prostitute to “going to McDonald’s.” Indeed, on the Internet, where a person can remain relatively anonymous, many johns refer to women as “material,” Gerheim notes, and may also describe misogynistic submission fantasies.

Some sex purchasers may even have a social agenda to go along with their personal predilections. For many of them, Månsson opines, a prostitute’s bed represents the last bastion of antifeminism. Only there can men reestablish the traditional male dominance over women.

Catering to such men, brothels in countries where these institutions are legal hawk women like merchandise on their Web sites. Meanwhile nudist clubs in nations such as Germany attract customers with “all-inclusive” deals: for a fixed price (often less than $100), men can have sex with any of the women present. Some clubs even offer happy-hour specials.

Månsson believes that johns are usually psychologically disturbed and in need of counseling and treatment. Many Swedish johns similarly view their sexual behavior as “out of control” or “psychologically toxic,” a self-characterization certain scientists reject. In the opinion of these dissenters, johns in the U.S. and other countries that ban prostitution are unjustly criminalized and labeled mentally unstable.

However toxic the activity might be to the men, the women often end up more seriously wounded by it. At the very least, prostitutes suffer psychologically from trying to wall off their own emotions so that they can sell intimacy as a commodity. In addition, they often suffer from physical abuse at the hands of johns. The 2006 annual report of KARO, an organization trying to thwart prostitution in the region dividing Germany and the Czech Republic, noted many incidents of brutality related to the selling of sex. Prostitutes in the U.S. are also subject to high levels of violence.

Prostitution is not a profession women pursue because they like the work. As stated on the KARO Web site: “Very few women have ever said that they voluntarily became prostitutes.” Poverty, drug addiction or fear of violence from pimps often pushes women into the sex trade.

Thus, many experts argue that the female sex workers are not the real drivers of prostitution. Instead the business survives because of demand from the legions of males who have problems in their relationships with women. This rationale lies behind the law in Sweden that came into force in 1999 under which selling sex is legal but buying sex is not. The same notion also propels a growing crop of workshops and classes in the U.S. aimed at discouraging offending males from repeating an act that many consider a crime against women. M

(Further Reading)

- Prostitution policies by nation: http://prostitution.procon.org/viewresource.asp?resourceID=772
Abnormal Attraction

MOST PEOPLE ARE REPULSED BY THE IDEA OF SEX WITH CHILDREN. BUT KEEPING CHILDREN SAFE FROM PEDOPHILES MEANS TRYING TO DISCOVER HOW THIS DISASTROUS CRAVING COMES ABOUT—AND HOW TO TAME IT

BY PEER BRIKEN, ANDREAS HILL AND WOLFGANG BERNER

A girl and a man are sitting on a park bench. She’s staring into a book; he’s staring at her. After a while they start to talk and get into a friendly conversation. “Would you like to sit on my lap?” he asks softly. The stirrings of sexual excitement are faintly audible in his voice.

Uncomfortable, moviegoers squirm in their seats. They are watching Nicole Kassell’s The Woodsman, a 2004 movie about the life of a pedophile. After 12 years behind bars for child molestation, Walter is trying to make a new life for himself. He has his own apartment, holds a job and has recently married. But the path to a normal existence is difficult. His co-workers are suspicious and give him the cold shoulder; his sister and the police have nothing but contempt for him. Viewers wonder whether such a man can ever find redemption. Perhaps he should be permanently removed from society.
GUILT MEETS INNOCENCE: Pedophiles live in a constant struggle with their sexual urges. Most of them conceal their feelings their entire life for fear of condemnation and punishment.
The public does not like to take chances with pedophiles—people who are sexually excited by children. Some 89,000 children in the U.S. were sexually abused in 2002, according to the Department of Health and Human Services, and other studies suggest far higher numbers. Meanwhile one in seven youngsters aged 10 to 17 received an online sexual solicitation in 2005, reports the National Center for Missing and Exploited Children. Pedophiles are responsible for many of these solicitations and abuse cases. And among convicted pedophiles—especially those drawn to boys—the recidivism rate is high.

Yet not all adults who abuse children are pedophiles. Some of the abusers are not, in fact, especially attracted to children but target them because they are weaker and more pliable than adults. What is more, not all people who have pedophile tendencies act on them or turn violent. Indeed, given the consequences of being identified, many pedophiles remain undercover, surrounded by children while struggling with their secret desire.

And that can be dangerous.

