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Spectrum Montreal

Magazine of the Montreal Cognitive Neuroscience Autism Research Group

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The Montreal Cognitive Neuroscience Autism Research Group focuses on brain function, auditory and visual perception, exceptional skills and interventions in autism.

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This first issue highlights some of the core research projects that have been conducted in the lab over the last decade. These projects are featured because they remain highly relevant and provide a framework for our current research programs.

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You will also find details on other research projects and recruitment on the last page of this issue.

No. 1

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A WORD FROM THE EDITOR

Valérie Courchesne

Spectrum Montreal aims to make scientific research on autism more accessible to the public.

This first issue includes a collection of entries that summarize the findings of important research articles. The content is simplified, but nevertheless provides an excellent starting point for understanding key findings in the field of autism. We encourage you, however, to consult the original articles if you are interested to know more about what you read here.

Spectrum Montreal also includes a variety of articles and perspectives, including current issues for individuals and families, myths about autism, important findings from other labs, and debates.

A word about the team...

Spectrum Montreal is the magazine of the Montreal Cognitive Neuroscience Autism Research Group, which connects researchers, students, and clinicians with mutual interests in autism. For further information about the group or to register to the *Spectrum Montreal* mailing list, please visit our website: www.autismresearchgroupmontreal.ca.

The articles summarized in *Spectrum Montreal* are mainly those that were published by the group. These summaries are written by students and reviewed by researchers. The students who contributed a summary to *Spectrum Montreal* are not necessarily those who conducted the studies or authored the original articles. These students simply gave of their time to contribute to this project.

Other articles are written by clinicians who work with autistics and are considered experts in this domain. These clinicians also volunteered and wrote on themes that they found particularly relevant to their clinical work.

Acknowledgments

I would like to thank all of the students, researchers, and clinicians who generously contributed their time to this project. I would especially like to thank Janie Degré-Pelletier, who created the logo and helped with the layout of the journal. I appreciate the support of the Fondation des Petits Trésors and thank them for their help throughout this first issue. I would also like to thank all of the research participants without whom none of this would be possible.

PERCEIVING THE FOREST AND THE TREES

By Catherine Cimon-Paquet, undergraduate student at Université De Montréal

A study conducted by researchers from Montreal, Canada, demonstrated that there is an increased sensitivity to mirror symmetry in autism.

Several studies suggest a superior performance in autism on various visuospatial tasks. One hypothesis used to explain such superiority is that autistics have an enhanced ability to perceive details (local information) preventing them from being able to perceive the bigger picture (global information) when necessary. Alternatively, a second hypothesis stipulates that autistics are able to perceive global information even if they are better able to perceive details in a pattern.

In the present study, seventeen autistics and 15 non-autistics completed a mirror symmetry detection task.

Mirror symmetry is present when half of a pattern is a mirror reflection of the other. It is highly related to object perception and recognition. It also requires a processing of global information. It has been demonstrated that mirror symmetry is more easily perceived if the symmetry axis is vertical. This finding may be explained by the presence of many vertically symmetrical objects in our environment (i.e. human faces).

Participants indicated which of two images was symmetrical. The first image was either vertically, horizontally or obliquely (45°) symmetrical, whereas the second did not depict symmetry. Autistics and non-autistics both performed better for the detection of vertical symmetry as compared to the detection of horizontal or oblique symmetry.

Therefore, as is the case for non-autistics, autistics were more sensitive to vertical symmetry, which is found in social stimuli, such as human faces.

Furthermore, autistics detected mirror symmetry more easily than non-autistics across all three axes of orientation, which was noted by lower symmetry detection thresholds in the autistic group as compared to the typically developing group across all axes of orientation. These findings are consistent with the premise that autistics are able to perceive global information when it is required to achieve a task.

From these results, it is possible to predict that autistics may not only able to see the trees but may also be able to perceive the forest.

Original study: Perreault, A., Gurnsey, R., Dawson, M., Mottron, L., & Bertone, A. (2011). Increased Sensitivity to Mirror Symmetry in Autism. *PLoS ONE, 6*(4), e19519. doi: 10.1371/journal.pone.0019519

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ENHANCED PERCEPTUAL PROCESSING IN THE AUTISTIC BRAIN

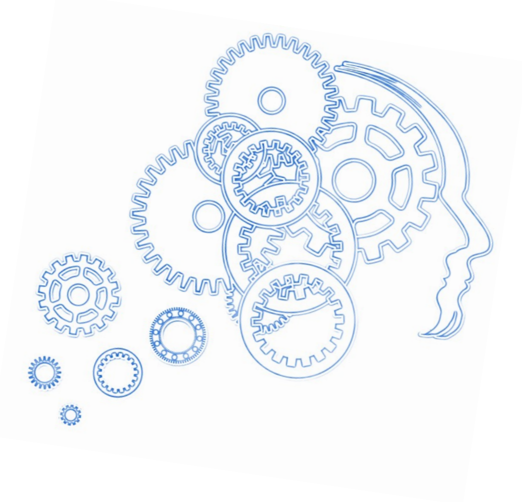
By Fabienne Samson, Ph.D.

Autism is characterized by social and communication impairments as well as by superior performance in perceptual tasks. Could enhanced perceptual processing characterize the autistic brain?

