Lust for Life

NEUROSCIENTISTS ARE LEARNING HOW PURE SEXUAL DESIRE CONTRIBUTES TO LASTING RELATIONSHIPS

By Stephanie Cacioppo and John T. Cacioppo

People often think of love and lust as polar opposites—love exalted as the binder of two souls, lust the transient devil on our shoulders, disturbing and disruptive. Now neuroscientists are discovering that lust and love work together more closely than we think. Indeed, the strongest relationships have elements of both.

The bifurcated treatment of love and lust dates to antiquity. The study of love as an academic subject is nearly a century old, with the sentiment covered in introductory textbooks of social psychology. Psychologists, primatologists, neuroanatomists and neurophysiologists came to see love—defined as an intense and complex feeling of deep affection—as responsible for long-term coupling and close relation-
The Brain in Love (and Lust)

The color hues in the “heat maps” show brain networks related to lust (blue) and love (red). In passionate love, red and blue regions light up in tandem, with interaction between lust and love most pronounced in the insula and the striatum (inset). As lust progresses to love, activity cascades from the back of the insula to the front and from the bottom of the striatum to the top. And while “sexual addiction” is a controversial diagnosis, lust does recruit some of the same brain regions—the prefrontal cortex, nucleus accumbens and ventral tegmental area—as addiction.

**FAST FACTS**

**Decoding Desire**

1. Brain imaging is revealing the distinct but interlocking patterns of neural activation associated with lust and love.

2. Lust most likely is grounded in the concrete sensations of the moment, whereas love is a more abstract gloss on our experiences with another person.

3. Imaging is also helping to decipher the disorders of lust, including anorgasmia. More than 80 discrete areas in the brain fire at the point of orgasm—meaning there are at least 80 different ways to develop anorgasmia.

ships. The first psychological tools for measuring love appeared in the 1940s. In a review of the literature published in 2011, psychologist Elaine Hatfield and her colleagues at the University of Hawaii at Manoa identified 33 scales for measuring love’s gradations.

In contrast, researchers have traditionally regarded lust as little more than uncontrolled sexual urges. The scientific study of lust remained verboten or limited to clinicians, psychiatrists and sex therapists dealing with social and behavioral problems. When the topic of lust did appear in the scientific literature, it was cast as an archaic emotion, a sinful feeling that needed to be suppressed or denied lest it challenge societal order, or an addiction that hijacked human thought, emotion and behavior in insidious ways.

Now, though, neuroimaging investigations are beginning to flesh out the relationship between lust and love. Some research does support the Jekyll and Hyde dichotomy. Studies have revealed that lust and love each has a unique brain signature [see box on page 00], suggesting they are separable, with
the brain able to generate lust in the absence of love and vice versa. In one study of 500 individuals conducted in the mid-1960s by psychologist Dorothy Tennov of the University of Bridgeport, 53 percent of the women and 79 percent of the men agreed with the statement, “I have been sexually attracted without feeling the slightest trace of love”; and 61 percent of the women and 35 percent of the men agreed with the statement, “I have been in love without feeling any need for sex.” Neuroimaging studies have also shown considerable overlap between the network for lust and the network underlying addiction, suggesting that the craving associated with lust brings with it impulsivity, lack of self-control and risk taking.

Other studies reveal a more complex and synergistic connection between lust and love. Both feelings can activate regions in the brain related to emotions, including euphoria, reward, motivation, addiction and body image. What is more, lust and love activate different parts of the same brain structures, the insula and the striatum.

A recent meta-analysis that we conducted of 20 studies with a total of 429 participants revealed that the posterior region of the insula is activated by lust but not love and the anterior region of the insula is activated by love but not lust. This back-to-front distinction is in line with a broader principle of brain organization: posterior regions are involved in current, concrete sensations, feelings and responses, and anterior regions are involved in the integration of abstract concepts ranging from the distant past to alternative futures. In this model, lust would be grounded in particular sensory and

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motor experiences, with love as a more abstract, future-oriented gloss on those experiences with another person.

Studies show that as lust progresses to love, activity cascades from the back of the insula to the front, with the pleasing sensations of lust (sparked at the back) joined by the abstract feelings of affection (triggered at the front). A similar pattern for lust and love emerges in the striatum, this time traveling from bottom to top.

