Pontifícia Universidade Católica
do Rio de Janeiro

Louise do Nascimento Marques

An analysis of the variability of the inhibitory control performance in children and adolescents with Autism Spectrum Disorder (ASD)

Dissertação de Mestrado

Dissertation presented to the Programa de Pós-Graduação em Psicologia of PUC-RIO in partial fulfillment of the requirements for the degree of Master em Psicologia.

Advisor: Helenice Charchat-Fichman

Rio de Janeiro,
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ABSTRACT

Marques, Louise do Nascimento. Charchat-Fichman, Helenice (Advisor). **An analysis of the variability of the inhibitory control performance in children and adolescents with Autism Spectrum Disorder (ASD)**. Rio de Janeiro, 2025. 113p. Dissertação de Mestrado – Departamento de Psicologia, Pontifícia Universidade Católica do Rio de Janeiro.

Inhibitory control regulates behavior, emotions, and cognition, playing a crucial role in environmental adaptation. In Autism Spectrum Disorder (ASD), deficits in this function impact academic and social performance. In Study 1 (n = 82), children and adolescents with ASD (n = 18), Intellectual Developmental Disorder (IDD) (n = 16), and typical development (n = 48) completed the Stroop Victoria (reading inhibition) and the Go/No-Go task (motor inhibition). In Study 2 (n = 97), latent profile analysis identified subgroups within the ASD sample, incorporating the Five-Digit Test (FDT) to assess inhibitory control and cognitive flexibility. In Study 1, children with ASD showed difficulties in the Go/No-Go task, making more errors, whereas their performance on Stroop Victoria was similar to the control group but superior to the IDD group. In Study 2, three profiles emerged: Medium (34%), Lower Medium (41%), and Below Average (25%), the latter showing greater deficits and more comorbidities, such as ADHD symptoms. The performance of the ASD group varied depending on the task and its level of difficulty, highlighting the heterogeneity of inhibitory control in the sample and the influence of age and educational level.

Keywords:

Executive Functions; Executive control; Assessment; Autism spectrum disorder; Neurodevelopmental disorders.

RESUMO

Marques, Louise do Nascimento. Charchat-Fichman, Helenice. **Uma análise da variabilidade do desempenho no controle inibitório em crianças e adolescentes com Transtorno do Espectro Autista (TEA)**. Rio de Janeiro, 2025. 113p. Dissertação de Mestrado – Departamento de Psicologia, Pontifícia Universidade Católica do Rio de Janeiro.

O controle inibitório regula comportamentos, emoções e cognição, sendo essencial para a adaptação ambiental. No Transtorno do Espectro Autista (TEA), déficits nessa função afetam desempenho acadêmico e social. No Estudo 1 (n = 82), crianças e adolescentes com TEA (n = 18), Transtorno do Desenvolvimento Intelectual (TDI) (n = 16) e desenvolvimento típico (n = 48) realizaram o Stroop Victoria (inibição de leitura) e o Go/No-Go (inibição motora). No Estudo 2 (n = 97), a análise de perfis latentes identificou subgrupos dentro do TEA, incluindo o Five-Digit Test (FDT) para avaliar controle inibitório e flexibilidade cognitiva. No Estudo 1, crianças com TEA apresentaram dificuldades no Go/No-Go, com mais erros, enquanto no Stroop Victoria seu desempenho foi semelhante ao grupo controle, mas superior ao grupo TDI. No Estudo 2, emergiram três perfis: Médio (34%), Médio Inferior (41%) e Abaixo da Média (25%), este último com maiores déficits e mais comorbidades, como sintomas de TDAH. O desempenho do grupo TEA variou conforme a tarefa e o nível de dificuldade, destacando a heterogeneidade do controle inibitório na amostra e a influência da idade e escolaridade.

Palavras-Chave:

Funções Executivas; Controle executivo; Avaliação; Transtorno do espectro autista; Transtornos do neurodesenvolvimento.

RESUMO EXPANDIDO

O controle inibitório é uma função executiva essencial para a regulação de comportamentos, emoções e cognição, permitindo a supressão de respostas impulsivas ou automáticas em favor de ações mais adequadas ao contexto. No Transtorno do Espectro Autista (TEA), déficits nessa habilidade podem prejudicar a adaptação a demandas ambientais, afetando o desempenho acadêmico, a interação social e a autorregulação emocional.