Perception can be defined as the processes involved in acquiring and processing information in light of previous knowledge, expectations and experience. In autism, perception is different and it is often found to be enhanced. For instance, autistics outperform non-autistics in tasks requiring to find a shape embedded in a larger figure [2] or to find a target among distractors [3]. Also, in commonly used intelligence tests, autistics usually perform better on subtests based on perception (e.g. reproduction of patterns with blocks in the Block Design subtest) compared to other subtests requiring the use of language [4].

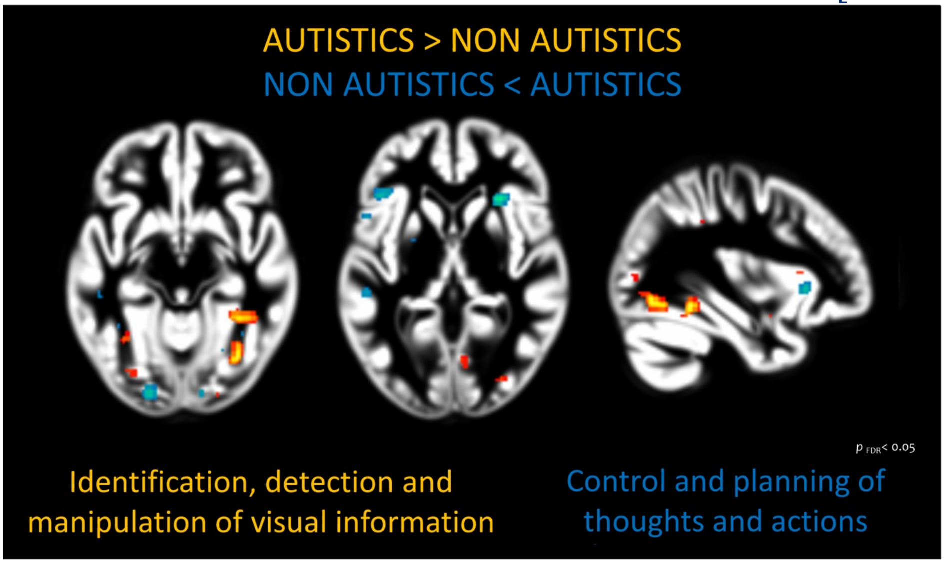
These behavioural superiorities suggest that perceptual processing might operate in a different way in the autistic brain. In the brain, specific functions are known to rely on specific regions. For example, visual perception tasks mostly involve the posterior (i.e. occipital) part of the brain, while more anterior regions (i.e. frontal) are thought to subserve reasoning and higher executive functions. Neuroimaging methods, such as functional magnetic resonance imaging (fMRI), can be used to visualize the implication of specific cortical regions for a given task and to look at differences between groups of subjects. An fMRI study where autistic and non-autistic participants completed the Raven's progressive matrices, a non-verbal perceptual reasoning task, reported greater activity in regions associated with visual perception and less activity in frontal regions in individuals with autism compared to controls [5]. In combination with behavioural evidence for enhanced perception in autism, this pattern of brain activity suggests a *superior role* of perceptual processes in the autistic brain. Autistic individuals would rely more on the cortical regions associated with perception, for perceptual as well as non-perceptual tasks which typically involve more anterior (i.e. frontal) regions.

Meta-analysis is a method that can be used to summarize the results of the literature on a given topic. It quantifies the level of concordance between independent studies and identifies



the brain regions most consistently involved in a specific task. Here, a quantitative meta-analysis has been conducted to summarize and compare patterns of activity related to visual processing in autistics and non-autistics.

Twenty-six studies where visual information (images of faces, objects, written words or sentences) was presented to a total of 370 non-autistic and 257 autistic individuals were included in the meta-analysis. For each study, the list of brain regions activated during the task was extracted for both groups. Maps showing regions consistently activated across studies were then computed for each group and compared between groups. This analysis revealed a greater implication of perceptual brain regions in autism. Cortical regions associated with visual



processing (i.e. detection, manipulation and identification of visual information) in occipital and temporal lobes showed more activity in autistics, while frontal regions, involved in motor preparation, cognitive control, decision and planning, etc., showed more activity in controls. The studies included covered a broad range of visual stimuli (shapes, objects, faces, letters, etc.) and tasks (target detection, matching tasks, emotion identification, semantic judgement, etc.). Interestingly, there were no differences in task performance between autistics and non-autistics for 18 out of the 26 studies. This suggests that individuals with autism use perceptual brain regions to achieve the same performance as non-autistics who rely on higher-level brain regions. This indicates *a different but not detrimental* way to process information in autism.

The results of the meta-analysis also demonstrate that enhanced perceptual activation in autism is not limited to a single processing domain. When the analyses were conducted separately for objects, faces, or written language, higher activity in regions associated with perception was systematically observed. These activations are mostly found in the cerebral region associated with visual expertise called the *fusiform gyrus*. This suggests an atypical development of perceptual expertise in autism. The greater cerebral plasticity hypothesis, the ability of the human brain to remodel cortical connections based on experience, has been suggested to explain these differences. According to this hypothesis, the brain of autistic individuals is transformed throughout development via cerebral plasticity mechanisms in favor of perceptual processes. This cerebral functional reallocation could underlie the cognitive strengths for processing visual information, the atypical processing of faces but also some exceptional abilities like hyperlexia (i.e. early acquisition of reading skills) often observed in the autistic population.