Thus, some researchers are pushing the public to see pedophilia as a psychological disorder that calls for study and treatment—for no less a reason than the safety of children worldwide. The idea is to separate this mental state from criminal acts of child abuse, because the two do not always go hand in hand. This tactic, after all, may be the only way to bring into treatment the untold numbers of undiscovered pedophiles and reduce the chances that any of them will ever harm a child.

**Officially Sick**

In 1886 German psychiatrist Richard Freiherr von Krafft-Ebing coined the term “pedophile” (from the Greek *pais*, meaning “child,” and *philia*, meaning “love” or “friendship”). Krafft-Ebing was also one of the first to separate the desire for children from the behavior of child abuse. In his then revolutionary work *Psychopathia Sexualis* (*Psychopathy of Sex*), Krafft-Ebing opined that sexually deviant thoughts were not criminal per se but should in some cases be seen as an illness. Indeed, pedophilia is listed in the American Psychiatric Association’s *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV*). This volume defines pedophilia as all recurrent sexually exciting fantasies, impulsive desires and behaviors that include sexual acts with a child and that occur over a period of at least six months.

Krafft-Ebing also pioneered a distinction between hard-core pedophiles—those whose predilection came to the fore at puberty—and other forms of child abuse in which children are used as substitutes for adults. These pedophiles turn to children later, after an adult relationship has failed or they realize that the possibility of one is remote.

Among the latter class are “situational molesters.” These people are usually incapable of having relationships with an equal—perhaps because of a mental disability—or may turn to children after experiencing frustration or humiliation in an adult relationship. In a subcategory called senescent pedophilia, for example, men target impressionable and compliant partners because of their own senility or increasing impotence. Situational molesters also include individuals who have ongoing contact with children because of their work and thus may be drawn into situations in which they use their charges for their own sexual gratification.

**Love Gone Awry**

Research into the causes and treatment of pedophilia remains somewhat fragmentary. One deterrent to such research is that scientists and clinicians who study and try to treat the condition are often branded as supporters of illegal sexual acts against children rather than as people trying to understand and alleviate a psychiatric disorder.
Nevertheless, like other complex psychological traits, pedophilia is thought to stem from a combination of genetic and environmental factors. Many experts believe that disorders of sexual preference emerge from childhood experiences during critical periods in human development. In particular, several studies have confirmed that pedophiles are unusually likely to have been victims of violence and sex abuse as children. In one such study in 2001, researchers at the Royal Free Hospital School of Medicine and University College London reviewed the case notes of 225 male sex abusers and 522 other male patients being treated in a London clinic for sex offenders and sexual deviants. They found that abusers had themselves been victims of sexual violence considerably more often than the patients who had not committed sex abuse, suggesting a victim-to-perpetrator cycle in some men who commit sex crimes.

David Skuse and his colleagues at the Institute of Child Health in London went further, identifying other factors that push a male sex-abuse victim to commit a sex crime later on. Of 224 young male victims of sex abuse, 26 (12 percent) ended up committing sexual offenses, typically with children, by the time the researchers stopped following them seven to 19 years later. The victims who became perpetrators, the scientists reported in 2003, commonly had experienced neglect and lack of supervision, along with abuse by a female; often they had also witnessed violence among family members. Such a hostile childhood, psychoanalytic theory goes, can create a need to replace feelings of “defeat” with those of “triumph.” To accomplish this emotional shift, a person may turn the tables and become the sexual aggressor as an adult.

In other cases, however, the abused or otherwise troubled pedophile seeks less to dominate than to establish a “genuine” relationship with a child, opines sociologist David Finkelhor of the University of New Hampshire. Such men tend to identify strongly with the thought patterns and lives of children, a trait that often goes along with a lack of education and of self-esteem. In such cases of so-called emotional congruence, a man may feel happiest and most secure when he spends much of his time with children and may even act childish himself.

Pedophiles often have other issues, too, according to Finkelhor, such as deep-seated sexual anxiety that blocks the development of normal sexuality. A general lack of inhibition rounds out the picture: pedophiles may suffer from psychosis, poor impulse control or alcoholism. Supporting the notion of pedophiles as impulsive, a research team led by psychologist Ronald Langevin of the University of Toronto discovered differences in an area of the frontal lobe in men who molest children as compared with normal men. This region of the brain is critical for impulse control among its other, higher-level reasoning functions.

Biology to Blame?

In some cases, the roots of pedophilia may be less psychological than biological. For instance, preliminary data from 2002 link childhood brain trauma to pedophilia. A research team led by Ray Blanchard of the University of Toronto took the medical histories of about 400 pedophiles and 800 nonpedophiles and found that the pedophiles were more likely than the others to have had accidents causing loss of consciousness before age six. (Such accidents were also associated with lower intelligence and educational level.)

