DEEP DIVE

How 'social touch' shapes autism traits

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Artwork by Cinyee Chiu and Edwin Tse

Even the slightest touch can consume **Kirsten Lindsmith**'s attention. When someone shakes her hand or her cat snuggles up against her, for example, it becomes hard for her to think about anything else. "I'm taken out of the moment for however long the sensation lasts," she says. Some everyday sensations, such as getting her hands wet, can feel like torture: "I usually compare it to the visceral, repulsive feeling you'd get plunging your hand into a pile of rotting garbage," says the 27-year-old autistic writer.

Stephanie Dehennin, an autistic illustrator who lives in Belgium, detests gentle touches but doesn't mind firm hugs. "I will feel actual rage if someone strokes me or touches me very lightly," she says. Dehennin seeks out deep pressure to relieve her stress. "I'll sit between my bed and my nightstand, for example — squeezed between furniture."

Strong reactions to touch are remarkably widespread among people who have autism, despite the condition's famed heterogeneity. "The touch thing is as close to universal as they come," says **Gavin Bollard**, an autistic blogger who lives in Australia and writes about his and his autistic sons' experiences. These responses are often described as a general hypersensitivity, but they are more complex than that: Sometimes autistic people crave touch; sometimes they cringe from it. For many people on the spectrum, these sensations are so intense that they take measures to shape their 'touchscape.' Some pile on heavy blankets at night for the extra weight; others cut off their clothing tags.

The common thread may be an altered perception of 'affective touch,' a sense discovered in people only a few decades ago. 'Discriminative touch' tells us when something impinges on our skin, with what force and where; affective touch, by contrast, conveys nuanced social and emotional information. The kinds of touch that autistic people may find loathsome, such as a soft caress, are associated with this latter system.

Research on affective touch is still nascent, but the idea that it is linked to autism is tantalizing, experts say. A growing number of studies indicate that affective touch is at least partly responsible for our ability to develop a concept of self, something long thought to **differ in people with autism**. Even newer is the idea that an atypical sense of affective touch may be one of autism's underlying causes.

"Maybe this is actually getting at a biological marker that gets us a better understanding of the causes of autism and, at the very least, a very early detection of autism," says **Kevin Pelphrey**, a neuroscientist at the University of Virginia in Charlottesville.

A sixth sense:

Despite the many anecdotes about an altered sense of touch in autistic people, quantifying the differences has proved difficult. In some experiments, autistic people notice a light pressure on their skin that their typical peers are oblivious to. But others show less sensitivity than or no real difference from controls. "There's all this clinical evidence around, but the actual empirical studies are confused," says **Carissa Cascio**, associate professor of psychiatry and behavioral sciences at Vanderbilt University Medical Center in Nashville, Tennessee.

One reason for this confusion is that not every study or clinical report distinguishes between affective and discriminative touch. Discriminative touch conveys signals about pressure, vibration and stretching of the skin. These signals shoot along thick ‘type A’ nerve fibers, or ‘afferents,’ at speeds of more than 200 miles per hour to the brain’s sensory regions. Affective touch signals, meanwhile, travel slowly via thinner ‘type C’ afferents and communicate pain, itch and temperature; the variety of type C nerve fibers that communicate touch — called C-tactile fibers — register in emotion centers in the brain.

C-tactile fibers respond only to specific kinds of touch. Researchers use a specialized technique called ‘microneurography’ to find the fibers and measure their activity. The method involves sticking an acupuncture-like needle deep into the skin, typically near the elbow, and then feeding in electrical pulses. As the needle gets closer to a nerve, less current is needed to evoke a tingling sensation. Once the needle is within the nerve, it can begin measuring the nerve’s electrical activity. The system is set up to have nerves produce clicks or light drumrolls on a loudspeaker whenever they fire. The C-tactile fibers crackle loudest when a participant is stroked lightly, no faster than a few inches per second, and at 32 degrees Celsius — the same temperature as human skin. Because the signals propagate slowly, the sound is delayed by about a half a second.