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1. Samson, F., et al., *Enhanced visual functioning in autism: an ALE meta-analysis.* Hum Brain Mapp, 2012. **33**(7): p. 1553-81.
2. Jolliffe, T. and S. Baron-Cohen, *Are people with autism and Asperger syndrome faster than normal on the Embedded Figures Test?* J Child Psychol Psychiatry, 1997. **38**(5): p. 527-34.
3. Joseph, R.M., et al., *Why is visual search superior in autism spectrum disorder?* Dev Sci, 2009. **12** (6): p. 1083-96.
4. Caron, M.J., et al., *Cognitive mechanisms, specificity and neural underpinnings of visuospatial peaks in autism.* Brain, 2006. **129**(Pt 7): p. 1789-802.
5. Soulières, I., et al., *Enhanced visual processing contributes to matrix reasoning in autism.* Hum Brain Mapp, 2009. **30** (12): p. 4082-107.

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ENHANCED PERCEPTUAL FUNCTIONING IN AUTISM

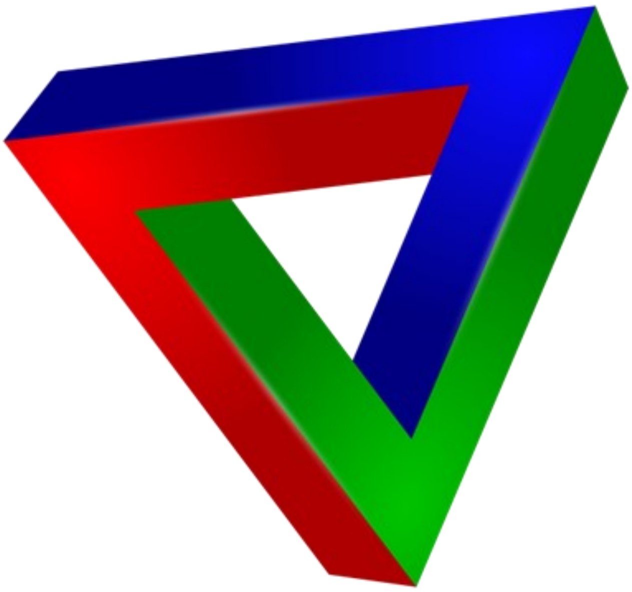
By Alexis Beauchamp-Châtel, Master's degree student and resident in psychiatry

WHAT IS PERCEPTION?

Our brain is arguably what makes us so different from other species. It allows us to read, think, plan ahead, make decisions and feel emotions. However, before doing these "higher-order" tasks it must decode signals sent by the sense organs (skin, eyes, ears, tongue, nose…). The task of receiving and decoding all these inputs is what is called "perception" and includes subtasks like stimuli selection, organisation and interpretation. Let's take vision as an example: light bounces off an object, enters the eye through the pupil, hits the retina, and activates specialized cells (cones and rods), which send chemical signals to a succession of neurons that finally relay the signal to the visual cortex. In this region, the signal is decoded and translated into an internal representation of the object. Other regions of the brain can then be recruited to help identify and locate the object, as well as understand any possible emotional meaning linked to it.

PERCEPTION IN AUTISM

Many studies have found that perception in autistic individuals is either equal to or even superior to perception in non-autistics. Some researchers have suggested that this superiority could explain why autistic people differ from non-autistics, and at the same time, why these individuals present with very different symptoms but still represent the same entity. Mottron, Dawson, Soulières, Hubert and Burack have thus created the "Enhanced Perceptual Functioning" (EPF) model, which outlines 8 principles (see next page). These 8 principles may be summarised in 3 overarching characteristics of autistic perception: 1) superiorities in low level tasks; 2) a greater independence from top-down processes (i.e., emotions, attention, expectations, etc.); 3) generally, a more central role in cognitive processes (e.g., intelligence and decoding of social situations).



Example of impossible figure

THE 8 PRINCIPLES OF THE EPF MODEL

#1 Perception is oriented more towards local elements in autistic than in typical individuals. For example, autistic individuals are better at copying impossible images (see figure 1) because they are better able to concentrate on local elements without being distracted by the overall "impossible" image.

#2 Perception in autism is superior for simple but not complex information. That is, perception of static stimuli (which are not very complex) is superior in autism, but perception of movements (which are more complex) is not superior.

#3 Some atypical behaviours in autistics could help filter stimuli that the senses receive and then send to the brain. For example, lateral gazes (which are frequently observed in young autistics) diminish the quantity of visual details received by the eye and enhance the perception of movements.

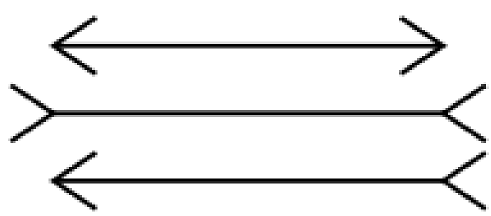
#4 Autistic individuals demonstrate a different pattern of brain activation in social and non-social tasks than typical individuals. For example, autistic individuals show a greater activation in visual and perceptive than frontal areas, but no differences in behavioural performances relative to typical individuals.

