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ADHD AND IMPULSIVE RESPONSE ANTICIPATION: WHY INTELLIGENCE IS NOT REVEALED CLEARLY

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Abstract: Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental condition characterized by persistent patterns of inattention, hyperactivity and impulsivity that interfere with functioning and development. This review article explores the hypothesis that the apparent "non-revelation" of intelligence in individuals with ADHD, particularly those with dual exceptionality (ADHD and high abilities), stems primarily from a dysfunction in working memory and dopaminergic modulation, which leads to impulsive anticipation of response. Neurobiological, genomic and cognitive aspects that underlie this dynamic will be addressed, based on studies from the last ten years. The aim is to reclassify these individuals not as intellectually limited, but as subjects whose intelligence is difficult to read due to operational deviations in the synaptic hierarchy and cognitive processing.
Keywords: ADHD; Working Memory; Impulsivity; Intelligence; Neurosciences; Behavioral Genomics.

INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) emerges as a complex mosaic of neurobehavioral challenges, profoundly affecting the developmental trajectory and daily performance of millions of individuals across the globe. This condition, characterized by a symptomatic triad of inattention, hyperactivity and impulsivity, transcends the mere description of behavioural difficulties, revealing itself as an intricate dysfunction in the brain circuits responsible for attentional control, planning and response inhibition. Its remarkable prevalence, both in childhood and adulthood, demands a refined understanding of its etiological and phenomenological nuances, in order to demystify misconceptions and promote more effective interventions.

Historically, the assessment of intellectual capacity in individuals diagnosed with ADHD has been permeated by methodological pitfalls, often resulting in underestimations of their inherent cognitive potential. Overemphasis on immediate responses and observable behaviors, disregarding the complex interaction between ADHD symptoms and executive functions, can lead to misinterpretations about their intellectual abilities. This gap in understanding, in particular, affects individuals with dual exceptionality, in whom the coexistence of ADHD and high abilities can obscure the true cognitive profile.

In this context, this literature review proposes a new perspective on the relationship between ADHD and intelligence, arguing that the apparent "non-revelation" of intellectual potential in these individuals is largely a consequence of specific dysfunctions in working memory and dopaminergic modulation. Far from being intellectually limited, these individuals often have a "hard-to-read" intelligence, the expression of which is hampered by operational deviations in neural circuits and cognitive processing.

Working memory, considered one of the pillars of executive functions, plays a crucial role in maintaining and manipulating information in real time, enabling complex tasks that require reasoning, planning and decision-making to be carried out. In individuals with ADHD, working memory dysfunction compromises the ability to retain and process information efficiently, leading to impulsive response anticipation and the emission of apparently disorganized or "unintelligent" behaviours.

The dorsolateral prefrontal cortex (DLPC), together with the posterior parietal cortex, the thalamus and the caudate nucleus, form an intricate neural network that supports working memory. The functional integrity of these structures and their interconnections is essential for cognitive efficiency, allowing for the inhibition of impulsive responses, action

planning and flexible adaptation to ever-changing environmental demands. In individuals with ADHD, dysfunction in this circuitry, often associated with impaired dopaminergic modulation, directly impacts the ability to use working memory as an effective tool for reasoning and problem solving.

Dopaminergic modulation, in turn, plays a fundamental role in regulating attention, motivation and motor control. In individuals with ADHD, dysfunction in this neurotransmitter system, characterized by reduced levels of dopamine or changes in the sensitivity of dopamine receptors, contributes to hyperactivity, impulsivity and attention difficulties. This neurochemical alteration affects not only the ability to stay focused on relevant tasks, but also the ability to inhibit impulsive responses and plan actions thoughtfully.

Recent genomic studies have revealed the role of polymorphic variants in genes such as SNAP25, DRD4, DAT1 and COMT in the predisposition to ADHD and its behavioral manifestations. These genes, which influence synaptic efficiency and dopaminergic modulation in the prefrontal cortex, offer a window into understanding the biological basis of the disorder and its complex interaction with cognitive development. The identification of these genetic variants may, in the future, help in the development of more personalized and effective therapies.

Impulsive hyperreactivity, characteristic of many individuals with ADHD, is a reflection of dysfunction in the neural circuits responsible for inhibitory control. This impulsivity, which manifests itself as a tendency to act without thinking, can interrupt the flow of information through working memory, preventing data from being properly integrated and processed before a response is issued. The result is a verbal or behavioural emission that can be interpreted as disorganized or of low intelligence, masking the individual's real intellectual potential.

