Searching for Significance: An Evolutionary Advantage in Autism Spectrum Disorder

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ABSTRACT: This paper explores theories and evidence supporting visual search ability being an evolutionary advantage in people with Autism Spectrum Disorder (ASD), resulting in the persistence of the Broader Autism Phenotype (BAP) in the gene pool. Through evaluation of the existing psychological literature, an overview of the evolutionary advantages of superior visual search ability is presented. Specifically, focus is centred on advantages in threat detection and foraging behaviour. Explorations of the experimentally found superiority among those with genetic markers for autism are also discussed through the perspective of destigmatization of the disorder. The paper details that the superiority holds among various experimental paradigms with moderate effect sizes even in variable age groups. It overviews the Autism Advantage and evaluates the validity of research in this area. The paper concludes that individuals with ASD have generally advantageous visual search abilities in comparison to neurotypical control populations which may be indicative of an evolutionary trade-off of the disorder.

KEYWORDS: Autism Spectrum Disorder, developmental disorders, psychology, evolution, biology, evolutionary psychology

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Everything in the human genome comes from somewhere– but some heritable traits are not as obvious as others in how they have provided an evolutionary advantage. This holds true for cognitive diversity, deemed ‘disorders’ in today’s world, that contain a heritable genetic component and that have persisted in the gene pool over time. One of these less obviously advantageous disorders is Autism Spectrum Disorder (ASD). ASD is an umbrella term encompassing a spectrum of previously separately diagnosed conditions, including Autistic Disorder, Aspbergers, Childhood Disintegrative Disorder and Pervasive Developmental Disorder.[1] This condition, ASD, is clinically characterized by difficulties in social interactions and restricted and repetitive behaviour patterns.[2] ASD is common in the general population, affecting approximately one in one hundred children worldwide today[3] and has been demonstrated to be highly genetically heritable.[4] Due to its genetic relevance, it has been shown that relatives of individuals with ASD can also exhibit characteristics indicative of autism. This is referred to as the Broader Autism Phenotype (BAP)[5] and has special relevance when discussing the advantages associated with some of these traits.

As stigma surrounding ASD has waned, diagnosis has increased and developmental professionals, clinicians, and people with autism have changed their tune, with a paper from Bagatell showing that many look at autism as an opportunity to provide support rather than something to be cured.[6] In line with this view, researchers have found areas in which there seems to be an ‘autism advantage’, like visual search ability, the area of interest for this paper. Visual search is characterized as the ability to locate a target stimulus among distractor stimuli[7] and has been suggested to be involved in multiple processes that contribute to species survival.

In the sections to follow, this paper will delve into humans’ historical need for visual search ability in our evolutionary past and will relate it to the superior abilities displayed by those with Autism today in order to highlight one of many reasons for the persistence of the Broader Autism Phenotype within the species. This paper will elucidate the link between the superiority in visual search and the continuation of a genetic cognitive difference in the gene pool, previously thought of as mainly disadvantageous.

Visual Search and Survival

Visual search, as described above, consists of looking for and finding a target among several neutral distractors.[8] These target or distractor stimuli can be almost anything, but research on visual search is often focused on things like faces, symbols (see fig. 1), or more complex stimuli like natural scenes. Each of these research paradigms is mirrored in or includes aspects of the real world, and it is for this reason that researchers take such interest in the ability of various groups to sift through them for a relevant target. The aspects of the real world that this section will focus on are threat detection and foraging behaviour, both of which have been quasi-reproduced in visual search experiments, and both of which have evolutionary significance in their aid in survival for the human species.

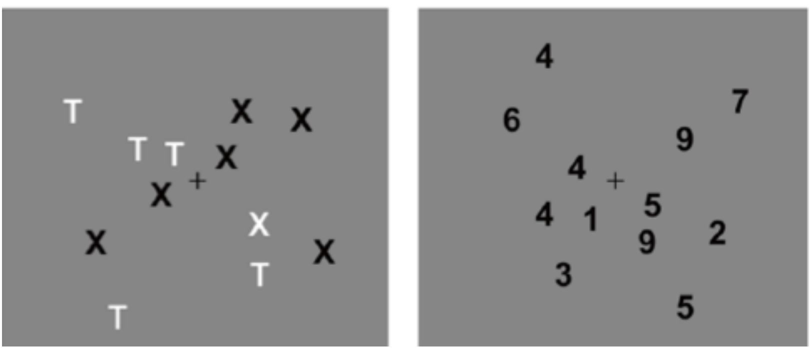

Figure 1. Examples of two visual search tasks, one using conjunctive search of colour and letters and one using numbers. (Source: Aya Shirama, Nobumasa Kato, and Makio Kashino, "When Do Individuals With Autism Spectrum Disorder Show Superiority in Visual Search?," Autism 21, no. 8 (November 29, 2016): 942–51, https://doi.org/10.1177/1362361316656943.)