#5 The influence of "top-down" processing (for example: expectations, prior knowledge and conscious reasoning) is mandatory in typical individuals, but optional in autistic individuals. For example, an optical illusion happens when the brain builds an internal image that is different from reality because of an interference with how visual information is integrated (which uses top-down influences). In an experiment, autistic individuals were as sensitive to an illusion when they were asked "which line LOOKS longer" (which is influenced by higher-order psychological factors), but were more likely than non-autistics to give the correct answer when they were asked "which line IS longer" (which is a factual question less influenced by higher-order processes). This demonstrates that autistic individuals are able to ignore the distorting effect of higher-order processes in certain circumstances, contrary to non-autistics.

#6 The superiority of autistic perception relates to some of the special abilities seen in Savant Syndrome. A special ability in an autistic individual can emerge from a preference for certain perceptual stimuli. For example, an early interest in numbers and letters can lead to a special ability in calendar computation later in life. Stephen Wiltshire, an artist and autistic individual without intellectual disability, is an example of someone with incredible abilities: he can draw exquisitely precise city landscapes (e.g., Rome, London, New York City, Tokyo…) from memory after flying over in helicopter only once!

#7 Savant Syndrome could be a model to further classify the autism spectrum, especially in the absence of clear genetic subtypes. Indeed, differences in autism symptomatology could be due to an early overspecialization of perception, which would later transform into special abilities (peak in language ability, peak in visuo-spatial abilities, specific interests, etc.). This specialization could happen at the expense of other important functions. For example, autistic individuals who present with early language abilities (i.e. with Asperger's syndrome) do not exhibit strengths in visuo-spatial tasks and, conversely, those with an early peak in visuo-spatial tasks tend to do poorly in language.

#8 Enhanced perceptual functioning explains the 7 aforementioned principles of autistic perception.



Illusion of the lines in principles #5

WHY IS IT IMPORTANT?

The EPF model is able to explain why symptoms that are vastly different (for example, calendar computation and communication difficulties) could result from a single process: specialization in one domain but not in others due to inborn differences in the perceptual process. Another important contribution is that the EPF model does not imply that the autistic brain is fundamentally flawed. On the contrary, it makes the assumption that it is superior to the non-autistic brain in terms of perception. This implies that interventions should focus not on repairing something broken, nor on alleviating fundamental flaws. Instead, they should target the specific strengths of an individual and use them to improve upon weaknesses in less functional domains. Eventually, these kinds of interventions could complement current interventions, which are far from perfect.

Original study: Mottron, L., Dawson, M., Soulières, I., Hubert, B., & Burack, J. (2006). Enhanced Perceptual Functioning in Autism: An Update, and Eight Principles of Autistic Perception. Journal of Autism and Developmental Disorders, 36(1), 27–43. doi: 10.1007/s10803-005-0040-7

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THE RAVEN'S GENIUS

By Véronique D. Therien, Ph.D. student in neuropsychology at UQAM

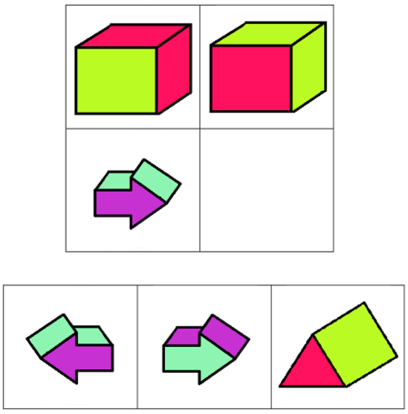
"Autistic intelligence is underestimated by conventional IQ tests".

This has been observed in a study conducted by the Montreal Cognitive Neuroscience Autism Research Group.

The idea that cognitive functioning is impaired in autism is largely assumed among the general and scientific communities. Even if some autistics present with strong or savant skills, abnormal neural functioning has been the leading argument to account for these exceptional abilities rather than being considered a true form of intelligence. To improve our understanding of the level and nature of autistic intelligence, a group of researchers has empirically explored these pervasive beliefs.

INTELLECTUAL PROFILE IN AUTISM

Wechsler intelligence scales are commonly used to assess cognitive potential in clinical and scientific practice. These scales comprise approximately ten verbal and nonverbal subtests soliciting verbal comprehension, perceptual reasoning, working memory and processing speed skills. Prominent peaks and troughs are commonly observed among autistics on this standard IQ test.



For example, selective impairments are often found in autistics on one of the verbal subtests, Comprehension. In contrast, they typically demonstrate marked strengths on perceptual reasoning subtests (e.g., Block Design). This spiky IQ profile in autism strikingly differs from the homogenous profile generally observed among non-autistics.

ASSESSING AUTISTIC INTELLIGENCE: A CHALLENGE

All Wechsler subtests are orally delivered and some of them also require oral responses. Oral language skills are therefore a prerequisite to a good performance on this intellectual assessment. Thus, the Wechsler IQ test may fail to capture the true cognitive potential of autistics, given their language and communication atypicalities.

Raven's Progressive Matrices (RPM) is very different test of intelligence in its format and demands. Reasoning, novel problem solving, and high-level abstraction abilities are required to perform well on RPM. The examinee must infer rules, draw up and test different hypotheses and manage simultaneously a hierarchy of goals. Unlike Wechsler, RPM requires minimal instructions and no verbal responses, and thus can be administered to a wider diversity of individuals. Yet RPM has been found to be a highly reliable indicator of intelligence in non-autistics, whose performance on Wechsler intelligence scales and RPM are equivalent.

