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INVITED PAPER

ADHD AND ASD ARE NORMAL BIOLOGICAL VARIATIONS AS PART OF HUMAN EVOLUTION AND ARE NOT "DISORDERS"

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Abstract

Recent developments driven by people with attention-deficit hyperactivity disorder (ADHD) and/or autism spectrum disorder (ASD) have highlighted that far from being disorders, ADHD and/or ASD can be seen as natural variations in neurodevelopment. The neurodiversity movement acknowledges that people with ADHD and/or ASD have specific strengths, that can help them outperform neurotypical individuals in certain situations and that these conditions should therefore not be seen as disorders. This view is supported by evolutionary science, which can be used as a framework to understand ADHD and/or ASD as natural variations that were not eliminated by natural selection due to their benefit to the individual and group in certain situations. The evolutionary perspective supports neurodiversity as relevant and important in helping our species thrive.

Key words: neurodiversity, evolution, ADHD, autism, neurodevelopment, variation

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Introduction

The view that ADHD and ASD are 'disorders' is increasingly being challenged (Baron-Cohen, 2017; Sonuga-Barke & Thapar, 2021). Both ADHD and ASD are dimensional and occur on a spectrum across the population, rather than being categorical disorders (Sonuga-Barke & Thapar, 2021). Doyle (2020) lists how people with ADHD have above average skills in creative thinking, visuospatial reasoning and courage, while people with ASD excel at memory, innovative thinking, observation of details and often have specialist skills. Furthermore, ASD is linked with high intelligence, and it is common that autistic people excel and outperform neurotypical people in careers in science, mathematics and technology (Crespi, 2016). It is therefore not correct to only consider the neurotypical way of being as 'normal', because people who are neurodiverse often outcompete the neurotypical majority. They can then hardly be considered to have a 'disorder' and neurodiversity can be closer to a 'superpower'.

Brinkmann (2024) makes the salient point that 'a person can only be said to be mentally ill or disordered if that person experiences suffering or distress to a considerable extent', which cannot be said for many people who are neurodiverse and lead happy and successful lives.

This does not negate the considerable difficulties that the small number of people experience whose symptoms are so extreme that they are clearly outside normal variation. These people often have underlying genetic syndromes that are linked with intellectual disability (Shah et al., 2022). Also, those individuals whose developing brains were exposed to drugs or alcohol *in utero* and subsequently develop ADHD or ASD, cannot be considered to be part of a normal variation and are correctly considered to have a 'disorder'.

The neurodiversity movement correctly views variations in brain function, such as those associated with (high functioning) ASD and ADHD as normal variations rather than as 'disorders' (Pluck 2023). Neurodiversity is therefore defined as the normal range of function in a population (Pluck 2023).

It is important to note that traits characteristic of ADHD and ASD can be either advantageous or disadvantageous, depending on the context (Swanepoel et al., 2022). We therefore need to focus on finding and remedying the aspects of the environment which are disabling for the individual, rather than pathologizing the individual. As Baron-Cohen (2017) states: 'The concept of neurodiversity is highly compatible with the civil rights plea for minorities to be accepted with respect and dignity' and continues that 'we need a framework that does not pathologize and focus disproportionately on what the person struggles with, and instead takes a more balanced view, to give equal attention to what the person can do.' Also, experts in ADHD research (Cortese et al., 2022) argue that research has focused on the medical model and mainly neglected to consider social and environmental factors, neurodiversity and stigma.

In this paper, I aim to show that evolutionary science can provide the framework (Troisi, 2024) that Baron-

Cohen identifies as being needed (Baron-Cohen, 2017), bridge the gap between biological and environmental factors (Swanepoel et al., 2024), support neurodiversity and reduce stigma (Swanepoel et al., 2022).

Evolutionary perspective

Basic points

Before focusing on the evolutionary perspective of ADHD and ASD, it is important to clarify some basic points that are often misunderstood. Evolution is not about 'survival of the fittest' in the sense that only the most intelligent, fastest and strongest survive. It is rather about the survival and reproduction of those who fit best into their environment. That is why tortoises, slugs and sloths also exist, as they have found a niche in which they can thrive. It is the "goodness of fit" that is most predictive of whether an organism will survive and reproduce.

It is also important to note that evolution is neither conscious nor intentional. Charles Darwin realised that there is an overproduction of young and that those who have even a slight advantage over their peers are the ones who are more likely to survive and reproduce and whose genes will remain in the gene pool.