At first glance, these fibers seems pointless. They don’t help you hold a pencil or feel a vibrating phone. They are found only in skin that has hair — the face and the forearm, for instance — and not in fingertips, palms, soles or genitals, body parts we typically associate with touch. Yet studies show that they give physical contact its emotional timbre; they relay the warm feelings that can come with a friend’s caress, for example, or the icy shivers that can follow a brush with a stranger.

In this way, the fibers serve as a mode of communication between people, a channel not of physical information but of intimacy. “These fibers are signaling something that isn’t really touch; it’s something we don’t have a name for,” says **Håkan Olausson**, professor of clinical neuroscience at Linköping University in Sweden, who co-discovered the fibers in people in the 1980s. (For lack of a better word, he still calls it touch.)

> “When I shake a person’s hand, I feel as though a part of myself is commandeered by their touch.” Kirsten Lindsmith

Olausson and others owe much of what they have learned about affective touch to a woman known in the medical literature as ‘**Patient G.L.**’ In April 1979, this woman checked into a hospital in Montreal with Guillain-Barré syndrome, a rare autoimmune disorder that attacks muscle and sensory neurons. In her case, it had destroyed her type A nerve fibers but spared her type C’s.

She was left with the tactile equivalent of ‘blindsight’: Although she no longer felt contact, motion or pressure against her skin, she could still have an emotional reaction to being touched. It was an early clue that these nerve fibers carry emotional freight.

To confirm the idea, Olausson and his colleagues turned to brain imaging. In 2002, they scanned G.L. as they touched her skin. Their actions **evoked no response** in her somatosensory cortex, which ordinarily receives input from type A fibers, but her emotion-processing posterior insula did react. She reported feeling a faint, hard-to-place, pleasant sensation. In recent years, her brain seems to have compensated for her lost sense of discriminative touch by repurposing her affective-touch system. “When we last met about a year ago, she said that she has started to feel touch sensations in daily life — for example, when she puts on her stockings,” Olausson says.

His team has collected additional evidence linking type C nerve fibers to emotional communication by studying about 20 members of a community in remote northern Sweden. These individuals all share a congenital loss of these fibers — in a sense, the inverse of G.L.’s condition. In a study of five of the people, they showed no activity in the insula in response to skin stroking and rated the sensation as **less pleasant** than controls did. In some ways, their experience of touch might resemble that of autistic people, although there is no evidence that autism is particularly prevalent in this community.

Even when both touch systems are intact, social context can dampen or amplify our perception of affective touch. In a study published in February, researchers scanned the brains of 27 neurotypical adults. When a lab assistant stroked the participants’ forearms, social areas of their brains, such as the superior temporal gyrus, lit up with activity. When the participants stroked their own arms, those regions showed no change in activity — which is to be expected because the task is not social. What was unexpected was that the participants’ basic sensory-processing areas also stayed silent. In stroking their own arms, they had desensitized that part of their body to touch in general.

In a companion study, the team also tested people’s touch sensitivity by poking their forearms with von Frey fibers — plastic hairs that deliver a calibrated force — while a lab assistant stroked their arms or the participants stroked a pillow or themselves. The pillow had no effect on the participants’ sensitivity to touch: They felt the von Frey fibers just as they would if they weren’t being stroked at all. By contrast, when a lab assistant stroked the participant — a social gesture — the researchers had to poke the participant’s arm harder with the von Frey fibers for the touch to be felt. They had to apply an even stronger force when the participants stroked their own arms. “Touching your own arm numbs this area,” says lead investigator **Rebecca Boehme**, a researcher also at Linköping. Together, these results suggest that the affective touch system is **tuned to recognize human contact** and to differentiate self from other.