No primeiro estudo (n = 82), foram comparados três grupos: crianças e adolescentes com TEA (n = 18), com Transtorno do Desenvolvimento Intelectual (TDI) (n = 16) e com desenvolvimento típico (n = 48). O controle inibitório foi avaliado por meio de duas tarefas clássicas. O *Victoria Stroop Test* mede a capacidade de inibir uma resposta automática de leitura para nomear a cor da tinta das palavras apresentadas, avaliando a habilidade de controle de interferência cognitiva. Já a tarefa *Go/No-Go* avalia a inibição motora ao exigir que os participantes respondam rapidamente a estímulos-alvo (Go), enquanto precisam suprimir a resposta diante de estímulos *No-Go*.

No segundo estudo (n = 97), buscou-se identificar perfis distintos de controle inibitório dentro do grupo TEA por meio da análise de perfis latentes. Para isso, além das tarefas *Stroop* e *Go/No-Go*, foi incluído o *Five-Digit Test* (FDT), um teste que avalia controle inibitório, velocidade de processamento e flexibilidade cognitiva. O FDT exige que os participantes realizem diferentes respostas a estímulos numéricos de acordo com regras variáveis, sendo utilizado para mensurar a capacidade de alternância entre demandas cognitivas e a supressão de respostas impulsivas. A análise de perfis latentes permitiu classificar os participantes do grupo TEA em três subgrupos distintos, com base no desempenho nas três tarefas, identificando padrões de controle inibitório e sua relação com variáveis cognitivas e comportamentais.

No Estudo 1, foram comparadas as *performances* dos três grupos nas tarefas de controle inibitório. Na tarefa *Victoria Stroop Test*, não foram encontradas diferenças significativas entre os grupos TEA e controle, indicando que crianças com TEA apresentaram desempenho semelhante ao das crianças com desenvolvimento típico na inibição de respostas automáticas

em um contexto altamente estruturado. No entanto, crianças com Transtorno do Desenvolvimento Intelectual (TDI) tiveram desempenho inferior às dos outros dois grupos na tarefa *Stroop*, sugerindo maiores dificuldades na inibição de interferências cognitivas. Na tarefa *Go/No-Go*, crianças com TEA apresentaram desempenho significativamente inferior ao grupo controle, evidenciado por um maior número de erros de omissão, ou seja, falhas em responder corretamente aos estímulos-alvo, e erros de comissão, caracterizados por respostas inadequadas a estímulos *No-Go*. O grupo TDI também demonstrou dificuldades nessa tarefa, mas sem diferenças estatisticamente significativas em relação ao grupo TEA, sugerindo que ambos os grupos clínicos enfrentam desafios na inibição de respostas impulsivas.

No Estudo 2, a análise de perfis latentes foi utilizada para identificar padrões distintos de controle inibitório no grupo TEA, considerando os desempenhos nas tarefas *Stroop, Go/No-Go e Five-Digit Test (FDT)*. Três subgrupos foram identificados. O perfil médio, que correspondeu a 34% dos participantes, apresentou desempenho próximo à média da amostra nas três tarefas, sem grandes déficits em controle inibitório. O perfil médio inferior, composto por 41% dos participantes, demonstrou dificuldades moderadas nas tarefas, especialmente no *Go/No-Go*, indicando fragilidades no controle da impulsividade. Já o perfil abaixo da média, representando 25% dos participantes, caracterizou-se por déficits mais graves no controle inibitório, com alto número de erros em todas as tarefas. Esse grupo apresentou maior incidência de queixas comportamentais, incluindo impulsividade elevada, dificuldades na autorregulação emocional e maior presença de comorbidades, como sintomas de Transtorno de Déficit de Atenção/Hiperatividade (TDAH).

Os achados destacam a relevância do formato das tarefas na avaliação do controle inibitório, evidenciando que crianças com TEA apresentam maior dificuldade em tarefas que exigem resistência a distrações visuais e controle motor. Além disso, idade e nível educacional influenciaram significativamente o desempenho nas tarefas. Os resultados reforçam a heterogeneidade do controle inibitório no TEA e a necessidade de abordagens

avaliativas que considerem tanto as demandas das tarefas quanto as características individuais.

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1. PRESENTATION

The present dissertation investigates inhibitory control in children and adolescents with Autism Spectrum Disorder (ASD) as part of a broader research initiative, "Neuropsychological, Socioemotional, Behavioral, and Neurophysiological Profile of Autism Spectrum Disorder", previously approved by the ethics committee through Plataforma Brasil (CAEE: 41590720.4.0000.5257).

This larger project seeks to comprehensively map the cognitive and behavioral characteristics of children and adolescents with ASD by integrating neuropsychological assessments with socioemotional and behavioral measures. Within this context, the current research focuses specifically on the variability of inhibitory control performance in ASD, considering different task demands and individual differences. To achieve this goal, inhibitory control was assessed using three established paradigms:

1. **Victoria Stroop Test** – Evaluates the ability to suppress an automatic reading response to name the color of the ink, measuring cognitive interference control.