Retrospectively, we are therefore the descendants of those who survived long enough to reproduce. Evolution does not select for happiness or wellbeing, but only for survival and reproduction. Life goes on as long as people survive and reproduce, even if it is at the cost of great suffering.

Why has natural selection not eliminated ASD and ADHD?

From an evolutionary point of view, we need to ask why ADHD and ASD continue to exist if they are pathological disorders. We know that disorders that arise in later adulthood are not eliminated by natural selection, as reproduction and the transmission of genes to the next generation has already occurred. Natural selection therefore does not act on adult-onset disorders like dementia.

However, both ADHD and ASD are already present in childhood and have a neurodevelopmental origin. They are therefore susceptible to being eliminated by natural selection if they do not confer any benefit.

If we consider rare childhood genetic syndromes that are associated with severe intellectual disability and multi-system involvement, we can see that these syndromes usually arise from de novo mutations and do not run in families. These disorders are not adaptive, and the carriers of these genes generally do not reproduce. Clearly, this is not relevant for most people with ADHD and/or ASD, who commonly have families and where we know that their children have a high chance of having neurodevelopmental disorders too.

ADHD and/or ASD therefore do not fit the pattern of a 'disorder' in the evolutionary sense as they are not selected against. This supports the claim that ADHD and ASD are variations that add value to the individual and/or group and have therefore not been eliminated from the gene pool.

Did ADHD and ASD exist in hunter-gatherers?

Humans lived in hunter-gatherer groups for over 95% of our more than 200 000-year-old evolutionary history. The last 10 000 years that we developed agriculture and changed how we lived, is brief in evolutionary terms. It is therefore sensible to consider the hunter-gatherer way of life as that is arguably what we have evolved to expect and to cope with (Chaudhary & Swanepoel, 2023). Hunter-gatherers lived in groups with multi-family units ranging between 50 and 150 people (Chaudhary & Swanepoel, 2023). This would mean that if we assume that they had a conservative prevalence of ADHD and ASD at around 3% and 1% respectively, each group would have had a few neurodiverse people. It is therefore theoretically possible that neurodiverse individuals benefited the hunter-gatherer societies they lived in and that they therefore survived and reproduced and that is why neurodiversity still exists today (Swanepoel et al, 2022).

In evolutionary science there are three different concepts that we need to consider in the context of the possible benefit of neurodiversity. These are "individual fitness" which refers to the number of offspring an individual leaves, whether they raise them or not; "inclusive fitness" refers to the number of offspring that an individual rears or supports, regardless of who the biological parents are; and "group selection", which is a proposed mechanism of evolution in which natural selection acts at the level of the group, instead of at the level of the individual or gene.

We know that children with ADHD with the characteristics of hyperactivity, impulsivity and inattention are at a disadvantage in our modern schools where children are expected to sit still and listen. They are caught in an 'evolutionary mismatch' where they are not adapted to what is expected in modern schools in our WEIRD societies (Western, Educated, Industrialised, Rich and Democratic) (Swanepoel et al, 2017).

However, in our evolutionary past it is possible that having high levels of energy, a willingness to take risks, and distractable attention were beneficial in situations where people had to move in harsh environments and be quick to notice danger (Swanepoel et al., 2017). For example, the Ariaal in Kenya who had a higher proportion of the DRD4 receptor, which is associated with ADHD, were better nourished than those without the DRD4 receptor when they were nomadic, but not when they were settled (Williams & Taylor, 2006; Swanepoel, 2024). In harsh conditions that required lots of physical activity, an awareness of danger and a willingness to take risks, people with ADHD may outperform those who are neurotypical (Swanepoel et al., 2017).

It is also likely that the few individuals with autistic traits benefited the tribe through their superior abilities regarding memory, visuospatial skills and special interests, which may have included crafts that were useful to the tribe (Swanepoel et al., 2022).

We can therefore argue that both ADHD (Williams & Taylor, 2006) and autism (Hunt & Jaeggi, 2022) in hunter-gatherers may have had benefits in terms of group selection, which proposes that traits may exist even if they are disadvantageous to the individuals themselves because they benefit the group in which the individual lives. This theory dates back to Darwin, but it fell into disfavour in the 1970s when it was widely presumed that the forces of natural selection operated much more strongly on individuals. More recently, however, there has been a resurgence in group selection theory (Wilson and Sober, 1994), though it is still controversial. In a recent review, Nesse (2023) makes the point that natural selection can maintain genetic subgroups within a species that thrive in specialised niches but specifies that this is unlikely to be relevant for mental disorders.

