

Training by repetition actually prevents learning for those with autism

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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.

Individuals with autism spectrum disorder (ASD) sometimes acquire a new behavior or skill only in a specific context, but they have difficulty transferring that learned skill or information to a new context.

For example, children with autism can be taught what a dog is by showing them a picture of a dog and repeating the word "dog" over and over. But, when they are then taught what a cat is or even shown another type of dog, the previous knowledge does not transfer, and they have to learn this information from scratch.

A new study published in *Nature Neuroscience* shows that training individuals with ASD to acquire new information by repeating the information actually harms their ability to apply that learned knowledge to other situations. This finding, by an international research team, challenges the popular educational approaches designed for ASD individuals that focus on repetition and drills.

"There have been few systematic investigations into the fundamental mechanisms by which information is acquired by ASD individuals - and into the potential reasons for their restricted, atypical [learning](#)," said Marlene Behrmann, the Cowan Professor of Cognitive Neuroscience at Carnegie Mellon University and a faculty member in the Center for the Neural Basis of Cognition (CNBC). "This study begins to scratch the surface of the phenomenon."

Using a computer screen, high-functioning ASD adults and control participants were trained to find the location of three diagonal bars surrounded by horizontal lines. Both groups were asked to identify the diagonal bars during eight daily practice sessions and their speed and accuracy were measured. The bars stayed in the same location for the first four days and were moved to a second location in the display for days five through eight.

"It was crucial to set up the experiment this way so that we could initially observe the learning in the ASD individuals in a simple, well-established task but then also document the difficulty in transferring the knowledge as the experiment progressed," said Dov Sagi of the Weizmann Institute

of Science.

The results showed that for the first four days - with the diagonal bars in the first location - learning was equivalent for the ASD and control groups. However, once the location of the diagonal bars changed, there was a substantial difference. The control group smoothly transitioned to learning the new location and their performance continued to improve.

In contrast, the individuals with autism performed poorly when the target location was changed and they were not able to improve their performance, indicating that they received no benefit from initially learning the first location. Even more interesting, they were never able to learn the second location as well as the first, demonstrating an interference in learning that may reflect the consequences of extensive repetition.

"It's like they showed 'hyperspecificity' of learning - their learning became fixed and inflexible - since learning the first location adversely influenced their ability to learn the second instance," said Hila Harris, the study's lead author from the Weizmann Institute.

Next, the researchers looked for ways to circumvent the hyperspecificity. With a new group of ASD adults and controls, they ran the exact same experiment, but this time they occasionally inserted "dummy" screens that did not contain any diagonal bars.

This time, when the location of the bars changed on the fifth day, the ASD group efficiently learned the new [location](#).

"Our conclusion is that breaks in repetition allow the visual system some time to rest and allow autistic individuals to learn efficiently and to then generalize," said New York University's David Heeger. "Repeated stimulation leads to sensory adaptation which interferes with learning

and makes learning specific to the adapted conditions. Without adaptation, learning is more efficient and can be generalized."

The research team believes that the findings have important implications for educating individuals with autism.

"Individuals with autism need to be taught in ways that support or promote generalization rather than in ways that reinforce over specificity," said Nancy Minshew, professor of psychiatry and neurology at the University of Pittsburgh and in the joint CMU-Pitt CNBC. "For example, in the context of learning what a dog is, using a full range of examples of dogs - and even of animals, more generally - incorporates variability from the beginning and promotes learning a broad concept rather than a specific example."

More information: *Nature Neuroscience*,
[nature.com/articles/doi:10.1038/nn.4129](https://doi.org/10.1038/nn.4129)

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