That does not necessarily mean that the early brain trauma caused the pedophilia, the authors note. It is possible that pedophiles are more likely to have been born with brain defects that can lead to pedophilia and that also made them accident-prone. In that instance, the brain injury would be incidental to the pedophilia and not its cause. Other brain-based abnormalities—such as attention-deficit hyperactivity disorder (ADHD)—have been loosely associated with pedophilia and being accident-prone. (Although pedophiles are more likely than others to have been diagnosed with ADHD as children, this does not mean that children with ADHD are likely to become pedophiles.)

(The Authors)

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Meanwhile, using family-history questionnaires, a team led by Fred Berlin at the Johns Hopkins School of Medicine found higher rates of pedophilia among members of pedophiles’ immediate families than among the families of nonpedophiles. No one has found specific gene variants associated with pedophilia, however. Even if such genes are discovered, they are unlikely to fully account for the disorder.

**Getting Help**

Treatment for pedophilia typically involves a combination of talk therapy and medication. Psychotherapy can take one of two forms. Freudian psychoanalysis involves bringing to light traumatic events and identity crises from a patient’s childhood so that such problems may be discussed and resolved. Cognitive-behavioral therapy, on the other hand, is geared more practically toward helping patients identify—and avoid—the kinds of situations that may tempt them to engage in harmful behaviors. Therapists may also try to correct a patient’s cognitive distortions, such as the twisted notion that “the kid liked it.” Avoiding pornography may be one way for pedophiles to reduce temptation. Some experts believe

—Interview by Sabine Kersebaum

**SA Mind: Can pedophiles be changed?**

*Beier:* A person’s sexual preference can never be completely reoriented; this includes his sexual orientation, age preference and predilection for particular sexual practices. Many disturbances or diseases can’t be cured per se, but they can be effectively treated. Take diabetes. A diabetic has to keep his or her blood sugar within a normal range, eat sensibly and exercise. Over time, he or she learns to pass by the doughnut shop or ice cream parlor. The same applies to sexual disorders: people who are affected have to learn to control their impulses so that they don’t harm themselves or others.

**SA Mind: How do you support your patients in this endeavor?**

*Beier:* It is counterproductive to blame these men for their sexual orientation and fantasies. But everyone is responsible for his own behavior. In our treatment program, we help patients develop strategies for avoiding sexual situations with children so that they don’t act on their fantasies. That said, patients must want to change. No one can be successfully treated against his will.

**SA Mind: Are pedophiles responsible for all child sex abuse?**

*Beier:* By no means. Many molesters are sexually attracted to adults. They act out on children because [the latter] can’t defend themselves the way adults can. Our project is not geared toward this group of perpetrators.

For those who are exclusively attracted to children, we teach them to live responsibly with their predilection—that is, to come to terms with it while understanding that they can never act on this particular sexual desire.

**SA Mind: You’ve been talking exclusively about men. What about women?**

*Beier:* Although it is true that women are capable of and have committed child sex abuse, there is no such thing as a pedophile woman. At least I have never seen or heard of a single case over the course of my career.

**SA Mind: There are different types of pedophiles. Do you then offer different types of treatment to reflect that?**

*Beier:* There are basically two groups: those oriented exclusively toward children and those oriented toward both adults and children. Treatment is primarily based on inclusion in one of these groups rather than on personality factors.

**SA Mind: What are some of the differences in treating these two forms?**

*Beier:* Men who do not respond exclusively to children have better prospects for channeling their sexuality in socially acceptable ways. We foster this in treatment by, for example, including his partner in the process—if he in fact has one. Sometimes shyness and insecurity with women are behind a man’s sexual interest in children.

For those who are exclusively attracted to children, we teach them to live responsibly with their predilection—that is, to come to terms with it while understanding that they can never act on this particular sexual desire.

**Klaus M. Beier studies diagnosis and treatment of sexual preference and behavior disorders.**

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that pornography depicting children as sexual partners may fuel fantasies and reduce inhibitions.

A 2008 study of 341 convicted child molesters led by Drew A. Kingston of the University of Ottawa found that higher-risk offenders who used pornography were significantly more likely to commit new offenses, especially when they viewed pornography containing deviant content. Sex crimes against children have not risen in recent years despite the rapid expansion of the Internet, however, and the relation between pornography and criminal behavior remains unclear.