Sensing the self:

To many researchers, the affective touch system suggests a compelling mechanism at autism's roots. Touch is one of the dominant modes of perception and social interaction in the earliest weeks and months of a baby's life. "A whole lot of your world is coming to you through caregiver touch — there's a whole lot of cuddling, cradling, rocking," Cascio says. If babies' perceptions of these touches are altered in some way, it could transform how they situate themselves in the world and learn to interact with others. Those changes, in turn, could account for autism's hallmark social challenges.

Most researchers interviewed for this article subscribe to some version of this idea but admit it is still tentative. "We really don't have strong evidence for it yet," Cascio says. What evidence they do have falls somewhere along a three-link chain of logic.

The first link is the observation that affective touch seems crucial for delineating our sense of 'self.' To explore that idea, some researchers have turned to the 'rubber-hand illusion,' in which an experimenter strokes a participant's hand and a stuffed rubber glove at the same time until the participant mistakes the fake hand for her own. In typical people, the illusion is strongest when the stroking speed and textures involved elicit the peak response of C-tactile fibers. "You make an almost unconscious-to-the-individual change, and that makes a big change in their perception," says **Aikaterini Fotopoulou**, a cognitive neuroscientist at University College London.

Yet another hint that affective touch is important to self-definition comes from people who have had a stroke and feel one of their arms is not their own. In a study of seven people who lost the ability to recognize their left arm, Fotopoulou and her colleagues stroked that arm to activate the participants' C-tactile fibers. The participants then reported reconnecting with their 'lost' limbs. "They start saying things like, 'Well, after you touched it, I said to my arm: Come, I welcome you back,'" Fotopoulou says.

The second link is more theoretical: If affective touch can redraw a person's boundaries such that they mistake a fake hand for their own, perhaps it is responsible for drawing those boundaries to begin with. This link in the chain holds that our entire sense of body ownership may be one grand rubber-hand illusion imparted from all that cuddling we got as babies. "I put my leg there, or my fingers there, and then there is a response. I say, 'Oh, that's me,'" says **Anna Ciaunica**, a philosopher of mind at University College London who works with Fotopoulou.

The third link connects these two ideas to autism. Cascio and others have found that autistic people are less susceptible to the **rubber-hand illusion** than neurotypical people are, suggesting their sense of self is somehow less flexible. That rigidity might explain the strong response many of

them have to touch. “If you have a very clear border of your own body, then of course everything else that touches you will bother you,” Boehme says. Many autistic people also say they relate their feelings about touch directly to their sense of self. Kirsten Lindsmith has **written about this** in her blog: “When I shake a person’s hand I feel as though a tiny part of myself — my awareness, my consciousness, my identity — is commandeered by their touch, and I no longer feel fully autonomous.” Dehennin also says she experiences that sensation: “I often feel like I’m not ‘in’ my body; deep pressure helps that.”

Several imaging studies also suggest that autistic people have an altered sense of affective touch. In 2012, for example, Cascio led a series of experiments in which a lab assistant stroked autistic and typical adults’ forearms with a soft cosmetics brush, bumpy burlap or scratchy plastic mesh. Both groups described each texture much in the same way, but brain imaging revealed that they **processed the sensations differently**: The autistic group showed more activity than controls in brain regions associated with discriminative touch and less in those associated with affective touch.

Most interesting, Cascio says, was that burlap in particular lit up social brain regions in the controls, even though burlap has no obvious social significance. She interprets this activity as subconscious deliberation — that is, the burlap touch could be considered positive or negative depending on social cues. “We’re seeing processing in those regions that would make us think that they’re trying to figure out how pleasant or unpleasant it feels,” she says. The social brain areas of autistic participants, however, don’t seem to show this internal deliberation. Or if they do, as Cascio’s newer work suggests, they do so after a delay.

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In another experiment, autistic people and controls both said they liked the sensation of being stroked rhythmically on the arm or hand with a watercolor paintbrush. “A lot of the field would be like, ‘Well, that’s kind of a dead end; maybe touch isn’t affected in autism,’” says Pelphrey, one of the researchers. But brain scans again showed clear distinctions between the groups. Stroking the forearm, rich in type C afferents, lit up social brain areas in the controls, but stroking the palm, which contains predominantly type A nerve fibers, had no such effect. In autistic participants, location didn’t matter; their social brain activity remained at a constant level in between the extremes shown by the typical participants. “Individuals with autism showed the middle response for everything,” Pelphrey says.

