Does the Brain Work the Same Way

for All Autistic People?

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Visual Perception in People with Autism

Visuospatial skills are a person's ability to perceive and analyze the objects and environment around them, in both two- and three-dimensions. For example, we use these skills when drawing or parallel parking. In fact, they are considered an important component of human intelligence.

Numerous studies have shown that autistic people have visuospatial skills superior to neurotypical people. Autistic people often perform better in tasks requiring them to mentally manipulate an image, find a hidden target element among distractors, locate a hidden figure in a complex image, or reproduce a model using blocks. People with autism are also more likely to perceive the details that make up an image first, before analyzing the overall image, unlike neurotypicals, who usually perceive the overall image first. This prioritization of detail perception by autistic people could help explain their superior performance on visuospatial tasks.

However, other studies have also shown that autistic people perform similarly or less well than neurotypicals on visuospatial tasks. These divergent results could be explained by the heterogeneity of autistic people's profiles. **Nearly half of all people with autism demonstrate a visuospatial strength**, which could explain the lack of consistency between the results of the studies. Moreover, autistic people who have these visuospatial strengths often present a distinct profile: they represent a subgroup among autistic people who have had language delay, or atypical language development in early childhood.

Study Description

To better understand the brain function associated with superior visuospatial skills, Véronique D. Thérien and her colleagues set out **to compare the performance of three groups of adults on visuospatial tasks: two groups of men with autism, who differ in their visuospatial skills, and one group of neurotypical men**. To form the two groups of autistic people, the researchers measured their intelligence quotient (IQ) using the Wechsler Intelligence Scales. This test includes the Block subtest, which requires the reproduction of images using blocks. Autistic people who

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had exhibited a peak of performance on this task, i.e., their performance was significantly higher compared to their performance on the other subtests in the intelligence scale (personal strength), formed one group, and autistic people who scored lower formed a second group.

To compare the three groups of participants, the researchers **measured functional connectivity and brain activation during two tasks involving different visuospatial skills**. Functional connectivity refers to the simultaneous activation of different brain regions during the performance of a task. The first task was a mental rotation task: participants were shown several pairs of images of three-dimensional objects and asked to indicate whether the objects were identical or mirrored. The objects were rotated by 0°, 70°, 140° or 180°, which informed the level of difficulty (see image "Task 1: Mental rotation"). In the second task, participants had to mentally sort images with different levels of perceptual coherence. An image with high perceptual coherence represents a pattern that can be easily identified by participants, such as a cross or zigzags. An image with low perceptual coherence does not represent an easily identifiable pattern (see image "Task 2: Blocks").

To measure brain connectivity and activation, the researchers used functional magnetic resonance imaging (fMRI), a type of imaging that allows us to observe which brain regions are activated during task performance.

Main Results

Across the two tasks, **several differences were observed between the three groups in the activation of brain regions and the connectivity between these regions.**

In terms of brain activation, both autistic groups showed greater activation in posterior regions (occipital and parietal) than the neurotypical group. Additionally, the autistic group with a visuospatial peak showed greater activation of regions specialized in visual perception, located in the posterior part of the brain, compared to the autistic group without a peak.

When the complexity of the tasks was increased (by increasing the angle of rotation or the level of perceptual coherence), the researchers observed very little effect in the brain regions used by autistic people with a visuospatial peak. They used more or less the same regions specialized in visual perception for the most complex tasks, suggesting that they utilise more perceptive processes. Conversely, for participants in the other two groups (autistic persons without a peak and neurotypicals), the brain regions involved were much more extensive, further involving frontal regions, as the complexity of tasks increased.

Regarding connectivity between regions, the researchers observed greater connectivity between regions specialized in visual perception in autistic people with visual perception compared with the other two groups. However, in autistic participants with a visuospatial peak, the posterior regions were less connected with the frontal regions during the tasks compared to those autistic participants without a peak and neurotypicals.

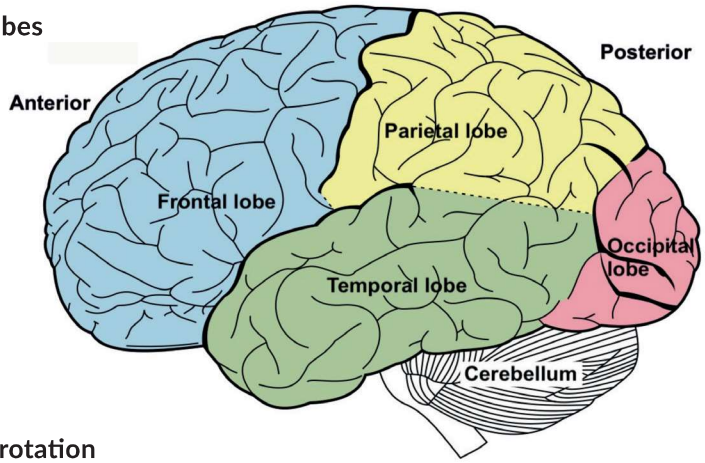
What does it mean?

The work of Véronique D. Thérien and colleagues shows that when performing visuospatial tasks, **there are differences in the activation and connectivity of brain regions not only between autistic and neurotypical people, but also between autistic people** with different visuospatial skills. Notably, autistic people with a visuospatial peak appear to use a more specialized brain connectivity network than participants in other groups, with greater activation specifically in regions specialized in visual perception. The brain network of autistic participants with a visuospatial peak also appears to be more autonomous, with greater connectivity between posterior regions, but less connectivity between posterior and frontal regions, compared with the other groups. These distinctions observed in the autistic group with a visuospatial peak compared to the other participants could explain their strength at visuospatial level.

