ENHANCED PERCEPTUAL PROCESSING IN THE AUTISTIC BRAIN

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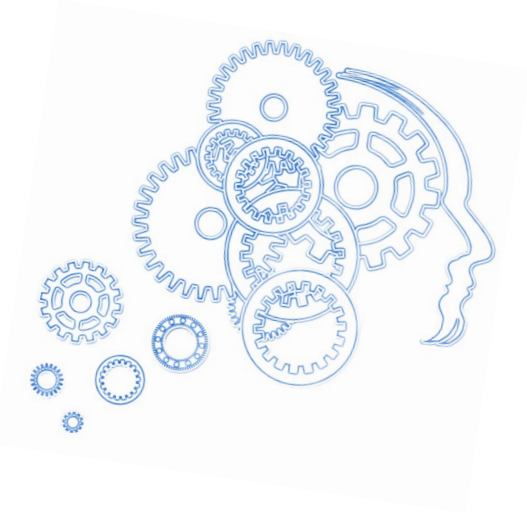
Autism is characterized by social and communication impairments as well as by superior performance in perceptual tasks. Could enhanced perceptual processing characterize the autistic brain?

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].

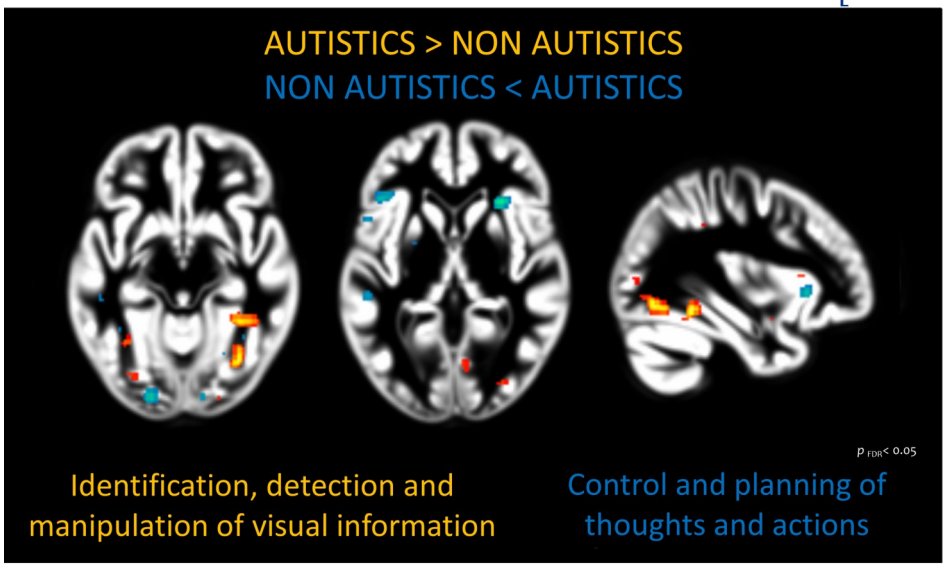
These behavioural superiorities suggest that perceptual processing might operate in a different way in the autistic brain. In the brain, specific functions are known to rely on specific regions. For example, visual perception tasks mostly involve the posterior (i.e. occipital) part of the brain, while 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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