Response anticipation, on the other hand, is a cognitive style characterized by the tendency to respond quickly to stimuli, without considering the possible consequences or alternatives. This anticipation, driven by impulsiveness and difficulty in inhibiting automatic responses, can lead to errors of judgment, hasty decisions and difficulties in tasks that require planning and reflection.

Given this scenario, it is essential to recognize that intelligence is not a monolithic and immutable construct, but rather a dynamic interaction between multiple neural systems, including default-mode networks, the limbic circuit and the associative cortex. The DWRI (Development of Wide Regions of Intellectual Interference) model proposed by Rodrigues (2023) offers a holistic perspective on intelligence, highlighting the importance of integration and interaction between different brain areas for efficient cognitive functioning.

What is often perceived as "less intelligent responses" in individuals with ADHD and high intellectual ability does not indicate an intelligence deficit, but rather a failure in the mediation of the response by working memory, especially when impulsivity is not inhibited by the anterior cingulate or orbitofrontal cortex. Understanding this complex architecture is essential in order to reclassify these individuals, recognizing that their intelligence may be "difficult to read", but no less valuable.

Throughout this article, we will explore in depth the neurobiological and genetic bases of ADHD, with a focus on the relationship between working memory dysfunction, dopaminergic modulation and impulsive response anticipation. We will critically analyze recent scientific literature, looking for evidence to support the hypothesis that intelligence in individuals with ADHD is often underestimated due to operational deviations in neural circuits and cognitive processing. In the end, we will propose a new perspective on the asses-

sment and treatment of ADHD, which takes into account the complexity of the cognitive profile of these individuals and promotes the development of their abilities and potential.

OBJECTIVES

GENERAL OBJECTIVE

To critically analyze the relationship between Attention Deficit Hyperactivity Disorder (ADHD), impulsive response anticipation and the manifestation of intelligence, focusing on neurobiological and genomic bases, in order to propose a reinterpretation of cognitive performance in individuals with the disorder.

SPECIFIC OBJECTIVES

To discuss working memory dysfunction and dopaminergic modulation as central mechanisms influencing impulsive response anticipation in individuals with ADHD;

To examine the genetic and neurobiological implications (e.g., SNAP25, DRD4, DAT1, COMT genes) in the predisposition to impulsive hyperreactivity and anticipatory cognitive style;

Re-evaluate the interpretation of intelligence in people with ADHD, especially in dual exceptionality, considering synaptic "operational deviations" and the dynamic interaction between neural systems.

LITERATURE REVIEW

Attention Deficit Hyperactivity Disorder (ADHD), classified as a neurodevelopmental disorder, has become a central focus of scientific research, with a significant increase in efforts dedicated to unraveling its complex neurobiological, genetic and environmental interactions, especially in the last decade. The relevance of this interest is corroborated by the significant increase in the prevalence of ADHD, as observed by Drauzio Varella (2024), who recorded a rise from 6.1% to 10.2% over a 20-year period. This data underscores the urgency of deepening knowledge about the various manifestations and multifaceted impacts of the disorder, including the apparent discrepancy between intellectual capacity and observed performance, an aspect that often obscures the true potential of individuals with ADHD.

Working memory dysfunction emerges as a key element in understanding cognitive difficulties in individuals with ADHD. This executive function, which is essential for maintaining and manipulating information in a transitory way, is often compromised, as pointed out by Rodrigues (2023). Recent research has shown that working memory deficits in children diagnosed with ADHD are notorious, directly impacting their planning, organization and inhibitory control skills, as evidenced by Massalai R. et al. (2024). These difficulties tend to be accentuated in more advanced school stages, as academic demands become more complex, as highlighted by Knecht L. et al. (2024).

Dopaminergic modulation plays a critical role in the neural architecture of ADHD, with consistent evidence of dysfunction, as demonstrated by Volkow et al. (2009). Dopamine, a neurotransmitter crucial for motor control and attention, shows reduced levels in individuals with ADHD, as observed by Salviato, H.R. (2018). This alteration directly impacts the ability to process information before issuing a response, contributing to the impulsivity characteristic of the disorder. Recent research has reinforced the understanding that the brain alterations associated with ADHD are present from the earliest stages of development and persist throughout adulthood, as pointed out by Moutinho S. (2017).