Sex offenders who successfully complete a psychological treatment program are less likely to commit another offense, or if they do reoffend the crime is typically not sexual in nature, write University of Leicester criminologist Charlotte Bilby and psychologist Belinda Brooks-Gordon of Birkbeck, University of London, in a July 2006 review in the British Medical Journal. But not all pedophiles respond to psychotherapy, Bilby and Brooks-Gordon observe.

For additional help in subverting pedophilia, doctors may also prescribe medications such as selective serotonin reuptake inhibitors (SSRIs). These drugs are typically used to treat depression, anxiety and compulsive disorders but can sometimes help pedophiles control their sexual urges. SSRIs boost the amount of the messenger substance serotonin in the brain; this boost is thought to have a positive effect on a person’s emotional state. Our team reported in 2003 that these medications significantly decreased sexual fantasies, sexual desire and compulsive masturbation in pedophiles. These drugs, however, have not yet been proved to work against pedophilia in a clinical trial that compares them with a placebo.

Other promising medications target the hormonal regulatory system that is governed by a duet of small regions at the base of the brain: the hypothalamus and the pituitary gland. In one of their hormonal collaborations, the hypothalamus produces something called luteinizing hormone-releasing hormone (LHRH), which in turn causes the pituitary to release LH. LH then prompts the testes to produce and secrete the male sex hormone testosterone.

Drugs such as leuprolide acetate, a so-called LHRH analogue, can block this sequence of events and thus dramatically decrease testosterone production, reducing it to castration levels. Patients with deviant sexual tendencies are significantly less apt to act on their impulses when using these medications. In some cases, these drugs and others enable patients to feel sufficiently unburdened to talk openly about their compulsive and often agonizing sexual fantasies and behaviors.

Ironically, successful treatment can bring about its own complications. Often helping men gain control over their deviant sexuality ends up forcing them to let go of a distortion that formerly propped up their self-esteem. As a result, patients confront a major personal crisis. At this point, a psychotherapist tries to help a pedophile find a suitable replacement for the emotional stability he had received from his pedophilic sexuality. But even then, the work is far from done. Most pedophiles must struggle to restrain their predilections for the rest of their life.

(Further Reading)

- Crimes against Children Research Center: www.unh.edu/ccrc
- FBI Kids’ Page: www.fbi.gov/fbikids.htm
- Stop It Now (Child Abuse Prevention): www.stopitnow.org
Misunderstood Crimes

Once a sex offender, always a sex offender?

BY HAL ARKOWITZ AND SCOTT O. LILIENTHAL

SEX CRIMES evince such strong feelings of revulsion and repugnance that it is perhaps not surprising that people misunderstand their nature. The public, whose opinions are reinforced by portrayals in the media and in popular culture, believes that sex offenders will almost always repeat their predatory acts in the future and that all treatments for perpetrators are ineffective. The truth is not so cut and dried—and gives us cause for hope in certain cases.

Before we discuss these beliefs, a few basics are in order. The two most common types of sex offenses are rape and child molestation, but others exist (see box on page 84). In most cases, the victim, usually female, knows the perpetrator, usually male. By some estimates, one third or more of all sex offenders are under the age of 18, with some even as young as five years. Most begin to offend sexually in adolescence. Now what does the research tell us about common beliefs?

Repeat Offenders

First, the notion that recidivism (repeat offending) is inevitable needs a second look. Recently sex crimes researcher Jill Levenson of Lynn University in Florida and her colleagues found that the average member of the general public believes that 75 percent of sex offenders will reoffend. This perception is consistent with media portrayals in such television programs as Law and Order: Special Victims Unit, in which sex offenders are almost always portrayed as chronic repeaters.

The evidence suggests otherwise. Sex crimes researchers R. Karl Hanson and Kelly E. Morton-Bourgon, both at Public Safety Canada, conducted a large-scale meta-analysis (quantitative review) of recidivism rates among adult sex offenders. They found a rate of 14 percent over a period averaging five to six years. Recidivism rates increased over time, reaching 24 percent by 15 years. The figures are clearly out of alignment with the public’s more dire expectations.

Also contrary to media depictions, most offenders do not “specialize” in one type of sex crime. Most are “generalists” who engage in a variety of sex and nonsexual crimes as well. Hanson and Morton-Bourgon found that sex offenders had a total recidivism rate (for both sex crimes and nonsexual violent crimes) of approximately 36 percent over a period of five to six years. Nevertheless, perpetrators of different types of sex crimes exhibit varying rates of repeat offending. The 15-year recidivism rate is 13 percent for incest perpetrators, 24 percent for rapists and 35 percent for child molesters of boy victims.