This was not the case for autistic individuals in the study conducted by the Montreal Cognitive Neuroscience Autism Research Group. Instead there were important discrepancies between Wechsler and RPM scores in autistic children and adults. Thirty-eight autistic children and twenty-four non-autistic children aged between 6 and 16 years were assessed with both Wechsler intelligence scales and RPM. For the autism group, RPM scores were significantly higher than Wechsler scores, on average by 30 percentile points, with some autistic children showing a discrepancy of more than 70 percentile points favoring RPM. Furthermore, one third of autistic children performed in the range of intellectual disability on Wechsler, compared to only 5% on RPM. Also, whereas a third of the autistic children scored at or above the 90th percentile on the RPM, only a minority scored in the average range or higher on the Wechsler. Such discrepancies were not observed in non-autistic children, whose Wechsler and RPM scores did not significantly differ. In addition, the study found similar results in smaller groups of autistic and non-autistic adults.

Using a popular test, an autistic adolescent was judged to have an IQ below the 1st percentile (i.e. in the range of intellectual disability). But then he performed remarkably well on Raven's Progressive Matrices, with a score at the 95th percentile. What does the Raven's Genius tell us about autism?

This study demonstrated that the intelligence of autistic individuals may be underestimated by conventional IQ test batteries, such as Wechsler scales of intelligence. It also refutes claims that autistic abilities are confined to simple perceptual stimuli or isolated low-level "islets of ability" without real utility. To the contrary, autistic potential may better be estimated through the use of RPM, the most complex single test of intelligence, which allows autistics to demonstrate their high-level reasoning and problem-solving abilities.

In conclusion, researchers from the Montreal Cognitive Neuroscience Autism Research Group strongly caution against judging autistic intelligence based solely on IQ scores assessed via popular test batteries such as Wechsler. These assessments may not take into account autistics' atypical cognitive processes and range of abilities, and could lead to an underestimation of the true cognitive potential of autistic individuals.

Original study: Dawson, M., Soulières, I., Gernsbacher, A. M., & Mottron, L. (2007). The Level and Nature of Autistic Intelligence. *Psychological Science, 18* (8), 657-662. doi: 10.1111/j.1467-9280.2007.01954.x

Related study: Charman, T., Pickles, A., Simonoff, E., Chandler, S., Loucas, T., & Baird, G. (2011). IQ in children with autism spectrum disorders: data from the Special Needs and Autism Project (SNAP). *Psychological Medicine, 41*(03), 619-627. doi: 10.1017/S0033291710000991

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MYTH BUSTERS:

The Gluten-Free and Casein-Free Diet is not Effective in Treating Autism and its Related Behaviors

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Ghitza Thermidor M.Sc., psychoeducator at the CIUSSS du Nord de l'Ile de Montréal

Translated from French by Sabrina Censi

In our clinical practice, parents frequently ask us whether the gluten-free/casein-free diet would help in diminishing the symptoms related to their child's autism diagnosis or even cure it. Parents often tell us that they have spoken to their local autism association who strongly recommend that they remove gluten and casein from their child's diet. They feel guilty for not following this recommendation and would like to know if there is any scientific data supporting this recommendation. Here is what the science has to say about it.

IS THERE SCIENTIFIC EVIDENCE TO SUPPORT THE IDEA THAT A GLUTEN-FREE/ CASEIN-FREE DIET IS EFFECTIVE IN AUTISM?

No and here is why

The two published double-blind studies (2006[1], 2016[2]) found that there were no differences in autism symptomatology or its related behaviours (i.e., agitation, tantrums, difficulty sleeping) following the introduction or the removal of casein and gluten in the diet of children with autism. During these studies, many of the parents reported that they had observed positive changes in their child's behaviour which they attributed to the specialized diet. At the end of these studies parents were informed that their children were in fact not following a gluten-free/casein-free diet at the time they reported positive changes. Therefore, the perceived changes were due to a placebo effect.

In order to determine the effectiveness of a treatment, researchers must be able to eliminate the placebo effect. This is done by using studies that are "controlled", "randomized", and "double blind". A "controlled" study is when one group of participants receive a treatment while those in another group do not. At times, participants can be receiving treatment for part of an experiment and then go without treatment for the remainder of the experiment. Studies are said to be "randomized" when the people participating are randomly allocated to treatment groups, without the ability to choose who is in what group by neither the researchers nor the participants. "Double blind" occurs when both the participants and the researchers are unaware if the treatment is being administered or not.

THEREFORE WHERE DOES THIS BELIEF COME FROM?

It comes from two studies (2002[3], 2010[4]) reporting significant improvements in social interactions, communication, and atypical behaviours with the gluten-free/casein-free diet. However, parents answering questions about the effectiveness of the diet were not blind to the fact that their child was receiving a specialized diet. More so, the researchers in the 2010[4] article stated that there were no reported effects when observers were blind to the treatment group (i.e., the child was observed by someone who did not know if the child was receiving a specialized diet or not). Again, the placebo effect in this study explains the positive improvements reported by parents.

WHAT ARE THE RISKS TO A GLUTEN-FREE/ CASEIN-FREE DIET?

There are few studies that have looked at the health effects of this type of specialized diet in children. From the 2010[4] study, the researchers reported adverse effects while the parents did not report any secondary effects. The study in 2016₂ concluded that the specialized gluten-free/casein-free diet is safe as long as the diet is being supervised by a dietician. The Academy of Nutrition and Dietetics caution that going on this specialized diet can lead to deficiencies with certain nutrients and minerals (particularly Vitamin D and iron). They also highlight that anyone on this specialized diet, as those with coeliac disease, should always be supervised by a dietician. Also, a child with autism may already be a "picky eater" therefore further changes to their diet may be difficult.