2. **Go/No-Go Task** – Assesses motor response inhibition by requiring participants to respond to target stimuli (*Go*) while inhibiting responses to non-target stimuli (*No-Go*).

3. **Five-Digit Test (FDT)** – Examines cognitive flexibility and inhibitory control by requiring participants to alternate between different response rules when presented with numerical stimuli.

This dissertation is structured around two empirical studies. The first study aimed to compare the inhibitory control performance of three groups—children with ASD, children with Intellectual Development Disorder (IDD), and typically developing children—using the Victoria Stroop and Go/No-Go tasks. The second study applied all three inhibitory control measures to explore distinct inhibitory control profiles within the ASD group, analyzing their association with cognitive abilities and clinical characteristics.

Additionally, this study compared the ASD group with a non-clinical group of children from a public school.

During the project, I participated as a collaborative researcher at a child and adolescent psychiatry outpatient clinic in Rio de Janeiro, where I was directly involved in study design and data collection. Simultaneously, I trained undergraduate and graduate students in the use of the research protocol (test administration and scoring) to support data collection. During this period, I also assisted in the supervision of outpatient cases. In a later phase, I trained new undergraduate students and collected data at a public school, following approval from the Rio de Janeiro Department of Education. Over these two years of my master's program, I elaborated two articles directly related to my project (one approved and the other in preparation) and two additional articles based on my work at the outpatient clinic—one on Theory of Mind in children with ASD and with Intellectual Development Disorder (IDD) and a case study of twins with language impairments.

Following the presentation of these two studies, the dissertation discusses how task format, cognitive characteristics, and clinical variables influence inhibitory control performance in ASD. The findings contribute to the understanding of the heterogeneity of inhibitory control deficits in ASD and aim to guide professionals in selecting appropriate assessment tools for this population.

2. INTRODUCTION

Understanding executive functions and their development is essential for comprehending the cognitive and behavioral mechanisms underlying neurodevelopmental disorders. Executive functions, broadly defined as higher-order cognitive processes, enable goal-directed behavior by regulating thoughts, emotions, and actions. These functions include working memory, cognitive flexibility, and inhibitory control — each critical for managing everyday challenges such as decision-making, problem-solving, and self-regulation (Diamond, 2013; Zelazo & Carlson, 2020).

Among these functions, inhibitory control stands out as a foundational mechanism that underpins various aspects of cognitive and behavioral regulation. It refers to the ability to suppress automatic, impulsive, or inappropriate responses, allowing individuals to act in a contextually appropriate manner. This capability is particularly significant for managing distractions, regulating emotions, and adapting to changing environments, which are vital for academic success, social interactions, and adaptive functioning (Nigg, 2001; Diamond, 2013).

Research highlights the importance of inhibitory control in understanding the unique cognitive and behavioral profiles of individuals with neurodevelopmental disorders, such as autism spectrum disorder (ASD) and Intellectual Development Disorder (IDD). Inhibitory control deficits are well-documented in these populations and are often associated with challenges in adaptive functioning, emotional regulation, and task execution. However, these impairments manifest differently depending on the task demands and individual characteristics, underscoring the need for nuanced evaluation methods (Spaniol & Danielsson, 2022; Adams & Jarrold, 2012).

Inhibitory Control in Autism Spectrum Disorder

The heterogeneity of inhibitory control deficits in ASD reflects the diverse cognitive profiles and challenges faced by this population. Studies have shown that individuals with ASD may perform comparably to typically

developing peers on tasks requiring response inhibition, such as the Stroop paradigm. However, they encounter significant difficulties in tasks like Go/No-Go, which demand resistance to visual distractors. This discrepancy underscores the role of task-specific demands in shaping performance outcomes (Adams & Jarrold, 2012; Spaniol & Danielsson, 2022).

Moreover, these challenges are influenced by factors such as comorbidities, cognitive abilities, and task format. For example, children with ASD who also exhibit symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD) tend to show pronounced difficulties in inhibitory control, particularly in tasks requiring sustained attention or resistance to distraction. These findings highlight the interplay between inhibitory control and other executive functions, such as working memory and cognitive flexibility, in shaping the cognitive and behavioral outcomes of individuals with ASD (Torenvliet et al., 2023; Zhou & Wilson, 2022). Table 1 illustrates the impairments in inhibitory control that may be present in children with ASD.

Table 1.