The research suggests that the strongest relationship—passionate love—involves activation of the home bases of both love and lust. Passionate love builds on the neural circuitry for lust, adding regions associated with reward expectancy, habit formation and abstract representation and control to those associated with rewards for sensations and the satisfaction of cravings.

For any two individuals, the strongest relationship is not necessarily the best outcome: some couplings are just meant to be one-night stands. Love and lust can exist in any combination, with either, both or neither emotion present and present to any degree. The combinations result in a variety of affiliations. When both people feel the same emotions, the relation-

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**Lust’s Reward**

**FOR MANY WOMEN, ORGASM REMAINS ELUSIVE. HELP MAY SOON BE AT HAND**

**By Kayt Sukel**

Six months after the birth of her second child, Patricia, a woman with an active and fulfilling sex life, found herself unable to achieve orgasm. “My partner and I tried everything,” she says. “And it was so frustrating because I’d almost reach climax, time and time again, and then ... nothing.”

After a few months, her frustration led her to visit a local clinic for sexual disorders. “They brought in a social worker who asked me a lot of questions about abuse. They seemed worried about possible psychological causes,” she notes. After grilling her about her sexual habits, her marriage and other potential stressors, they suggested her inability to reach orgasm might be because of birth-related nerve damage. “They told me, ‘Hopefully, the nerves will regenerate, but we don’t know,’” she says. “And I left thinking, ‘Wow, that was massively unhelpful.’”

They may say that all you need is love—but lust, love’s partner in crime (or, as some may say, its evil twin), refuses to be denied. And like love, it begs to be fulfilled.
ship ranges from passionate love (high love and high lust) to acquaintanceship (a little of each), with one-night stands (high lust, little love) and companionate love (as in a friendly marriage) in the middle. When the feelings of two people diverge, the results may be unwanted attention for one and unrequited love or lust for the other. The ideal state in any pairing is when there is agreement between the two people in their love-lust for-love or lust for the other. The ideal state in any pairing is when there is agreement between the two people in their love-lust formula, creating a healthy balance between love and desire and the best chance for a stable, satisfying, monogamous relationship. But whatever the end point, getting there is half the fun.

Patricia is far from alone in her frustration. The statistics vary, but most sources agree that less than one third of women consistently reach orgasm during sexual activity. If such an inability persists for more than six months and results in distress to the individual, the Diagnostic and Statistical Manual of Mental Disorders (the DSM, for short) classifies the condition as a psychosexual disorder: anorgasmia. The problem may be lifelong—the diagnosis for those who have never experienced an orgasm—or it may be acquired, as in Patricia’s case. And although a small percentage of men acquire anorgasmia later in life, usually as the result of chronic medical issues, anorgasmia is primarily a disorder of women.

Today scientists are hard at work to understand the causes of anorgasmia and inhibited sexual response. Laboratories across the globe are using a variety of imaging techniques to pinpoint what happens in the brain during orgasm, how irritation can interfere with sexual response, and how our hormones can help—or hinder—climax. Clinicians are now piecing together these different research threads in the hope of discovering new, more effective treatments.

Before scientists can figure out how to help people who cannot have orgasms, though, they need to better understand what happens in the brains and bodies of people who can. “We’re only really beginning to understand the orgasm, especially from a neuroscience perspective,” says Barry R. Komisaruk, a neuroscientist at Rutgers University.

Orgasm and the Brain

The first comprehensive scientific studies of orgasm were led by William H. Masters and Virginia E. Johnson in the 1960s. By considering both physiological and psychological factors, the duo came up with the four-stage model of sexual response: excitement (or arousal), plateau (full arousal), orgasm and resolution. They arrived at their findings primarily through direct observation in the laboratory; many of their initial study participants were professional sex workers. But the pair did not have the tools to investigate the neurobiological factors that might be in play.

Neuroimaging techniques such as positron-emission tomography and functional MRI are giving neuroscientists a unique way to study the phenomenon. Komisaruk and his colleague Nan Wise, a doctoral candidate at Rutgers and also a licensed sex therapist in New Jersey, have been using fMRI to study orgasm in a variety of populations.

