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Don't Know What the Angular Gyrus Is? Your Heart Does

By Stephen Heyman Nov. 8, 2017



Stephanie Cacioppo, right, and her husband, John Cacioppo, who are both neuroscience researchers at the University of Chicago. Credit...Whitten Sabbatini for The New York Times

“For years, science has relegated our love to this basic instinct, almost like an addiction that has no redeeming value.”

These are not the words of some New Age evangelist preaching from the mount at a couples retreat in Arizona but of Stephanie Cacioppo, a neuroscientist at the University of Chicago who has spent much of her career mapping the dynamics of love in the brain. Her research and some of the theories she has developed put her at odds with other scientists who have described romantic love as an emotion, a primitive drive, even a drug.

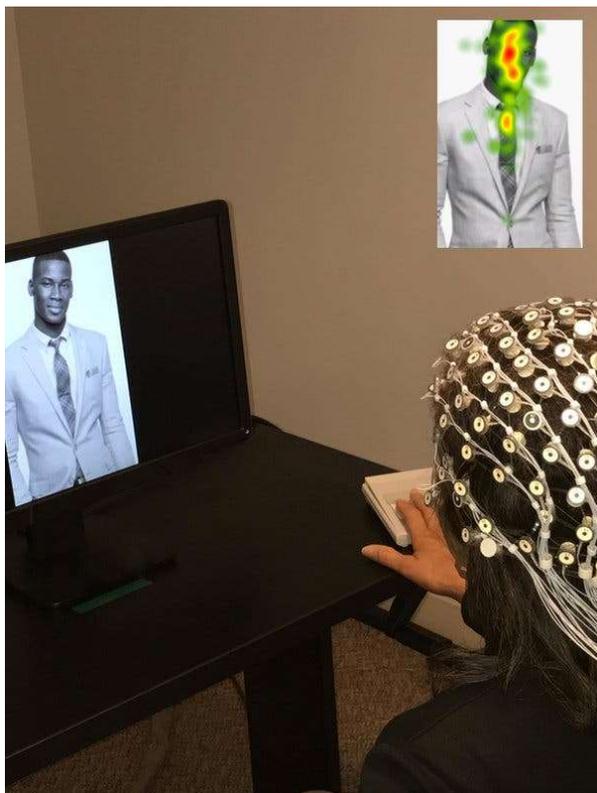
Using neuroimaging, Dr. Cacioppo has collected data that could suggest that this kind of love activates not only the emotional brain, but also regions that are involved in higher-level intellectual activities and cognition. “This means that it’s possible that love has a real function — not only to connect with people emotionally but also to improve our behavior,” she said.

Dr. Cacioppo attributes all kinds of mental and physical benefits to being in love. She says it can help you think faster, to better anticipate other people's thoughts and behavior, or to bounce back more quickly from an illness. "The empirical tests I've done in my lab suggest that, in many ways, when you're in love, you can be a better person," she said.

Talk to Dr. Cacioppo for long enough and you will be struck by how optimistic her views on traditional romance seem, especially in a world where divorce is commonplace, marriage rates are down, and polyamory and other forms of unconventional relationships are in the news.

While she acknowledges that many types of relationships can be healthy, she believes that we are all searching for a "true love" to complete us, that humans are hard-wired for monogamy and that there is indirect biological evidence for fairy-tale tropes like love at first sight.

Her parents were her very first case study. Growing up in the outskirts of Chambéry in the French Alps, she noticed how they would stare dreamily into each other's eyes or hold hands so often that their friends took to calling them "Les Amoureux de Peynet," after the love-struck couple depicted in the lithographs of the French illustrator Raymond Peynet.



In one experiment by Dr. Cacioppo and her team, subjects wore high-performance EEG head caps while looking at a stimulus on a monitor that was equipped with an infra-red eye-tracking system (not visible here). Heat maps illustrate a subject's eye movements. The study was designed to help differentiate responses to love and lust. Credit...Stephanie Cacioppo

“Watching them prepare a meal in the kitchen felt like watching a ballet,” Dr. Cacioppo said. “They always seemed to be in harmony, anticipating one another’s actions, finishing each other’s sentences.”

As a child, she thought the bond her parents enjoyed was almost magical, as if they had developed some kind of telepathic connection. She would later look closely at the biology behind such behavior, which in a sense is no less magical: how, she says, the brain’s [mirror neuron system](#) can help us predict what a spouse is going to do before he or she does it; how staring into each other’s eyes or holding hands increases levels of oxytocin, a neuropeptide that is sometimes called the “bonding hormone” because of how it increases our feelings of empathy and trust.