Inhibitory Control Deficits in Children with Autism Spectrum Disorder (ASD)

Level/Function of Inhibitory Control	Description	Observed Deficits in ASD	Key References
Response Inhibition	Suppression of prepotent motor responses.	Difficulty inhibiting motor responses; impulsiveness in tasks like Go/No-Go.	Adams & Jarrold, 2012; Torenvliet et al., 2023.
Interference Control	Managing conflicting stimuli (e.g., Stroop).	Comparable to non-clinical peers in structured tasks; struggles with complex stimuli.	Oliveira et al., 2016; Zhou & Wilson, 2022.
Emotional Regulation	Suppression of inappropriate emotional responses.	Heightened emotional reactivity; difficulty managing frustration and anxiety.	Diamond, 2013; Nigg, 2001.
Task-Specific Inhibition	Context-dependent inhibitory demands.	Increased errors in tasks with visual distractors or low support levels.	Adams & Jarrold, 2012; Zhou & Wilson, 2022.

Task-Specific Considerations in Inhibitory Control

The assessment of inhibitory control often relies on standardized paradigms such as the Stroop and Go/No-Go tasks. Each task provides unique insights into different aspects of inhibitory control, such as interference control and response inhibition. For example, the Stroop task requires participants to suppress a prepotent response (reading a word) to name the color of the ink, thereby measuring cognitive interference control. In contrast, the Go/No-Go task evaluates response inhibition by requiring participants to inhibit motor responses to specific stimuli (Oliveira et al., 2016; Adams & Jarrold, 2012).

Task format and complexity significantly influence performance outcomes. Research indicates that individuals with ASD often perform better on structured tasks like the Stroop paradigm but face greater challenges in tasks with higher visual distractor demands, such as the Go/No-Go paradigm. These differences highlight the importance of selecting task formats that align with the cognitive profiles of the population being studied (Adams & Jarrold, 2012; Torenvliet et al., 2023).

Similarly, the level of task standardization and the type of stimuli used can affect sensitivity in detecting inhibitory control deficits. For instance, while individuals with ASD may exhibit comparable performance to non-clinical peers on tasks with simple stimuli, their performance declines when tasks involve complex or socially salient stimuli. This variability emphasizes the need for careful task design and standardization in research and clinical assessments (Adams & Jarrold, 2012; Zhou & Wilson, 2022).

Inhibitory Control in Intellectual Development Disorder

Inhibitory control deficits are also prominent in individuals with IDD, often reflecting global executive function impairments. These deficits impact their ability to manage adaptive behaviors, regulate emotions, and execute daily tasks. For instance, individuals with IDD may struggle with response inhibition and interference control, which can manifest as increased impulsivity, difficulty following instructions, and challenges in adapting to new situations (Spaniol & Danielsson, 2022; Lanfranchi et al., 2010).

The presence of comorbidities in individuals with IDD further complicates the inhibitory control profile. For example, individuals with both IDD and ASD may exhibit compounded deficits due to overlapping impairments in executive functions. These comorbidities can exacerbate challenges in attention, impulse regulation, and cognitive flexibility, leading to more pronounced difficulties in academic and social contexts.

Additionally, comorbid conditions such as ADHD can amplify impulsivity and emotional dysregulation, creating a multifaceted profile that

requires comprehensive assessment and tailored intervention (Kenworthy et al., 2008; Scheuffgen et al., 2000; Torenvliet et al., 2023).

Moreover, the relationship between inhibitory control and cognitive abilities such as IQ is particularly relevant in IDD. Lower IQ scores are often associated with greater difficulties in inhibitory control tasks, reflecting challenges in understanding complex instructions and adapting responses to task demands. This highlights the importance of considering individual cognitive profiles and the impact of comorbidities when evaluating inhibitory control in this population (Kenworthy et al., 2008; Scheuffgen et al., 2000).

Implications for Research and Practice

Understanding the nuanced profiles of inhibitory control in ASD and IDD has significant implications for research and practice. Identifying specific deficits allows for the development of targeted interventions that address individual needs. For example, interventions focusing on cognitive flexibility and attentional control may benefit individuals with ASD, while strategies emphasizing adaptive behavior and emotional regulation may be more suitable for individuals with IDD (Diamond, 2013; Spaniol & Danielsson, 2022).

Moreover, integrating cognitive, behavioral, and pharmacological approaches can enhance the effectiveness of interventions. Tailored strategies, such as reducing distractions in learning environments or using visual supports to aid task comprehension, can help mitigate the impact of inhibitory control deficits on daily functioning and academic performance. These insights also underscore the importance of cross-disciplinary collaboration in designing comprehensive support systems for individuals with neurodevelopmental disorders (Torenvliet et al., 2023; Zhou & Wilson, 2022).