CONCLUSION

There is no scientific evidence to support that the gluten-free/ casein-free diet is effective in treating autism symptoms or its related behaviours. If an individual with autism believes they have Coeliac Disease, they should consult with a doctor. A doctor will be able to confirm the diagnosis and determine whether a specialized diet is necessary to aid in alleviating the symptoms of Coeliac Disease and not for treating autism symptomatology or its related behaviours.

References

Study 1: Harrison, J. et al. (2006). The Gluten-Free, Casein-Free Diet In Autism: Results of A Preliminary Double Blind Clinical Trial. Journal of Autism and Developmental Disorders, Vol.36 (3): 413-420

Study 2: Hyman, S.L. et al. (2016) The Gluten-Free/Casein-Free Diet: A Double-Blind Challenge Trial in Children with Autism. Journal of Autism and Developmental Disorders, Vol.46 (1):205–220.

Study 3: Knivsberg, A.M. et al. (2002) A randomised, controlled study of dietary intervention in autistic syndromes. Nutrional Neuroscience, Vol.5(4):251-61.

Study 4: Whiteley, P. et al. (2010) The ScanBrit randomised, controlled, singleblind study of a gluten- and casein-free dietary intervention for children with autism spectrum disorders. Nutritional. Neuroscience. Vol.13, No 2.

LATERAL GLANCES IN AUTISM SPECTRUM DISORDERS

By Janie Degré-Pelletier, undergraduate student in psychology at Université du Québec à Montréal (UQAM)

One of the two characteristics that are required to diagnose Autism Spectrum Disorders (ASD) is the presence of repetitive behaviors. Atypical visual exploratory behaviors for inanimate objects (AVEBIOs) are among the repetitive behaviors frequently found in autism. These atypical behaviors include *lateral glance* (the child looks at an object out of the corner of his eyes while turning his head or moving the object), *close gaze* (inspects an object within a 3-inch range to his eyes) or *obstructed gaze* (looks at an object by closing one eye or by placing another object between his eyes and the object of interest). Few studies have focused on AVEBIOs. The only empirical studies explored AVEBIOs within the broader set of repetitive behaviors.

Researchers from Rivière-des-Prairies Hospital developed a tool to identify, describe and assess AVEBIOs. First, they developed a list of all AVEBIOs in order to code 40 videos of ADOS-G assessments (*Autism Diagnostic Observation Schedule – Generic*; a clinical diagnostic tool). They identified AVEBIOs and determined their frequency and duration. They analysed the context surrounding AVEBIOs to determine the conditions under which these behaviors occur. Finally, they compared the AVEBIOs evident in autistic children to those exhibited by non-autistic children.

RESULTS

Lateral glances were the most common AVEBIO, and were five times more prevalent in autistic compared to typical children. In a significant number of sequences, lateral glance was accompanied by a head tilt. Furthermore, lateral glance was often associated with the presence of an element in movement in the environment. Although lateral glances were also found in some typical children, they took a unique form in autistic children. Autistic children use them to inspect moving objects, or place objects at the edge of their visual field, while typical children use lateral glance to follow a coveted object.

(a)

(b)

CLINICALLY

No link was found between frequency of lateral glance and verbal mental age or chronological age. This challenges the notion that repetitive behaviors, such as lateral glances, are linked to developmental delay. Furthermore, the absence of correlation between communication skills and lateral glances confirms that these two areas of symptoms are independent of one another. This result had also been confirmed by other researchers.

NEUROCOGNITIVE IMPLICATIONS

The association between lateral glances and moving objects suggests that AVEBIOs have a purpose. It has been shown that it is more difficult for autistic children to perform perceptual tasks that include movement. A possible explanation is that lateral glance is used to filter visual information. The resolution on the periphery of the visual field is lower and it is therefore possible that looking at an object laterally allows autistics to obtain visual information in a simpler form, making it easier to process and analyse.

In conclusion, these results suggest that some repetitive behaviors have an adaptive function, they could be helpful for autistic individuals and allow them to better adapt to their environment. Therefore, this brings into question the relevance of interventions aiming to eliminate these behaviors. Moreover, it seems that the AVEBIOs identified in this study are specific to autism and appear hastily in development. These results could qualify AVEBIOs as precursors, to and hence having an impact on the diagnosis of autism spectrum disorders.

Original study: Mottron, L., Mineau, S., Martel, G., St-Charles Bernier, C., Berthiaume, C., Dawson, M., Lemay, M., Palardy, S., Charman, T., & Faubert, J. (2007). Lateral glances toward moving stimuli among young children with autism: Early regulation of locally oriented perception? Development and Psychopathology, 19(01), 23-36. doi: 10.1017/S0954579407070022

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INTELLIGENCE IN AUTISM: THE ROLE OF PERCEPTION AS A UNIQUE " P" FACTOR?

By Dominique Girard, Ph.D. student in psychology at UQAM
and Andrée-Anne S. Meilleur, Ph.D., neuropsychologist.

