Voices may not trigger brain's reward centers in children with autism, research shows

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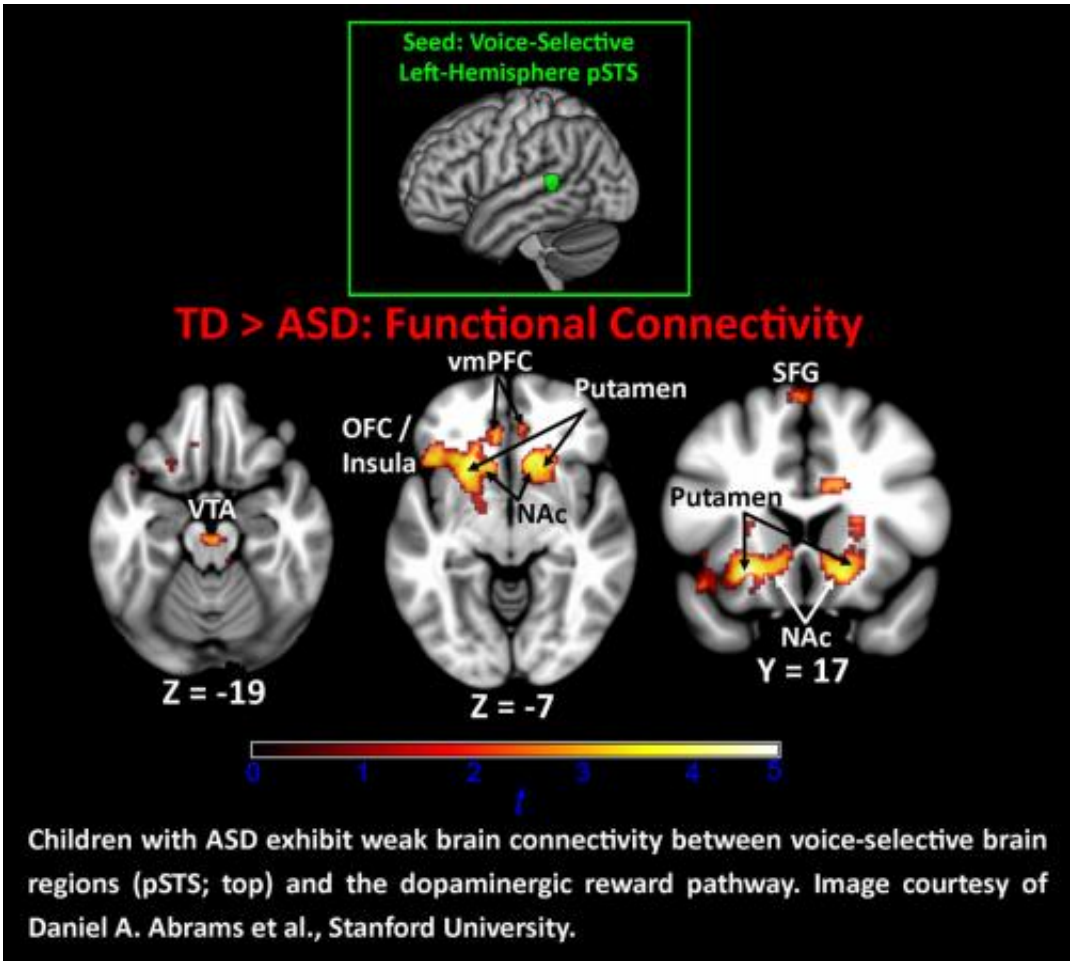

Brain scans of children with ASD showing weak connections between voice-selective regions and reward pathways. Credit: Daniel A. Abrams, Stanford University.

In autism, brain regions tailored to respond to voices are poorly connected to reward-processing circuits, according to a new study by scientists at the Stanford University School of Medicine.

The research could help explain why children with autism struggle to grasp the social and emotional aspects of human speech. "Weak brain connectivity may impede children with autism from experiencing speech as pleasurable," said Vinod Menon, PhD, senior author of the study, which will be published online June 17 in *Proceedings of the National Academy of Sciences*. Menon is a professor of psychiatry and behavioral sciences at Stanford and a member of the Child Health Research Institute at Lucile Packard Children's Hospital.

"The human voice is a very important sound; it not only conveys meaning but also provides critical emotional information to a child," said Daniel Abrams, PhD, a postdoctoral scholar in psychiatry and behavioral sciences who was the study's lead author. Insensitivity to the human voice is a hallmark of autism, Abrams said, adding, "We are the first to show that this insensitivity may originate from impaired reward circuitry in the brain."

The study focused on children with a high-functioning form of autism. They had IQ scores in the normal range and could speak and read, but had difficulty holding a back-and-forth conversation or understanding emotional cues in another person's voice.

The scientists compared functional magnetic resonance imaging brain scans from 20 of these children with scans from 19 typically developing children, paying particular attention to a portion of the brain that responds selectively to the sound of human voices. Prior research has shown that adults with autism had low voice-selective cortex activity in response to speech. But until this study by Menon and his colleagues, no one had looked at connections between the voice-selective cortex and

other brain regions in individuals with autism.

The new study found that in children with a high-functioning form of autism, the voice-selective cortex on the left side of the brain was weakly connected to the nucleus accumbens and the ventral tegmental area - brain structures that release dopamine in response to rewards. The voice-selective cortex on the right side of the brain, which specializes in detecting vocal cues such as intonation and pitch, was weakly connected to the amygdala, which processes emotional cues.

The weaker these connections in children with autism, the worse their communication deficits, the study showed. The researchers were able to predict the children's scores on the verbal portion of a standard test of autism severity by looking at the degree of impairment in these brain connections.

The findings may help to validate some autism therapies already in use, said co-author Jennifer Phillips, PhD, a clinical associate professor of psychiatry and behavioral sciences at Stanford who also treats children with autism at Packard Children's. For instance, pivotal-response training aims to increase social use of language in children who can speak some words but who usually do not talk to others.

"Pivotal-response training goes after ways to naturally motivate kids to start using language and other forms of social interaction," Phillips said. Future studies could test whether brain connections leading from voice to reward centers are strengthened by autism therapies, she added.

The findings also help resolve a long-standing debate about why individuals with autism show less-than-normal interest in human voices. The team investigated two competing theories to explain the phenomenon: that individuals with autism have a deficit in their social motivation, or, alternatively, that they have sensory-processing deficits

which impair their ability to fully hear human voices. The new study found normal connections between voice-selective cortex and primary auditory brain regions in children with high-functioning autism, suggesting that these children do not have sensory-processing deficits.

The next steps for researchers include studying the consequences of the weak voice-to-reward circuit in autism. "It is likely that children with autism don't attend to voices because they are not rewarding or emotionally interesting, impacting the development of their language and social communication skills," Menon said. "We have discovered an aberrant brain circuit underlying a core deficit in autism; our findings may aid the development of new treatments for this disorder."

More information: Underconnectivity between voice-selective cortex and reward circuitry in children with autism, www.pnas.org/cgi/doi/10.1073/pnas.1302982110

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