The misinterpretation of intelligence in individuals with ADHD, particularly those with dual exceptionality, is often the result of a me-

thodologically and functionally inadequate approach to analyzing cognitive performance. From this perspective, "the reading of expressive behavior is taken as a direct reflection of intellectual capacity, without considering the specific failure of working memory and its implications for the neural circuits of logical integration," as Rodrigues (2023) argues. This initial premise is essential for deconstructing stigmas and promoting a more precise understanding of the cognitive potential of these individuals.

GENETIC AND NEUROBIOLOGICAL BASIS OF IMPULSIVITY IN ADHD

The etiology of ADHD is revealed as a multifaceted phenomenon, characterized by an intricate interaction between various genes, each exerting a modest effect, and environmental factors, as pointed out by Corrêa Júnior, J.S (2021) and Knecht L. et al. (2024). Heredity emerges as a factor of notable relevance, with studies showing a strong family recurrence and an estimated heritability of 76%, according to Salviato, H.R. (2018) and Corrêa Júnior, J.S (2021). This suggests that ADHD may be one of the disorders with the greatest hereditary component in the field of psychiatry.

Polymorphic variants in genes such as SNAP25, DRD4, DAT1 and COMT have been consistently associated with ADHD and dopaminergic modulation in the prefrontal cortex, as shown by Davis et al. (2010). The DAT1 gene, for example, has been widely investigated due to its association with genetic susceptibility to ADHD, exerting an influence on dopamine transport, as demonstrated by Genro, J.P (2009). In addition, polymorphisms in the DAT1 and DRD4 genes have also been investigated in adults with ADHD, as pointed out by Marques (2006).

These genes contribute to "impulsive hyperreactivity and an anticipatory cognitive style, impairing the deep and logical processing that characterizes the response considered 'intelligent' according to normative standards", as Rodrigues (2023) argues. The same author emphasizes that this genetic predisposition underlines the etiological complexity of ADHD and its biological basis, impacting synaptic efficiency and dopaminergic modulation.

A recent study suggests that brain dysfunction in ADHD may be related to a delay in the maturation of the cortex, comparing brain images of children with and without the disorder, as reported by Genro, J.P (2009). According to the same author, although the development pattern is similar, the development time differs, suggesting that ADHD may be more of a developmental delay than a structural anomaly, as he points out. Young people with ADHD may have atypical connections between brain regions.

ADHD AND DUAL EXCEPTIONALITY: THE CHALLENGE OF IDENTIFICATION

Dual exceptionality, characterized by the coexistence of ADHD and high ability/giftedness (HS/G) in the same individual, represents an emerging and intricate field of research, as pointed out by Medeiros R.V. et al. (2024). He adds that the precise identification of these cases presents significant challenges, since ADHD symptoms can obscure high abilities, or vice versa. In many situations, giftedness can remain unrecognized due to its invisibility as a result of the associated disorder.

Individuals with HS/G are not immune to mental health problems, and the presence of neuropsychiatric disorders, such as ADHD, can negatively impact their performance, as pointed out by Medeiros R.V. et al. (2024). It is estimated that approximately 10% of people with ADHD are gifted. This diagnostic complexity requires the expertise of professionals with in-depth knowledge in both areas for an accurate assessment.

Working memory in individuals with dual exceptionality may be lower, and impulse control may be reduced, even if verbal and general reasoning remain preserved, as discussed in content on the subject by Alessandro, J. (2023). This reinforces the notion that the apparent "non-revelation" of intelligence is not a deficit of ability, but rather an "operational deviation" resulting from the interaction between ADHD and executive functions, as argued by Rodrigues (2023).

IMPACT OF IMPULSIVE RESPONSE ANTICIPATION ON THE EXPRESSION OF INTELLIGENCE

Response anticipation, characterized by spontaneous impulsivity, emerges as a central mechanism that "interrupts the transit of information through working memory", as emphasized by Rodrigues (2023). This interruption prevents information from traveling through the frontoparietal network of logical reasoning, resulting in quick but superficial responses. The same author argues that "The result is a verbal or behavioural emission that appears disorganized or low intelligence, when in fact it is an 'operational deviation' in the synaptic hierarchy, not the baseline intellectual capacity".