I volunteered to be one of their guinea pigs. Komisaruk and Wise were looking to track the time course of the orgasm—identifying which areas of the brain are recruited during genital stimulation, during the orgasm itself, and then postclimax. By doing so, they may be able to find potential candidates for what Komisaruk calls a “blockage,” or area that may interfere with orgasm when not activated properly.

When it came time for me to do my part at their laboratory in Newark, N.J., I found myself a bit apprehensive. My romantic soundtrack would consist of the spine-jangling clunks, clanks and whirs of the fMRI’s magnetic apparatus—about as far from Barry White as you can get. Clad in a paper-thin cotton hospital Johnny, I was slotted into the machine’s claustrophobia-inducing tubular metal housing, my head immobilized in a tight mesh mask to keep it as still as possible while the magnet virtually sliced my brain. I wasn’t feeling particularly sexy. Would I be able to climax in such a setting?

I could but try. Using my hand to stimulate my clitoris while the scanner belched and bellowed overhead, I found that pure determination (and fear of disappointing the researchers calmly waiting in the control room) did the trick. Within a few minutes, I pushed a button to let Komisaruk and Wise know that I had successfully donated my orgasm to science. The two then analyzed the data from my session, along with those from approximately a dozen other study participants, focusing on 80 discrete regions of the brain. They found a complex pattern of activation at the point of orgasm—suggesting many different ways to develop anorgasmia.

Parsing the interplay among all those regions is a daunting task. “We know the orgasm starts with activation in the sensory cortex,” Komisaruk says. “But do anorgasmic people have a normal sensory cortex response? Is the sensory information not being integrated by other parts of the brain? We don’t know yet.”

(Further Reading)

Searching for Answers

In trying to identify the cause of anorgasmia, scientists are exploring different realms: the physiological, the psychological and the chemical. Cindy M. Meston, director of the Sexual Psychophysiology Lab at the University of Texas at Austin, points to a few well-known medical and physiological factors that inhibit orgasm, including the nerve damage that Patricia may have suffered. “There are vascular disorders, spinal cord injuries, neuropathy, drug effects from antidepressants and other medicines,” Meston says. But, she adds, once you rule those factors out, no scientific evidence supports the idea that anorgasmia arises from dysfunctions in body systems.

A likelier culprit is the brain’s frontal lobe. This part of the brain is responsible for executive function—allocation of the mind’s attention and control as circumstances require. Komisaruk’s fMRI studies show that at the point of orgasm, the frontal pole, part of the frontal lobe, fires in tandem with areas in the temporal lobe associated with the senses and regions down deep, near the brain stem, that are associated with rewards.

Those linkages may account for a barrier to orgasm that Masters and Johnson called “spectatoring”—staying outside of a sexual encounter to monitor and judge it instead of fully experiencing it. The frontal lobe governs all that monitoring and judgment. “You may not get to the high level of arousal needed for orgasm if you are paying attention to what you look like, or how you measure up to past partners, or what’s happening in your relationship instead of what you’re actually feeling and experiencing during sex,” Meston says. “That kind of stuff is just not conducive to increasing arousal—and so it’s going to get in the way of your orgasm.”

The primacy of the mind in sexual response helps to explain a seemingly counterintuitive finding in clinical practice: treating anorgasmia is easiest in individuals for whom it has been a lifelong condition. The reason is that attitude is easier to alter than physiology. “It’s often a shame thing,” says Wise, who has treated many patients as a sex therapist, “and once you give someone permission to explore their body, to masturbate and learn what feels good, they figure it out. After all, you have to learn how to play your own instrument before you can play in a band.”

Directed masturbation, introduced back in the 1970s by Julia Heiman, now director of the Kinsey Institute, and Joseph LoPiccolo, a sex researcher at the University of Missouri, has proved to be remarkably effective in the treatment of lifelong anorgasmia. The technique is much as it sounds—patients work with therapists on focused masturbatory activities during one-on-one sessions. “A ton of research shows that women who have never had an orgasm can learn how just by learning more about their sexual anatomy and how to explore their own bodies” Meston says, with directed masturbation succeeding for about 90 percent of participants. As early as 1978, for instance, a study led by researchers Alan J. Riley and Elizabeth J. Riley of the University of London found that 18 of 20 women were able to reach orgasm after following a directed masturbation program. Other studies have since shown similar success. Indeed, the greatest obstacle to an antidote for anorgasmia may be squeamishness about masturbating in the presence of a stranger.