Her first formal breakthrough in the study of love came early in her career, when she was a postdoctoral researcher at Dartmouth College. In a series of experiments, she showed research subjects images and names of people — their significant others, along with random strangers and “neutral friends” — and used [functional M.R.I.](#) scanning techniques to see what sections of the brain lit up in response.

She used the data not only to sort out passionate, romantic love from more basic emotions (like happiness) and other types of love (like maternal, or unconditional), but also to identify 12 specific brain regions that were systematically activated by this version of love.

“What was fascinating to me was that I could see that love had its own brain signature, a kind of blueprint,” Dr. Cacioppo said. (Other emotions, like anger and disgust, according to many researchers, have similarly unique brain signatures.) Next, she attached electrodes to the heads of her subjects to see how quickly this “love network” was activated when subjects saw someone they loved. The result surprised her: “It took less than half a second, which is preconscious. So your brain already knows you love the person before you’re even aware of it.”

Of course, the often cold, sterile setting of a neuroscience lab is a vastly different environment from the real world, but these experiments allowed Dr. Cacioppo and her colleagues to pinpoint a specific area of the brain — the angular gyrus — that appears to be particularly sensitive to love. The more a participant reported feeling passionately in love, the more this region shifted into overdrive.

Located behind the ear, the angular gyrus is found only in apes and in humans, which means it developed relatively late in evolutionary history, and is connected to creativity and abstract thought. In fact, scientists who have studied Einstein’s brain found his angular gyrus [to be particularly enlarged](#) and theorize that it might have played some part in his genius.

Dr. Cacioppo likens the area to a “small robot in your head”: one that helps us process language and numbers and manages deep-seated, complex autobiographical data as well, like a person’s self-image and “theory of mind,” or the capacity to recognize and attribute mental states (like desires and thoughts) to oneself and to others.

Falling in love, according to Dr. Cacioppo, is an intense workout for the angular gyrus. “The way you make it stronger is by forming new associations — by learning, by traveling, by exploring

new concepts and cultures, and, yes, by being in love,” she said. “And because the angular gyrus is connected to so many different integrative parts of the brain, forming connections there can help you be smarter in situations that are not necessarily related to your significant other.”

She hopes her research will embolden people to have a more expansive view of the value of romantic love, instead of regarding it as just a mushy feeling sequestered in our private lives. “People have this misconception that, when you are in the first stages of love, you’re distracted and you won’t be focused at work, but I beg to differ,” she said. “Based on this science, we might want to hire people who are passionately in love because they’ll probably be more motivated and creative in their work.”

Love Versus Lust

Neuroscience involves a fair amount of detective work — following hunches, sifting through evidence, eliminating false leads. To get a better picture of how love works in the brain, Dr. Cacioppo needed to do more than identify the brain regions activated by love. She also had to disentangle love from its bedfellow: lust.

One area of the brain that offers clues about the relationship between romance and desire is called the insula, which is found deep in the cerebral cortex. The insula is divided into two parts: a smaller posterior insula (which registers pain, heat, sensual touch) and a larger anterior insula, which can help us make sense of these feelings and is thought to be involved in more abstract thought.

In her studies using functional magnetic resonance imaging, Dr. Cacioppo found that the posterior insula seemed to be more stimulated by feelings of lust, whereas the anterior insula was more stimulated by feelings of love. This research offered clues that the insula was involved in some powerful way in our ability to form and sustain loving relationships

But the fMRI results, while tantalizing, were hardly conclusive and were open to different interpretations. To test her hypothesis, Dr. Cacioppo needed more evidence.

One method neuroscientists use to test their theories is to look for people who have damage, whether through illness or other causes, to the specific regions of the brain they are examining. These case studies, often based on a single subject, are critical, said Dr. Cacioppo, because they represent such a “rare opportunity to address causation — rather than correlation — between a brain function and a behavior.”

Dr. Cacioppo and a team of colleagues tracked down a 48-year-old stroke patient in Argentina who had a brain lesion confined to the right anterior insula. The patient had not been aware of any changes to his capacity for love, but behavioral testing revealed he had a [selective deficit](#) — as compared to a control group — when making judgments about love. By contrast, no deficit was found for judgments about sexual desire. Some time after his stroke, the patient and his spouse divorced.