Young autistic children present particular behaviours associated with the sensory aspects of their environment (e.g. react strongly to certain textures, sensitive to noise, interested in objects in repetitive movement, etc.). In the most recent version of the DSM, the diagnostic criteria of the Autistic Spectrum Disorder (ASD) have been modified such that perceptual behaviours now hold a greater importance in the diagnosis of this condition. Given frequent clinical observations of sensory related behaviours in autistic children, our research group has focused on understanding how the autistic brain processes perceptual information.

VISUAL AND AUDITORY INFORMATION PROCESSING IN THE AUTISTIC BRAIN….

Studies have found that autistics' perceptual abilities differ from those of typically developing individuals. More precisely, autistics show more accurate processing of both auditory and visual information. In fact, autistic brains are more sensitive to changes in the elementary dimensions of visual and auditory information (e.g. luminance-contrast, spatial frequency, and pitch), in comparison to typically developing individuals with similar levels of intelligence (measured with IQ). These elementary dimensions are extracted from a stimulus during the early stages of perception through low-level information processing mechanisms located mainly in the primary perceptual regions of the brain.

As a result of these highly efficient low-level processes, autistics perform better in discrimination tasks (e.g. whether the pitch of 2 sounds is identical or different) compared to age- and intelligence-matched typically developing individuals. This generally enhanced processing of early perceptual information may be related to some common behaviours observed in young children with autism, such as hypersensitivity to noise and prolonged visual examination of objects.

Also, a strength has been documented in autistics for perceptual skills that involve mid-level information processing. Mid-level perceptual mechanisms involve later stages of perception that include activation of more complex brain networks (e.g. co-activation of frontal lobe). They are required to integrate low-level information (or signals) and group it together to make sense. For example, mid-level processing allows us to distinguish an object hidden within other visual stimuli and to understand how parts come together to form a whole. Mid-level processing is also more susceptible than low-level processing to the influence of expectations and anterior knowledge.

Researchers suggest that autistics are less sensitive to the influence of expectations and prior knowledge, compared to non-autistic individuals. This would allow them to reach high levels of performance in mid-level auditory and visual tasks. In fact, brain imaging studies have shown that autistics use the perceptual parts of their brain more often to complete a variety of tasks without systematically activating other cognitive processes, as is frequently found in typically developing individuals. Therefore, more autonomous cognitive processes that are less sensitive to external influences could give autistics an advantage when solving not only a variety of perceptual tasks, but also more complex task such as measures of fluid intelligence (i.e. matrix reasoning).

WHAT IS INTELLIGENCE?

Among the general population we find a correlation between perceptual skills and general intelligence. This means that the more intelligent you are, the better you will be at processing perceptual information. This positive relationship is also documented for other thinking skills (e.g. between memory and intelligence). Statisticians have identified a common factor to explain this positive relationship that exists between the different types of thinking skills. They called it the "g" factor, since it reflects the "global level of cognitive abilities".

AUTISTIC INTELLIGENCE: HOW DOES PERCEPTION RELATE TO GENERAL INTELLIGENCE?

Considering the presence of enhanced perception and the unique autonomy of brain mechanisms underlying such abilities in autism, researchers from the Rivière-des-Prairies Hospital designed an innovative study to investigate the intriguing relationship between perception and intelligence in autistics. They aimed to determine whether perceptual abilities are associated with general intelligence in autistics, in the same way as typically developing individuals. Specifically, they have examined 1) whether perceptual abilities are associated with each other, and 2) whether these perceptual performances are associated with the "g" factor (as demonstrated among non-autistic individuals).

In order to address these questions, 46 participants with an Autism Spectrum Disorder (ASD) diagnosis and 46 typically developing individuals, aged between 14 and 36 years old, were recruited. These participants were exposed to 4 perceptual tasks that assessed low- and mid-level auditory and visual skills. Intelligence was measured with the Wechsler Intelligence Scales (the most widely used IQ test) and the Progressive Raven Matrices (a test of fluid intelligence found to be one of the closest measures of the "g" factor).

SAME, BUT DIFFERENT…

As predicted by popular models of intelligence, this study finds an association between auditory and visual performances in both typically developing and autistic individuals. This means that when an individual performed well in a perceptual task, he/she generally performed just as well in other perceptual tasks.

Furthermore, results confirmed that perceptual skills are associated with general intelligence or the "g" factor among typically developing individuals. In this study, this meant that higher IQs were related to better performances in perceptual tasks. Interestingly, researchers found a different pattern of results in autistics: performance on perceptual tasks was not directly related to general intelligence. Surprised by this result, researchers conducted complex statistical analyses and identified a distinct factor that seems to underlie this specific association between visual and auditory perception in autism. This new factor was named the "p" factor, for perception.

WHAT DOES THE "P" FACTOR MEAN?

According to authors, the "p" factor is a fundamental component of intelligence in autism. It could reflect a unique neurocognitive profile, which emerged from a series of modifications acting on different brain systems. These modifications have likely been occurring in the autistic brain since early development. This unique developmental course could optimize perceptual information processing in autism, which in turn, could influence how autistics understand their environment, think, and learning. This study brings novel understanding on the nature of intelligence in autism, which leads us to reconsider current assessment and intervention methods and adapt these to meet the needs of this unique clinical population.

Original study: S.Meilleur, A-A. Berthiaume, C., Bertone, A., Mottron, L. (2014). Autism-Specific Covariation in Perceptual Performance «g» or «p» Factor? Plos One. 9:8. doi:e103781.