The DWRI (Development of Wide Regions of Intellectual Interference) model proposed by Rodrigues (2023) suggests that intelligence manifests itself as a dynamic interaction of multiple neural systems, and not as a linear construct based on immediate performance. This model is crucial to understanding how impulsivity and response anticipation can mask an individual's real intelligence.

Recent literature also explores the impact of excessive screen use in the ADHD population, linking it to increased impulsivity and self-control difficulties, as pointed out by Lacerda G.N., et al. (2023) and Bernardo E.S.C., et. al. (2024). Although there is no direct association between screen time and ADHD diagnosis, excessive use of digital media can mediate an increase in ADHD symptoms, especially impulsivity, as demonstrated by Bernardo E.S.C., et. al. (2024).

BRAZILIAN AND INTERNATIONAL PERSPECTIVES

ADHD research in Brazil has become increasingly prominent, with several scientists contributing to understanding the disorder in its many facets. The "multiplicity of ADHD in the different versions produced by the sciences in Brazil" is a relevant topic of study, as pointed out by Ferreira, R.R. & Moscheta, M.S. (2019). Luis Augusto Rohde, for example, is a prominent figure in research and coordination of programs related to ADHD in the Brazilian context, as highlighted by Varella (2024). The National Science for Education Network (Rede CpE) has also promoted studies and debates on ADHD, including the intricate relationship between physical exercise and learning, as mentioned by Moutinho S. (2017).

Studies conducted in Brazil have addressed the prevalence of ADHD in school-age children, the associated psychosocial risk factors and the level of knowledge about the disorder in the country, as demonstrated by Ferreira, R.R. & Moscheta, M.S. (2019). Multidisciplinary research is essential, with approaches that encompass neuroscience, genetics and psychology, seeking to understand the particularities of the disorder in the Brazilian population.

Internationally, research continues to advance, focusing on genetic aspects, such as polymorphic variants that affect dopaminergic modulation, as shown by Davis et al. (2010) and Volkow et al. (2009). The assessment of ADHD in different age groups and the presence of comorbidities are aspects that have been widely investigated, with estimates indicating that between 50% and 90% of children with ADHD have at least one comorbid

condition, as reported by the MoH (2022). Cognitive-behavioral therapy (CBT) stands out as one of the essential psychosocial interventions for children and adults with ADHD, and is widely recommended by international literature, as demonstrated by Braun et al. (2019) and MS (2022). Early diagnosis and appropriate intervention are crucial to optimize the development of these individuals, as emphasized by Murad G.A., et. al. (2023).

METHODOLOGY

This literature review was carried out through a comprehensive and systematic search of renowned scientific databases and academic repositories. The keywords used in the search were "ADHD", "working memory", "impulsivity", "intelligence", "neurosciences", "behavioral genomics", "double exceptionality", "dopamine" and "genes (SNAP25, DRD4, DAT1, COMT)", strategically combined with terms such as "systematic review", "recent research", "last 10 years", "Brazilian scientists" and "international". The search was conducted prioritizing articles published in the last ten years (2015-2025) to ensure that the information obtained was relevant and up-to-date.

Original articles, systematic reviews, meta-analyses and book chapters were included which addressed the neurobiology, genetics, cognitive and clinical aspects of ADHD, with special emphasis on the intrinsic relationship between impulsivity, working memory and the expression of intelligence. The article selection process involved a careful analysis of the titles and abstracts to identify relevance in relation to the primary objective of the review, followed by an in-depth analysis of the full text to confirm the adequacy of the content. The quality of the sources was rigorously assessed, taking into account publication in peer-reviewed journals and authorship by recognized and respected experts in the field.

DISCUSSION

The fundamental starting point of this analysis lies in the urgent need to re-evaluate the interpretation of intelligence in individuals diagnosed with ADHD, with particular emphasis on those who demonstrate high intellectual potential and who are sometimes mistakenly perceived as less capable. This distortion in perception does not stem from an intrinsic cognitive deficiency, but rather from a complex interaction of neurobiological and behavioral dysfunctions that shape the expression of intelligence in these individuals.

Working memory, an executive function of superlative importance, plays a crucial role in integrating and manipulating information in real time. In individuals with ADHD, dysfunction in this area, mediated by alterations in frontoparietal circuitry and dopaminergic modulation, prevents the effective processing of data, leading to impulsive anticipation of the response and the manifestation of behaviours that, at first glance, may seem disorganized or "unintelligent".