When providing clarifications about the lower than generally acknowledged rates of recidivism, we must be careful not to oversimplify. Recidivism research is as difficult as it is important. For instance, although average rates tell us what percentage reoffends one or more times, we also need to be aware that a subset reoffends at a frighteningly high rate. In addition, there are reasons to think that published findings underestimate the true rates. Most research neces-

The notion that recidivism is inevitable needs a second look, as does the idea that all treatments are ineffective.
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sarily omits those offenders who were not detected and arrested or whose victims did not report the crime. Further, many sex offenders plea-bargain down to a nonsexual offense.

Still, there are other reasons to believe that recidivism rates may not be that different from what researchers have found. Frequent offenders are more likely than other offenders to be caught. Many safeguards probably help to keep the recidivism rate in check. Sex offenders released on probation are closely monitored, and those who are considered to be at high risk for recidivism are required to register with authorities. These registries are distributed to law-enforcement personnel. Finally, states are legally required to publicly identify higher-risk sex offenders. The Department of Justice coordinates a Web site (www.fbi.gov/hq/cid/cac/registry.htm) that enables anyone to search for the identity and location of known offenders.

Taking the research and its limitations into account, it is still likely that the public’s belief that very high recidivism rates are well documented is incorrect, although this verdict may change in the future.

Treatment Realities

If recidivism is not as common as people generally believe, how do their impressions of treatment’s failure or success hold up? Levenson and her colleagues also found that a whopping 50 percent of the public believes that treatment for sex offenders is ineffective and will not prevent them from relapsing. Yet some studies have shown that treatment can significantly reduce recidivism for both sex and nonsexual crimes. Hanson and his colleagues conducted a meta-analysis on treatment and found that 17 percent of untreated adult sex offenders reoffended, whereas 10 percent of treated subjects did so. When recidivism rates for sex and nonsexual violent crimes were combined, 51 percent of untreated and 32 percent of treated subjects reoffended.

The advantage for treatment over nontreatment does not appear to be that large; because meta-analyses group studies together, they may mask the fact that some of them found fairly large effects of treatment and others found smaller or no effects. Results of this meta-analysis also suggest that we might be making progress. More recent studies show significantly larger treatment benefits than do the older studies.

Most approaches employ a number of treatments. The majority include two components: cognitive-behavior therapy, which aims to change sexually deviant thoughts, behaviors and arousal patterns; and relapse prevention, which aims to teach sex offenders how to anticipate and cope with problems (such as feelings of anger or loneliness) that can lead to reoffending.

Although the development of treatments for sex offenders is still in its infancy, studies show that therapy can make a significant difference. Sex offenders are not all fated to repeat their horrible crimes, and we—through the actions of the general public, policy leaders and legislators—can encourage hope by supporting further research on such therapies.

HAL ARKOWITZ and SCOTT O. LILIENFELD serve on the board of advisers for Scientific American Mind. Arkowitz is a psychology professor at the University of Arizona. Lilienfeld is a psychology professor at Emory University. The authors thank R. Karl Hanson of Public Safety Canada and Laura Kirsch and Amanda Fanniff, both at the University of Arizona, for their invaluable help with this article. Any statements made in the article, however, are solely the responsibility of the co-authors.

(Further Reading)


Categories of Offenses

Many categories of sex offenses exist; precise legal descriptions of types of sex offenses can vary from state to state. Not all common sexual behaviors are illegal. For example, no laws bar transvestism, which usually involves a heterosexual man who dresses in women’s clothing.

—H.A. and S.O.L.

<table>
<thead>
<tr>
<th>Sex Offense</th>
<th>General Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rape</td>
<td>Sexual intercourse with a minor or unwilling adult</td>
</tr>
<tr>
<td>Child molestation</td>
<td>Sexual behaviors between an adult and juvenile who are not blood relatives</td>
</tr>
<tr>
<td>Incest</td>
<td>Sexual behaviors between an adult and juvenile who are blood relatives</td>
</tr>
<tr>
<td>Exhibitionism</td>
<td>Exposing one’s genitals to an unwilling stranger</td>
</tr>
<tr>
<td>Voyeurism</td>
<td>Watching unsuspecting others who either are in a state of undress or are having sexual relations</td>
</tr>
<tr>
<td>Frotteurism</td>
<td>Sexually oriented touching of an unsuspecting person</td>
</tr>
</tbody>
</table>

(Further Reading)

◆ Sexually oriented touching of an unsuspecting person

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