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UNDERSTANDING THE VISUOSPATIAL PEAKS IN AUTISM SPECTRUM DISORDERS

By Éliane Danis, Ph.D. student in neuropsychology at UQAM
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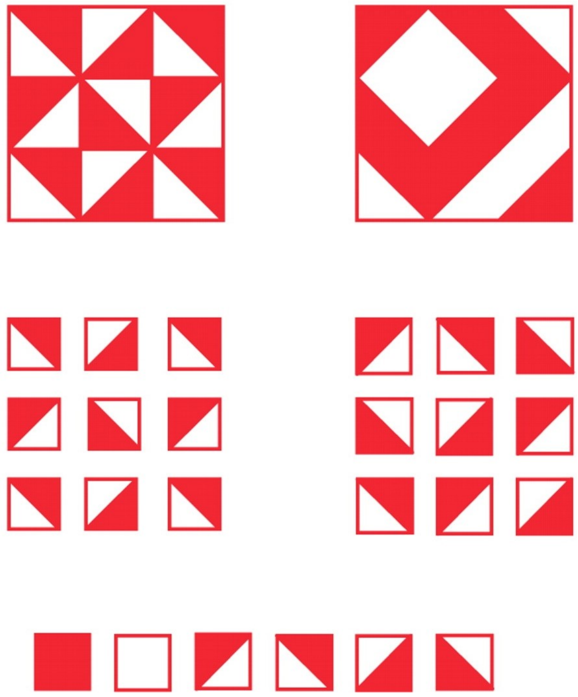
Treatment and manipulation of visuospatial information are well-known strengths in individuals with Autism Spectrum Disorder (ASD). These strengths are often measured by the Block Design subtest of the Wechsler Intelligence Scales. The Block Design subtest requires an individual to manipulate red and white blocks to recreate a constructed model or picture. A portion of individuals with ASD perform significantly better on this subtest compared to the other subtests of the Wechsler Scales. This strength in performance is also referred to as a "peak".

In a study by Caron, Mottron, Berthiaume, and Dawson, 5 different tasks were administered to evaluate different visual, perceptive, and cognitive processes possibly implicated in this visuospatial peak in ASD. The tasks were administered to 16 adolescents and young adults with ASD and 18 controls. The participants were matched by age. Eight participants from each group had a visuospatial peak which resulted in a total of 4 different groups: ASD, controls, those with peak performance, and those with no-peak performance. Most of the participants had an average Intelligence Quotient (IQ), except the control participants with a visuospatial peak who had an above average IQ.

The **first task** was a modified version of the Block Design subtest. For this task, the perceptual cohe-



siveness of the designs varied across trials. Higher perceptual cohesiveness is said to occur when the different blocks in the design form a coherent whole and are hard to segment from one another. As expected, both ASD and controls participants with a visuospatial peak performed better than participants without a strength in visuospatial abilities. It was also found that ASD participants (with and without a peak) were less influenced by the increase in perceptual cohesiveness compared to controls. These results indicated that individuals with ASD are better at segmenting a design (i.e., to treat information at a local level) despite the high level of perceptual cohesiveness of the designs. Other researchers have previously hypothesized that this advantage in treating local visual information (i.e., detailed or segmented information) in ASD was due to their inability to treat information globally. Consequently, it was believed that individuals with ASD were not influenced by the increase of perceptual cohesiveness. The results of the next two tasks from Caron and colleagues invalidated that hypothesis.

In the **second task**, participants had to pair whole designs to their respective segmented forms. Once again, the perceptual cohesiveness of the designs varied across items. All participants performed better when the designs to be paired had a high perceptual cohesiveness since they were easier to treat globally. However, ASD and control participants with a visuospatial peak were faster to complete the task, regardless of the level of perceptual cohesiveness of the designs.

In the **third task**, participants had to determine if a design had previously been presented. Again, designs forming a coherent global whole were better recalled by all participants but those with a visuospatial peak (ASD and controls) remembered more details of the designs than those without this visuospatial strength. In addition to confirming that the mechanisms underlying global treatment of visual information are intact in ASD, these tasks demonstrated that those with a visuospatial peak perform significantly better on perceptual tasks compared to individuals without this peak.

In the **fourth task**, participants had to find a predetermined block among distractors. All of the participants had a similar rate of accuracy; however those with a visuospatial peak were faster at responding than the participants without a peak.

In the **fifth and final task**, participants had to choose which of two block designs matched the initial design that had been presented to them a few seconds earlier. Presentation time of the initial designs varied across trials. The results showed that participants with a visuospatial peak needed less time to memorize the initial designs compared to other participants.

In summary, Caron and colleagues found that individuals with ASD, with or without a visuospatial peak, prefer to treat visual information locally and are better than controls in doing so. In addition to this local bias, the ability to treat information globally remains intact in ASD. They also found that individuals with a visuospatial peak had superior perceptual processing abilities compared to those without a peak. Therefore, understanding the visuospatial peak in individuals with ASD is twofold. First, they have a preference in treating visual information locally (which aids in segmenting block designs and are less influenced by the global whole of the image). Second, individuals with ASD have superior perceptual processing abilities which help them complete tasks faster and to treat information more efficiently.

Original study: Caron, M.-J., Mottron, L., Berthiaume, C., & Dawson, M. (2006). Cognitive mechanism, specificity and neural underpinnings of visuospatial peaks in autism. *Brain*, *129*(7), 1789-1802. doi : 10.1093/brain/aw1072

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