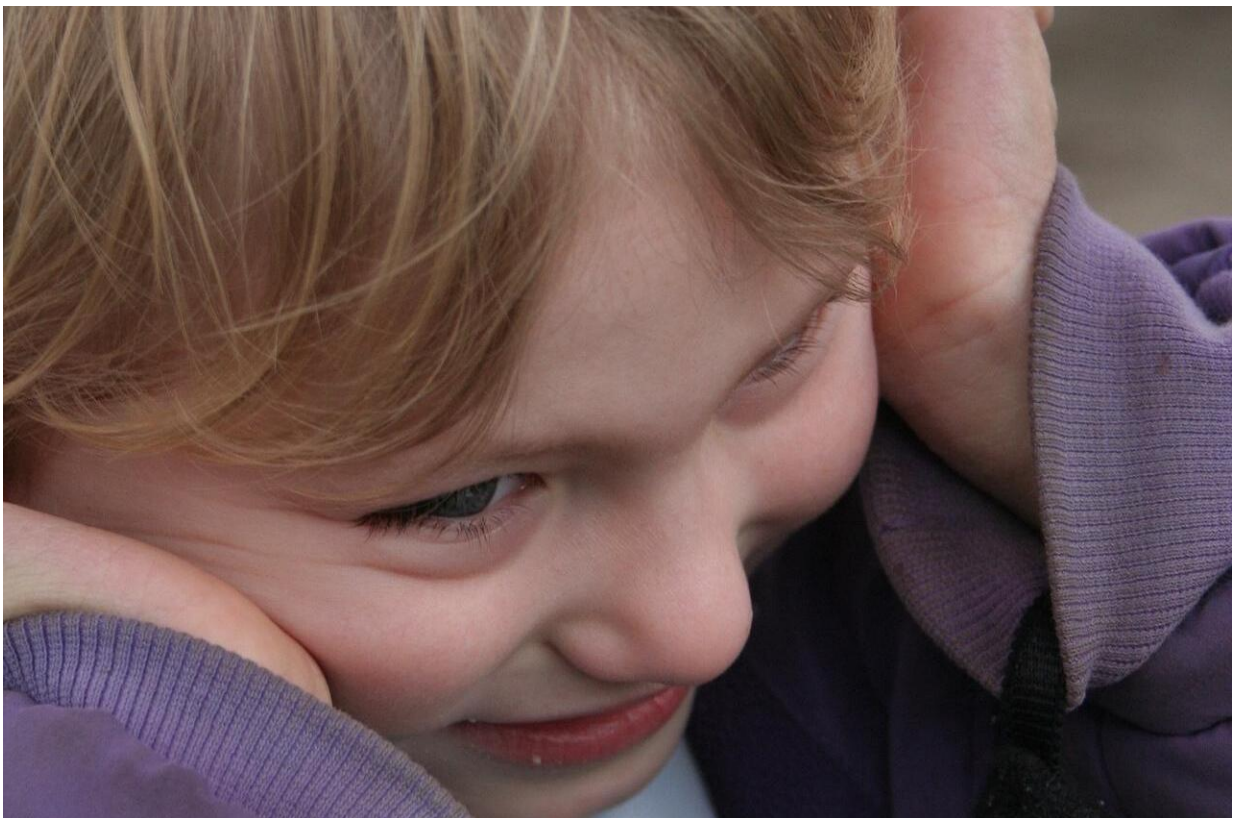


Research compares neural activity in children with and without autism spectrum disorder

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Pick a hand, any hand. That familiar refrain, repeated in schoolyards the world over, is the basis of a simple guessing game that was recently

adapted to study how and why kids with autism spectrum disorder (ASD) interact with the people around them.

The game is the brainchild of Katherine Stavropoulos, an assistant professor of special education in the Graduate School of Education at the University of California, Riverside. As a licensed clinical psychologist with a background in neuroscience, Stavropoulos looks closely at electrical activity in the brains of children with ASD and typical development, or TD, to discern differences in the respective groups' reward systems.

Historically, clinicians and scientists have proposed a variety of theories to explain why kids with ASD tend to be less socially communicative than their TD peers. One popular theory, the social motivation hypothesis, suggests that kids with ASD aren't intrinsically motivated to interact with other people because they aren't neurologically "rewarded" by social interactions the same way TD kids are.