Autistic people also appear to **process pain differently**, reflecting possible differences in their type C nerve fibers. In 2017, Cascio's lab affixed a small heating pad, about 1 inch in diameter, to the calves of autistic and neurotypical volunteers. They then brought the temperature to an agonizing 49 degrees Celsius for 15 seconds. (The pad was not hot enough to burn the skin.) Both groups rated the pain 7 out of 10. But once again brain imaging offered a nuanced picture. In brain areas that respond to pain, such as the anterior cingulate cortex, insula and thalamus, the reaction in the neurotypical people lasted 30 seconds, lingering after the heat was removed. In autistic people, it abated after only 10 seconds, even though heat was still being applied. "It really looks like, when you look at the data, that something's turning the pain response off," Cascio says.

Connecting the dots:

What all this experimental evidence means is still unclear, apart from generally confirming that, in autistic people, something unusual goes on in type C nerve fiber activity and touch perception. Whatever differences exist appear to be present from early in life. Parents often recall that their autistic children, as babies, recoiled from contact and avoided being picked up. "Human beings respond to the act of being picked up either by fighting back or by becoming rigid in ways that actually help you to pick them up," Pelphrey says. But babies who go on to be diagnosed with autism often do neither, which can make them feel curiously heavier than they are, he says.

His team is investigating whether unusual touch sensitivity in infants can predict a later autism diagnosis. They are testing '**baby siblings'** of children with autism, who are at an increased risk of being diagnosed with the condition. The researchers plan to record the babies' response — at 3, 6, 9 and 12 months of age — to touch on their palms and forearms, looking for differences in their senses of discriminative and affective touch, respectively. "We can hopefully develop something that will serve as a screener," Pelphrey says.

Other researchers are working on more sophisticated approaches to study touch in older children and adults with autism. They have their work cut out for them. The emotional quality of touch is difficult to measure, in part because it depends on more than just physical stimulus. Type C nerves are not yet fully understood. And simply asking people how they feel can mask important features of touch perception.

Researchers will also need to consider how differences in affective touch fit into the broader experience of being autistic. Layered on top of the raw sensations are cultural norms about touch, which vary and can make social situations fraught for people with the condition. A flinch can be read as a rebuff, a declined handshake as disinterest. Many autistic people say they learned as children to suppress their feelings about touch in order to conform to typical expectations — something that leaves them vulnerable to abuse. "'No' was trained out of us," says Ashley Smith-

Taylor, an autistic self-advocate and mother of four neurodiverse children.

Also hanging over the field is an old theory known as the **'refrigerator mother' hypothesis**. From the 1940s into the 1960s, psychologists attributed autism to parents who made no effort to connect with their children emotionally, including cuddling them. "There was this tendency to blame parents, and particularly mothers," Cascio says. She and others stress that if autism does originate in the sense of touch, it arises from deep in the nervous system and is entirely unrelated to nurture. It may also begin in the womb. During the first and second trimester, the fetus is covered by 'lanugo hair' that may stimulate the type C nerve fibers in utero; at this stage of development, these fibers provide our first sensory input. "That input, according to my theory, is basically the process which is beginning to let that developing brain know it's got a body," says **Francis McGlone**, professor of neuroscience at Liverpool John Moores University in the United Kingdom.

McGlone admits that there is no solid evidence that connects autism to a dearth of affective touch early in life, but he isn't waiting for it, either. He is developing a device that could be placed into incubators to stimulate type C nerve fibers in preterm infants. "The C-tactile afferent is the Higgs boson of the social brain. It's the missing particle that socializes the developing brain. It brings everything else together," he says. His invention could be useful for many children — even if it turns out that affective touch has little to do with autism's origins.