This supports the neurodiversity movement and the view that ADHD and autism are natural variations and not mental disorders. As Hunt & Jaeggi (2022) state: 'human evolution has selected for specialised minds' and go on to explain that modern economies are run with the division of labour, which may result from the continuation of our long evolutionary history of social niche specialisation, and that this has contributed to our species' success.

Life history theory

Evolution does not prepare us only for the optimum. When a mother is stressed due to her treacherous environment, her stress hormones prime the baby's developing stress systems to be sensitive to danger. Once the baby is born into the same harsh environment and has a sensitised stress system, it may promote survival compared to a young one who was too trusting. Intrauterine stress is one of the potential contributors to the development of ADHD and it is possible that the symptoms of hyperactivity, impulsivity and inattention may be beneficial in a dangerous situation where a lot of movement, the willingness to take risks, and distractible attention that is quick to note danger could promote survival (Swanepoel et al., 2022).

Life history theory describes the unconscious strategies that all living organisms follow in terms of the question of when to reproduce, how many children to have and how much care to provide to each. It differs both between species and within our own species. It ranges from a fast life history, (in which early reproduction and the quantity of offspring is prioritised) to a slow life history (in which reproduction is delayed, and great resources are invested in very few young ones) (Troisi, 2005).

It is important to note that there is no 'right' or 'wrong' life history strategy. In a harsh environment where many children are expected to die before they reach adulthood, those who had as many children as possible had a better chance of leaving at least some surviving descendants. On the other hand, in a benign environment where children are expected to reach adulthood, those who invest most in fewer children will have the greatest chance of having offspring who can outcompete their peers and rise in the hierarchy.

A fast life history is more typical in people with ADHD, who tend to have children at younger ages and have more children in total. A slow life history is found in ASD, where people wait longer before having fewer children, in whom they invest considerable resources.

Depending on how dangerous the environment is and what the mortality rate for children is, either of these strategies can be the optimal strategy to follow: fast for dangerous and slow for benign (Swanepoel, 2024).

Differential susceptibility

Nature really does not put all her eggs into one basket. The more variety there is in life, the better that at least some individuals will survive and reproduce. We know that this is also the case in terms of differential susceptibility (Troisi, 2018). Sensitivity to the environment, whether it is benign or harsh, is much more pronounced in some individuals (described as 'orchids') than in others, who like 'dandelions', thrive regardless of the quality of the environment.

It is important to note that the sensitive individuals do not have a just a vulnerability to harsh environments, they also have an advantage if they are in a benign environment, as they can outperform the more typical people then (Swanepoel et al., 2022). Nature hedges her bets: whether the environment is benign or harsh, there will always be some individuals who thrive.

Interestingly, this is much the same with investment in the financial markets, where the best advice is to diversify and to hedge your bets. Evolution has perfected these strategies over millions of years.

Conclusion

As Troisi (2005) states: "Since a major contribution of evolutionary theory is the insight that individual differences are core biological features of any animal species, including Homo sapiens, the application of the concept of alternative strategies to psychiatry and clinical psychology can be a powerful antidote to the growing tendency to medicalize human diversity".

We need to stop saying that people who are in a neurodiverse minority but outperform the neurotypical majority in select situations, suffer with a 'disorder'. We need to recognise that variations are the spice of life and that we are all stronger together if we are more diverse. To do that, we need to understand that one size does not fit all.

Shah et al. (2022) point out that we may be able to reduce impairment and suffering in neurodiverse individuals if we accommodate differences and reduce barriers to participation. It is important to note that this does not negate giving neurodiverse people clinical treatment where needed, if we also try to adapt environments and transform neurotypical attitudes by embracing neurodiversity (Sonuga-Barke & Thapar, 2021, Swanepoel 2021). We need to adjust our schools and workplaces to enable everyone to thrive.

Neurodiversity is natural and makes us stronger. It would be of benefit to all humans if the special skills and talents of neurodiverse people were recognised and fostered. Once neurodiversity is understood and accepted, it will have the added benefit of reducing stigma associated with ADHD and ASD. I hope that this paper will contribute to that aim.

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