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Researchers to explore movement signatures for detecting learning disability in children with autism

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An Indiana University physicist and neuroscientist who studies how physical movement can be used to detect autism in children and adults has received support from the National Science Foundation. The $750,000 NSF grant to IU scientist Jorge V. José and collaborators will be used to apply analytical methods pioneered at IU and Rutgers University toward diagnosing, and possibly treating, a wider range of learning disabilities.

The study, titled "Learning to Move and Moving to Learn," will measure the fine-grained movement of the body, face and eyes in middle- and high-school-age children to reveal measureable signs of learning disability. These methods could represent a powerful new tool for educators and physicians who often depend upon highly subjective methods -- such as conversations with parents and classroom observation -- to identify children who require assistance in learning.

The grant is part of NSF's Collaborative Networks for Learning program, which supports the establishment of research partnerships that advance knowledge on learning to address national challenges such as improving educational outcomes and strengthening workforce development.

Collaborators on the project are grant leader Leanne Chukoskie and co-leader Joseph Snider of the Institute for Neural Computation at the University of California, San Diego, who are experts in neuroscience and computer science. Other project partners include Elizabeth Torres at Rutgers University, Emo Todorov at the University of Washington and Terrence Sejnowski at the Salk Institute.

"By pooling our expertise to study movement signatures in children who experience learning difficulties in school, this study will develop new quantitative methods to detect learning disorders like ADHD, autism spectrum disorder and dystonia," said José, Distinguished Professor in the College of Arts and Sciences' Department of Physics.

Previous research by José, Torres and John Nurnberger at the IU School of Medicine found the first evidence that the analysis of bodily movement could reveal physically measureable signs, or "biomarkers," of autism spectrum disorder. The UC San Diego team members are experts in applying movement tracking to detect many other types of learning disorders, including autism. The study will also benefit from sophisticated movement detection technology at UC San Diego, which is capable of precisely tracking both physical movement and facial expression with extreme precision.

"The research team at UC San Diego is excited to partner with Dr. José in understanding how fine-scale differences in movement map onto differences in learning ability in children," Chukoskie said. "His expertise in novel mathematical analyses for characterizing movement will be central to this project. We expect that our collaboration will produce a novel and productive perspective for understanding learning disorders, including how we evaluate and treat them."

José's background as a physicist and neuroscientist will enable his lab to provide this mathematical modeling, based in large part upon his previous work on movement and autism.

"We're providing some highly advanced, extremely powerful quantitative methods to separate the physiologically significant 'signal' from the 'noise' in terms of the body's movement," José said.

He added that physical movements, like the ability to point quickly and accurately, can act as an indicator for learning disorders since physical movement is a learned behavior -- the same as learning to speak or read. In typically developing children, infants transition from uncontrolled movement to relatively sophisticated tasks such as tidying up a room or tying shoes by about age 4 or 5.

But children with learning disabilities can struggle to acquire these and other more basic skills -- such as moving their finger through space in a straight line.

"The difference between typically developing children and the children with autism spectrum disorder is that the latter group of children never completely

transition to fully controlling their movements," José said. "In our previous tests in autistic children, they never learn to control their movement with the same precision."

The data to be analyzed at IU under the new NSF-funded study will be collected at UC San Diego from middle- and high-school-age students with learning disabilities, as determined by a widely accepted educational assessment survey. These students will be asked to undertake a series of tasks while their body, face and eye movements are tracked using extremely sensitive sensor technology. For example, they may be asked to point to specific shapes on a screen filled with rapidly moving geometric forms. As the number and variety of forms increase, the challenge grows increasingly difficult.

The most extreme form of this test is "Where's Waldo," Jose said, noting that even typically developed adults struggle to identify a specific form -- such as Waldo -- when surrounding distractions are exceedingly complicated.

Fortunately, other studies have shown that the motor cortex -- the part of the brain responsible for the movement -- is also one of the most trainable parts of the brain, José said. So, in addition to tracking how movement reveals learning disabilities, the new project will also explore how this part of the brain, and general mental plasticity, can be used to improve cognitive functioning in children.

"Our joint work will set the stage to use this mental plasticity as a lever to improve cognitive functioning," José said. "Ultimately, our aim is that this work can be used to improve the chances that children who require early intervention due to learning disorders are more likely to get the assistance they need very early in their educational careers."

Source:

Indiana University