Acquired anorgasmia could require a different kind of toolkit. Sometimes partner conflicts are to blame; they can often be resolved with communication and psychotherapy. But what
One day people may be able to fine-tune their own brain for a remedy. Komisaruk is optimistic that neurobiofeedback techniques will help in complex cases. In such a set-up, a person hooked up to an electroencephalogram or an fMRI would see real-time displays of brain activity and learn to self-regulate and correct the problem. “Let’s say we see that the genital sensory cortex response is normal but other areas down the line are not being activated,” Komisaruk says. “We may be able to coach those with anorgasmia to voluntarily activate [those areas] and move themselves toward orgasm.”

Biofeedback has proved effective in the treatment of conditions such as blood pressure regulation and anxiety and has even helped stroke patients regain function in paralyzed muscles. But given how much is still unknown about the timing and sequence of neural connections during orgasm, this kind of system remains an exciting possibility for another day [see “A Transparent, Trainable Brain,” by Heather Chapin and Sean Mackey; SCIENTIFIC AMERICAN MIND, March/April 2013].

Chemistry Matters

In the meantime, relief may come from intervention in our brain chemistry. Researchers studying animals and human patients have identified an array of neurochemicals that help to promote orgasm. Testosterone, a sex steroid, works its magic in the brain and the genitals, and although its role in female sexuality remains controversial, it is linked to feelings of both desire and arousal. Oxytocin, often called the “cuddle chemical,” is released by the paraventricular nucleus—a small cluster of cells in the brain’s hypothalamus—at the onset of climax. It then floods oxytocin receptors on cells in the nucleus accumbens, a reward center in the brain, and releases a glut of dopamine, a feel-good neurotransmitter, which delivers the pleasant rush that accompanies orgasm. To counter dopamine’s effects (and keep us from having too much of a good thing, which could interfere with the brain’s natural learning mechanisms or lead to addictive behaviors), the neurotransmitter serotonin and the protein prolactin act as brakes, resulting in feelings of satisfaction and relaxation after orgasm—although too much of either interferes with sexual response and may prevent orgasm from occurring.

Researchers of anorgasmia are now trying to fine-tune this natural pharmacopeia. One new female desire drug, Lybridos, under development by Dutch research firm Emotional Brain, consists of serotonin-inhibiting buspirone coated in testosterone. Preliminary results from a four-week trial conducted last year with 56 women who have hypoactive sexual desire disorder, or low libido, indicate that Lybridos may increase desire and orgasms more than a placebo or testosterone with a serotonin promoter.

Waguih W. IsHak, a psychiatrist specializing in sexual medicine at Cedars-Sinai Medical Center in Los Angeles, has successfully treated anorgasmia with oxytocin and Dostinex, an antiprolactin agent, in individual case studies. But IsHak expresses caution. Anorgasmia is more complicated than an imbalance in one or two chemicals—and tinkering with these natural systems may result in fixes that may be only temporary or that bring unwanted side effects. “These are innovative interventions,” IsHak says. “But they should be used only as a last resort after you’ve ruled out everything else.”

Patricia, who found her own visit to the clinic “massively unhelpful,” regained her ability to reach orgasm after about three years. Her nerve damage, the likely cause, healed over time. In the future, better understanding of the brain may help improve diagnosis and treatment for individuals like Patricia—showing which pathways are damaged and perhaps how to redirect them. Wise is cautious but hopeful: “In more complex cases of anorgasmia, we’re probably looking at a combination of psychological, social and biological factors. If we can figure out how they interact as we better map out what is happening in the brain during orgasm—perhaps identifying critical structures or processes in the timeline that push people from arousal over into orgasm—there’s the possibility we can do a lot more.”

And that’s an outcome many women are waiting for. M