The ability to detect threats directly correlates with the ability to survive. This simple statement means that the better one's ability is to notice something that is in opposition to their survival, the better their chances at passing on their genes to their offspring. Much of the research on threat detection often includes discussions of the evolution of anxiety and other psychological phenomena.[9] Some scholars theorize that the detection of threats leads to these threat responses (anxiety, alarm responses), which leads to conservation of reproductive resources (life, health), which ultimately contributes to Darwinian fitness.[10] This multipart chain of events is all to say that being able to search the environment for that which the brain deems 'threatening' is advantageous to an individual's survival and their ability to pass on their genes. In the laboratory, researchers use visual search paradigms with targets meant to resemble threatening stimuli,[11] like predators or angry faces, and contend that these search experiments can be extrapolated to show threat detection ability. The better an individual is at searching for this target, the better their threat detection, and the better their Darwinian fitness.

Another aspect of survival in the evolutionary past is success in foraging behaviour. Foraging behaviour, defined broadly as feeding and as a series of actions one takes to procure food, including relocation,[12] aids the ability to feed oneself, a self-evidently crucial aspect of reproductive fitness. With regard to visual search, many species, humans included, use visual search strategies when foraging.[13] This type of visual search is sometimes called hybrid-search or complex search,[14] and consists of looking for multiple of the same target among distractors, rather than just a single target. Experiments of this type involve stimuli that consist of certain shapes among similar or dissimilar distractors. An individual's ability to find success in this type of visual search paradigm, which is analogous to foraging behaviour, signifies to the researcher that they would have success in finding food and ensuring survival for many species, humans included.

The Autism Advantage: Evidence From Research

Visual search, in the general psychological literature, is anything but under-researched. As of the last few decades, however, autism research specifically has begun to incorporate visual search, following the phenomenon that some researchers deem the 'autism advantage' in this area. The visual search research on ASD in the literature has focused on a few specific areas: social, non-social, and natural. Here, we will discuss the abundance of evidence regarding people with ASD's superior ability in virtually all visual search paradigms while diving into specific examples associated with the advantageous traits discussed above.

Within the literature there exists a plethora of primary research, as well as reviews and meta-analyses, regarding visual search in autism which come at the question from every possible angle. Overarching reviews of the topic consistently find that regardless of the experimental paradigm employed, ASD groups typically perform significantly better than neurotypical groups when tasked with visual search.[15] One such paper finds variation in effect size depending on the paradigm being tested, with more complex search tasks, including conjunctive search, showing a higher effect size than simple search tasks.[16] It is worth noting that studies find many of these experiments tend to be biased toward ASD participants without intellectual disability.[17]

To illustrate the autism advantage using examples, one can look at foundational research done by O'Riordan et al. at the University of Cambridge,[18] as well as subsequent research that demonstrates consistency in visual search superiority over many different paradigms and experimental groups. Plainly, visual search ability for target shapes has been demonstrated to be superior in groups with autistic traits versus typically developed groups, especially among children.[19] This result holds when the participant group is adjusted to be only toddlers still in development,[20] as well as older, adult populations.[21] The consistency of this result continues when the experimental paradigm changes as well. Different types of search, like hybrid search mentioned when discussing foraging, yield results that show people with ASD continuing to outperform neurotypical control groups. These paradigms include conjunctive and complex visual search tasks,[22] as well as search tasks specifically designed for threat detection, like the previously mentioned study concerning predators.[23]

Whether these paradigms are comparable to the real world–live threats, constantly moving threats, etc–is still up for debate.

While these are valid concerns due to the difficulties of reproducing non-lab conditions within the lab, some researchers have attempted to assuage these doubts by continuing to increase the complexity of these tasks. Joseph et al., for example, employed dynamic search paradigms with moving targets and found that the ASD group has no disruptions in search superiority as with a static paradigm.[24] Of course, the concerns remain. The lab will never be a replication of real-life conditions, and gaps remain when looking at the problem at hand from this viewpoint which helps outline the importance of further research in this area.

Conclusion and Discussion

Through evaluation of the literature, it is abundantly clear that, despite a small number of caveats, visual search is generally superior among those with ASD when compared to neurotypical control populations in the vast majority of paradigms available in the lab, even if the size of this superiority varies. This advantage could make up one aspect of certain evolutionary trade-offs of the disorder, i.e. lesser social cognitive ability for increased visual search ability. In the present day, social cognition may play a much larger role in an individual's life over visual search, especially visual search regarding threats or food. This can help to explain the stigmas that think of ASD characteristics as much more disadvantageous than advantageous.

If increased visual search ability helps to preserve reproductive ability and survival by providing advantages in threat detection or foraging behaviour, and those with ASD characteristics are overwhelmingly more accurate and faster at visual search, then it must follow that those with ASD likely have an advantage in this field, helping their genes to persist over time.

This logical progression is underexplored in the literature and thus provides a path forward for evolutionary psychologists and researchers working to destigmatize ASD. Neurodiversity termed 'disordered' evokes thoughts of disadvantages and disadvantages only. When looking through an evolutionary lens, however, we can understand the ways in which people with ASD and similar genetic markers (BAP) are advantaged, not only in survival and the far away past, but also, albeit less-so, in every-day life, as we use visual search, simple and complex, in our daily tasks. An evolutionary lens applied to a hereditary condition like ASD, is imperative in achieving an in depth understanding of the disorder.

Notes

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