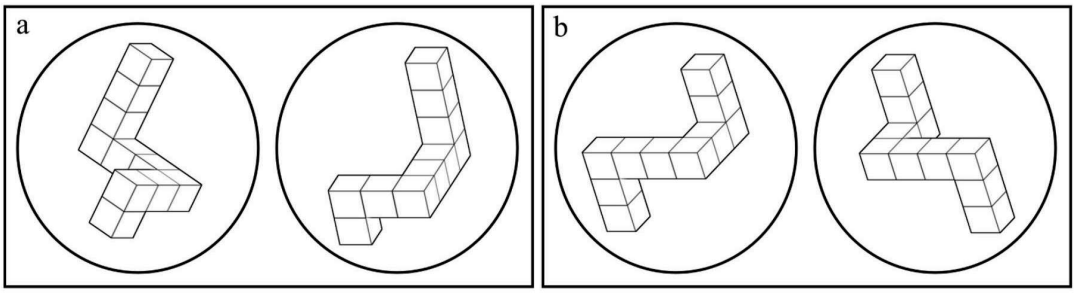
These results reveal the importance of taking into account the diversity of profiles of autistic people, not only in research to better understand the brain functioning of this population, but also in clinical and educational fields to better support autistic people.

However, further studies on this subject are needed. The participants in the study presented in this article were all adult males. In the future, it would be interesting to see whether similar (or different!) results could be obtained with adult women, or with participants across other age categories.

Human brain lobes

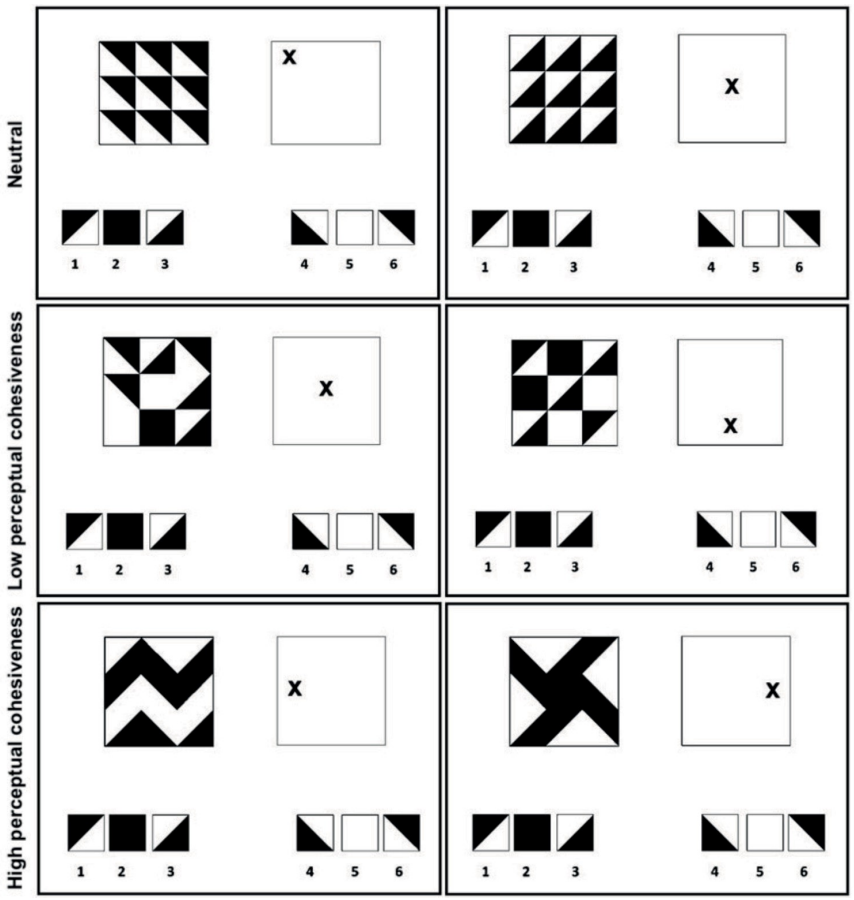


Task 1: Mental rotation



Examples of trials: (a) displays identical figures at 70-degree; (b) displays mirror figures at 0-degree.

Task 2: Blocks



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References:

Thérien, V. D., Degré-Pelletier, J., Barbeau, E. B., Samson, F. et Soulières, I. (2023). Different levels of visuo-spatial abilities linked to differential brain correlates underlying visual mental segmentation processes in autism. *Cerebral Cortex*, 33(14), 9186-9211. https://doi.org/10.1093/cercor/bhad195

Thérien, V. D., Degré-Pelletier, J., Barbeau, E. B., Samson, F. et Soulières, I. (2022). Differential neural correlates underlying mental rotation processes in two distinct cognitive profiles in autism. *NeuroImage: Clinical*, 36, 103221. https://doi.org/10.1016/j.nicl.2022.103221

Images:

Human brain lobes (source image : Wikipedia, https://en.wikipedia.org/wiki/Frontal_lobe#/media/File:Lobes_of_the_brain_NL.svg)