

Hands-on research: Neuroscientists show how brain responds to sensual caress

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A nuzzle of the neck, a stroke of the wrist, a brush of the knee—these caresses often signal a loving touch, but can also feel highly aversive, depending on who is delivering the touch, and to whom. Interested in how the brain makes connections between touch and emotion, neuroscientists at the California Institute of Technology (Caltech) have discovered that the association begins in the brain's primary somatosensory cortex, a region that, until now, was thought only to respond to basic touch, not to its emotional quality.

The new finding is described in this week's issue of the *Proceedings of the National Academy of Sciences (PNAS)*.

The team measured [brain](#) activation while self-identified heterosexual male subjects lay in a functional MRI scanner and were each caressed on the leg under two different conditions. In the first condition, they saw a video of an attractive female bending down to caress them; in the second, they saw a video of a masculine man doing the same thing. The men reported the experience as pleasurable when they thought the touch came from the woman, and aversive when they thought it came from the man. And their brains backed them up: this difference in experience was reflected in the activity measured in each man's primary somatosensory cortex.

"We demonstrated for the first time that the primary somatosensory cortex—the brain region encoding basic touch properties such as how rough or smooth an object is—also is sensitive to the social meaning of a touch," explains Michael Spezio, a visiting associate at Caltech who is also an assistant professor of psychology at Scripps College in Claremont, California. "It was generally thought that there are separate brain pathways for how we process the physical aspects of touch on the skin and for how we interpret that touch emotionally—that is, whether we feel it as pleasant, unpleasant, desired, or repulsive. Our study shows that, to the contrary, emotion is involved at the primary stages of social touch."

Unbeknownst to the subjects, the actual touches on their leg were always exactly the same—and always from a woman. Yet, it felt different to them when they believed a man versus a woman was doing the touching.

"The primary somatosensory cortex responded more to the 'female' touch than to the 'male' touch condition, even while subjects were only viewing a video showing a person approach their leg," says Ralph Adolphs, Bren Professor of Psychology and Neuroscience at Caltech and director of the Caltech Brain Imaging Center, where the research was done. "We see responses in a part of the brain thought to process only

basic touch that were elicited entirely by the emotional significance of social touch prior to the touch itself, simply in anticipation of the caress that our participants would receive."

The study was carried out in collaboration with the husband-and-wife team of Valeria Gazzola and Christian Keysers, who were visiting Caltech from the University of Groningen in the Netherlands.

"Intuitively, we all believe that when we are touched by someone, we first objectively perceive the physical properties of the touch—its speed, its gentleness, the roughness of the skin," says Gazzola. "Only thereafter, in a separable second step based on who touched us, do we believe we value this touch more or less."

The experiment showed that this two-step vision is incorrect, at least in terms of separation between brain regions, she says, and who we believe is touching us distorts even the supposedly objective representation of what the touch was like on the skin.

"Nothing in our brain is truly objective," adds Keysers. "Our perception is deeply and pervasively shaped by how we feel about the things we perceive."

One possible practical implication of the work is to help reshape social responses to touch in people with autism.

"Now that we have clear evidence that primary somatosensory cortex encodes emotional significance of touch, it may be possible to work with early sensory pathways to help children with autism respond more positively to the gentle touch of their parents and siblings," says Spezio.

The work also suggests that it may be possible to use film clips or virtual reality to reestablish positive responses to gentle [touch](#) in victims of

sexual and physical abuse, and torture.

Next, the researchers hope to test whether the effect is as robust in women as in men, and in both sexes across sexual orientation. They also plan to explore how these sensory pathways might develop in infants or children.

More information: “Primary somatosensory cortex discriminates affective significance in social touch,” by Valeria Gazzola et al. *PNAS*, 2012.

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