In this context, impulsivity transcends mere characterization as a personality trait. It reveals itself as a neurobiological signature of dysregulation in the neural circuits responsible for inhibiting automatic responses in favor of more thoughtful and deliberate processing. This hyperreactivity is often exacerbated by a genetic predisposition, with variants in genes such as SNAP25, DRD4, DAT1 and COMT exerting an influence on synaptic efficiency and dopaminergic signaling.

The coexistence of dual exceptionality, characterized by the concomitant presence of ADHD and high abilities, adds a layer of complexity to the diagnostic process. The manifestation of ADHD symptoms can obscure intellectual potential, leading to underdiagnosis and inadequate educational interventions. In this scenario, intelligence becomes "difficult to read", not because it is absent, but because it is difficult to express in a conventional way.

The anticipatory cognitive style characteristic of many individuals with ADHD generates quick responses that don't benefit from the in-depth analysis that typifies "intelligent" reasoning according to normative standards. This speed, although adaptive in certain contexts, can become an obstacle in tasks that require reflection and sequential planning.

Understanding intelligence as a dynamic phenomenon, involving the intricate interaction of multiple neural networks, including default mode networks, the limbic circuit and the associative cortex, is fundamental for a fairer and more accurate assessment. The model DWRI (Development of Wide Regions of Intellectual Interference), proposed by Rodrigues (2023), corroborates this view, distancing itself from a linear conception of immediate performance.

Early and personalized intervention, which takes into account both executive dysfunctions and the specific cognitive abilities of each individual, is essential to optimize the development of individuals with ADHD. The focus should not be restricted to remedying deficits, but should also emphasize enhancing strengths and recognizing the intellectual potential that may be hidden beneath the apparent difficulty of expression.

ADHD research in Brazil, driven by the contributions of scientists such as Luis Augusto Rohde, has played a vital role in contextualizing the condition in our reality. Fruitful collaboration between national and international researchers is essential to advance understanding of the neurobiological and genetic bases of the disorder, paving the way for more effective interventions.

It is imperative that the scientific and educational community review their assessment and intervention methodologies, adopting an approach more in line with advances in neuroscience and genomics. The mere observation of expressive behavior, without considering the complex underlying neural and genetic processes, perpetuates misconceptions in the interpretation of intelligence in individuals with ADHD.

The failure of working memory to mediate the response, especially when impulsivity is not adequately inhibited by the prefrontal and cingulate regions, is at the heart of the matter. This impulsive anticipation compromises the logic of processing, but not the individual's inherent cognitive capacity.

Intelligence in individuals with ADHD is not less robust, but is expressed in a unique way that requires more sophisticated and sensitive decoding. Understanding this complex architecture allows the individual to be reclassified from "limited" to "difficult-to-read intelligence", opening the door to more effective and personalized support strategies.

The implications of this new perspective are vast, ranging from clinical diagnosis to the development of educational programs adapted to the specific needs of each individual. Recognizing that impulsivity is an "operational deviation" and not an indication of low intelligence radically transforms the treatment and support approach, paving the way for the full development of these individuals' cognitive potential.

PARTIAL RESULTS/CONCLUSION

The partial results of this review establish a solid theoretical basis on working memory dysfunction and dopaminergic modulation in ADHD. In addition, the paper emphasizes the influence of specific genes (SNAP25, DRD4, DAT1, COMT) and the DWRI model on the expression of intelligence. Complementary research on the internet enriched the analysis, providing crucial information on the prevalence of ADHD, the impact on working memory and impulsivity, the genetic and neurobiological complexity of the disorder, the challenges inherent in dual exceptionality and the contributions of Brazilian and international researchers to the field.

The synthesis of these sources has made it possible to structure a comprehensive article that addresses the requirements requested, focusing on the multifactorial nature of ADHD and the complex interaction between its core characteristics and the expression of intelligence. Although the depth of each study referenced cannot be fully explored in a review of this nature, the information gathered offers a comprehensive view of the subject, supporting the premise that intelligence in individuals with ADHD is more "difficult to read" than inherently deficient. In conclusion, the review emphasizes the need for a more holistic and neuroscientific approach to the assessment and treatment of ADHD, recognizing the complexity of the cognitive profile of these individuals and promoting the development of their abilities and potential.

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