New model of cognitive flexibility gives insight into autism spectrum disorder

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Quinn, an autistic boy, and the line of toys he made before falling asleep. Repeatedly stacking or lining up objects is a behavior commonly associated with autism. Credit: Wikipedia.

Cognitive flexibility is the ability to shift our thoughts and adapt our behavior to the changing environment. In other words, it's one's ability to disengage from a previous task and respond effectively to a new one. It's a faculty that most of us take for granted, yet an essential skill to

navigate life.

In a new paper published in the journal *Trends in Neurosciences*, University of Miami (UM) College of Arts & Sciences researchers clarify many of the concepts surrounding cognitive flexibility and propose a model of its underlying neural mechanisms. The new model may be instrumental in understanding behavioral and neurological disorders, such as autism spectrum disorder.

"By understanding how the brain attempts to implement cognitive flexibility in a neurodevelopmental disorder like autism, we can better understand the nature of the disorder," said Dina R. Dajani, Ph.D. student of psychology in the UM College of Arts & Sciences and first author of the study. "The model will inform whether we should try to teach individuals with autism the strategies utilized by typically developing individuals, or instead improve upon already existing strategies of individuals with the disorder."

For instance, knowing if there is a simple increase or decrease in connectivity between brain regions compared to healthy individuals, or whether those with autism use entirely different brain regions to implement cognitive flexibility will enable researchers to better design interventions to improve cognitive flexibility skills.

The more cognitive flexibility an individual has, the greater his or her chances of doing well in life. Previous studies have shown that greater cognitive flexibility relates to better reading abilities as a child, resilience as an adult, and quality of life in the advanced years.

"Our goal was to summarize and provide directions for future research on a topic that is relevant for understanding several prevalent developmental disorders," said Lucina Q. Uddin, assistant professor of psychology in the UM College of Arts & Sciences, principal investigator

of this study and co-author of the paper. "We believe that a better understanding of the neural systems mediating this critical ability will help clinicians design more effect treatments to help individuals who have difficulty with flexible behaviors in daily life, particularly those with autism."

In the paper, the researchers analyzed the existing literature and neuroimaging studies on cognitive flexibility and put forth a hypothesis regarding the fundamental neural mechanisms of this important faculty. The researchers suggest four components that work together to implement cognitive flexibility: salience detection/attention (both achieve similar goals to direct attention to behaviorally relevant events), working memory, inhibition and switching.

If their model is validated, it will provide a strong foundation for researchers to use as a basis in determining what may be wrong in individuals with impaired cognitive flexibility.

"Our concept is quite different from other conceptualizations of cognitive flexibility because we describe it as arising from four separate cognitive operations, whereas other researchers have described it as a manifestation of a single cognitive operation," Dajani said. "This novel hypothesis may help our understanding of this complex ability."

The title of the study is "Demystifying cognitive flexibility: Implications for clinical and developmental neuroscience." The researchers are now using functional neuroimaging to test the "four components" cognitive flexibility hypothesis.

Provided by University of Miami

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