"Most of us get a hit of dopamine when we interact with other people, whether it's through making eye contact or sharing something good that's happened to us—it feels good to be social," Stavropoulos said. "The social motivation hypothesis says kids with autism don't get that same reward from [social interaction](#), so they don't go out of their way to engage with people because it's not rewarding for them."

A second theory, sensory over-responsivity—also known as the overly intense world hypothesis—posits that because kids with ASD interpret sensory cues more intensely than their TD peers, those with ASD tend to shy away from interactions they perceive as overwhelming or aversive.

"Kids with autism often find noises too loud or lights too bright, or they find them not intense enough," Stavropoulos said. "Most of us wouldn't want to talk to someone whom we perceive as screaming, especially in a

room that was already too bright, with ambient noise that was already too loud." Instead, sensory over-responsivity argues, such interactions compel many individuals with ASD to withdraw from socialization as a self-soothing behavior.

But according to Stavropoulos, who also serves as assistant director of UCR's SEARCH Family Autism Resource Center, it may be possible for these seemingly competing theories to exist in tandem.

Stavropoulos and UC San Diego's Leslie Carver, her research colleague and former graduate advisor, used electrophysiology to study the neural activity of 43 children between the ages of 7 and 10—23 of whom were TD and 20 of whom had ASD—during a guessing game-style simulation that provided participants with both social and nonsocial rewards. Their results, published this week in the journal *Molecular Autism*, provide a glimpse at the brain mechanisms behind autism.

Wearing a cap outfitted with 33 electrodes, each child sat before a computer screen showing pairs of boxes containing question marks. Much like the format of the "pick a hand" guessing game, the child then chose the box he or she thought was the "right" one (in reality, the answers were randomized).

Stavropoulos said it was crucial to design a simulation that would allow the researchers to study participants' neural reactions to social and nonsocial rewards during two stages: reward anticipation, or the period before the child knew whether he or she had chosen the correct answer, and [reward processing](#), or the period immediately after.

"We structured the game so that the kids would pick an answer, and then there would be a brief pause," Stavropoulos said. "It was during that pause that the kids would begin to wonder, 'Did I get it?' and we could observe them getting excited; the more rewarding something is to a

person, the more that anticipation builds."

Each participant played the game in two blocks. During the social block, kids who chose the right box saw a smiling face and kids who chose the wrong box saw a sad, frowning face. During the nonsocial block, meanwhile, the faces were scrambled and reformed in the shapes of arrows pointing up to denote correct answers and down to denote incorrect ones.

"After the kids saw whether they were right or wrong, we were then able to observe the post-stimulus reward-related activity," Stavropoulos said of the process, which involved comparing participants' neural oscillation patterns. The researchers gleaned several key findings from the simulation:

- TD kids anticipated social awards—in this case, the pictures of faces—more strongly than kids with ASD.
- Not only did children with ASD anticipate social rewards less than their TD peers, but within the ASD group, the researchers found that kids with more severe ASD were anticipating the nonsocial rewards, or the arrows, the most.
- During reward processing, or the period after participants learned whether they had chosen the right or wrong box, the researchers observed more reward-related brain activity in TD children but more attention-related brain activity among children with ASD, which Stavropoulos said may be related to feelings of sensory overload in kids with ASD.
- Among the autism group, meanwhile, kids with more severe ASD also showed heightened responsiveness to positive social feedback, which Stavropoulos said may indicate hyperactivity, or the state of being overwhelmed by "correct" social feedback that is commonly associated with sensory over-responsivity.

Stavropoulos said the duo's results provide support for both the social motivation hypothesis and the overly intense world hypothesis.

"Kids with autism might not be as rewarded by social interactions as typically developing kids are, but that doesn't mean their reward systems are entirely broken," she added. "This research makes the case for developing clinical interventions that help children with autism better understand the [reward](#) value of other people—to slowly teach these kids that interacting with others can be rewarding.

"But, it is critical to do this while being sensitive to these kids' sensory experiences," she continued. "We don't want to overwhelm them, or make them feel sensory overload. It's a delicate balance between making social interactions rewarding while being aware of how loudly we speak, how excited our voices sound, and how bright the lights are."

Provided by University of California - Riverside

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