The Cacioppo's share the same office and even the same desk. "I wouldn't necessarily try this at home," John joked. Credit...Whitten Sabbatini for The New York Times

Rather than viewing sexual desire as the polar opposite of love, Dr. Cacioppo's research has led her to see the two states as existing on a spectrum. The more visceral sensations associated with lust can sometimes lead to deeper abstract feelings of love. "Strong sexual desire, when reciprocated and co-activated with love, can promote fidelity, lasting love and monogamy," she said.

Though love and lust are often complementary, Dr. Cacioppo cautions that one is not a prerequisite for the other and that these two complex feelings change very differently over time. While love can deepen, lust can fade, which may explain the results of a [2010 meta-analysis](#) showing that infidelity is prevalent in married couples.

Science Yields Results

While Dr. Cacioppo, 43, has devoted much of her academic life to love, for a long time she had very little personal experience with the phenomenon. She dated only sporadically through graduate school and never had a serious boyfriend.

"I was super-boring," she said. "I felt like I was married to my work." She thought she might never fall in love, until one day six years ago when, attending a research conference in Shanghai, she happened to be seated next to the University of Chicago social neuroscientist John T. Cacioppo.

Whereas her academic specialty was love, he was focused on the opposite end of the social spectrum: loneliness. They connected immediately, even if their initial conversations did not exactly signal a romantic future. “One of the most amazing early conversations we had was about how we would never get married,” Dr. Cacioppo said. “We lived for our research. We both thought relationships with other people were not important.”

This may seem like yet another example of clinicians not practicing what they preach. After all, research done by both these neuroscientists underlines the importance of forming human connections — and the potential damage of failing to do so. Data from one of John Cacioppo’s [studies](#) revealed that people suffering from loneliness are more likely to die prematurely.

But both researchers thought they were happy in their solitary academic lives and, in truth, neither actually *felt* lonely. “One of the secrets to a good relationship is being attracted to someone out of choice rather than out of need,” said John Cacioppo, 66. “We weren’t running from anything aversive. We were moving toward something that was really unique.”

At the time, he was in Chicago and she was at the University of Geneva in Switzerland, so they scheduled their first dates around international scientific conferences. After each encounter, it became more difficult to separate.

They married in 2011 during a small ceremony in the Luxembourg Gardens in Paris. Though Dr. Cacioppo had over 50 publications under her maiden name, Ortigue, she took her husband’s name and joined him on the faculty of the University of Chicago’s Pritzker School of Medicine, where she now directs the Brain Dynamics Laboratory.

There they lead an incredibly close existence, sharing the same office (“The Cacioppos” is written on the door) and the same desk. “I wouldn’t necessarily try this at home,” John joked, explaining that the synergy he and his wife enjoy is in no way typical of every passionate romance, and that what works for them won’t work for everyone.

An Unanticipated Challenge

A serious illness is a nightmare scenario for any couple, and the Cacioppos faced such an ordeal in 2015 when John was diagnosed with a rare and aggressive form of salivary gland cancer. He underwent surgery followed by seven 14-day treatment cycles of chemotherapy and radiation. He lost the ability to eat by himself and had to be fed through a tube for months.

The weaker he became, the more he and his wife leaned on each other. “As a couple, we became more united than ever,” Stephanie said. “We shared the same bed at the hospital, we walked together hand in hand in the tunnel to the high-intensity radiation treatment every day, and we strived to maintain our usual routine.”

Dr. Everett Vokes, the oncologist at the University of Chicago who treated John, said he was struck by their unusually close connection, which extended even to color-coordinating their outfits in the hospital.

“We have many patients where there’s a partner who’s involved, who’s supportive, sometimes even pushy, wanting the patient to get better,” he said. “But John and Stephanie really stood out. It felt almost as if I was treating two people.”

After surgery and the intense treatment regimen, Dr. Vokes and his colleagues were able to effectively cure John Cacioppo’s cancer, allowing him to return to full-time teaching and research.

For his wife the experience is a reminder of the capacity of love not just to expand our minds — as her research might suggest — but also, in some cases, to help heal our bodies. She cited recent studies showing that married people, compared with unmarried individuals, have fewer physical problems, suffer less from long-term illnesses, and have a lower mortality rate and better survival rate for some diseases, including some cancers.

Dr. Cacioppo emphasized that it’s not the type of relationship but its quality that accounts for these results. “Marital status — the fact of being ‘married’ — is neither necessary nor sufficient for these health benefits,” she said. “Rather it’s how connected or disconnected one partner feels from the other partner that plays the crucial role.”

Note: John Cacioppo [died unexpectedly](#) on March 5 at home in Chicago.

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