Despite increasing research on executive functioning in ASD, several gaps remain. First, findings on inhibitory control deficits are inconsistent, largely due to methodological differences in task selection and participant characteristics (Christ et al., 2007; Geurts et al., 2014). Additionally, most studies focus on group-level comparisons, which overlook the variability of

cognitive profiles within ASD and IDD. Fernandes, Fichman & Barros (2020) emphasize the need for more precise diagnostic markers to differentiate ASD from IDD, particularly in executive functioning domains such as cognitive flexibility and inhibitory control. Their case analysis suggests that while ASD is primarily characterized by Theory of Mind (ToM) deficits, inhibitory control also contributes to their behavioral and cognitive profile. However, there is limited research on how different inhibitory control profiles emerge within the ASD population and how task format influences performance variability.

Addressing these gaps requires a more comprehensive approach to inhibitory control assessment, considering task demands, individual cognitive profiles, and comorbidities. Integrating findings across multiple inhibitory control paradigms can provide a clearer picture of which aspects of IC are most affected in ASD and IDD and how these deficits relate to daily functioning. Moreover, identifying specific inhibitory control profiles within ASD can inform tailored intervention strategies. For example, interventions targeting cognitive flexibility and attentional control may be particularly beneficial for ASD, while strategies emphasizing adaptive behavior and emotional regulation may better support individuals with IDD (Diamond, 2013; Spaniol & Danielsson, 2022).

Inhibitory control serves as a critical lens for understanding the cognitive and behavioral challenges associated with neurodevelopmental disorders. By examining task-specific demands, individual cognitive profiles, and the interplay between executive functions, researchers and practitioners can better address the diverse needs of individuals with ASD and IDD. Future research should continue to explore the nuanced relationships between inhibitory control and other cognitive domains, paving the way for more effective assessments and interventions.

3. OBJECTIVES

The primary objective of this dissertation is to analyze the variability of inhibitory control profiles in children with ASD. The study aims to identify the particularities of inhibitory control deficits in this population, considering

task-specific demands, cognitive profiles, and potential comorbidities, and to evaluate associations with their clinical history.

3.1 SPECIFIC OBJECTIVES

Based on the literature, individuals with ASD and IDD present distinct inhibitory control profiles, with ASD individuals often exhibiting difficulties in response inhibition (Christ et al., 2007; Geurts et al., 2014) and IDD individuals showing more generalized executive function deficits (Diamond, 2013). However, task format and individual differences introduce variability in these findings. Given this context, the present study aims to test the following hypotheses:

- H1: Children with ASD will show greater impairment in response inhibition tasks (Go/No-Go), while interference control (Stroop) may be more preserved compared to typically developing children.
- H2: The IDD group will exhibit broader inhibitory control deficits, performing worse than both ASD and typically developing children on inhibitory control tasks.
- H3: Distinct inhibitory control profiles will emerge within the ASD group, reflecting variability in executive function skills and comorbidities.
- H4: Comorbidities such as ADHD will negatively impact inhibitory control performance, particularly in tasks requiring sustained attention and motor response inhibition.
- H5: Task format (e.g., visual vs. motor inhibition, complexity of rules) will significantly influence inhibitory control performance in ASD.
- H6: Inhibitory control profiles will be associated with other executive functions, such as working memory and cognitive flexibility, as well as behavioral outcomes.
- H7: The selected inhibitory control tasks will demonstrate adequate sensitivity and specificity in distinguishing ASD from IDD and typically developing groups.

This study aims to address these gaps by systematically examining inhibitory control performance in ASD, IDD, and typically developing children, considering individual differences, comorbidities, and the impact of task characteristics. The research is guided by the following objectives:

- **Compare inhibitory control performance between the ASD, IDD, and non-clinical groups**

Examine and compare the performance of children with ASD, IDD, and typically developing peers across inhibitory control tasks (Stroop and Go/No-Go), testing H1 and H2.

- **Identify inhibitory control profiles within ASD**

  Use latent profile analysis to classify ASD participants into distinct inhibitory control subgroups, testing H3.
- **Assess the impact of comorbidities**

  Evaluate how co-occurring conditions, such as ADHD, influence inhibitory control performance in the ASD group, testing H4.
- **Analyze task-specific challenges**

  Investigate how task complexity and distractor demand affect inhibitory control performance, considering format-specific influences (H5).
- **Identify cognitive and behavioral associations**

  Examine relationships between inhibitory control profiles, working memory, cognitive flexibility, and behavioral measures, addressing H6.
- **Evaluate the discriminatory power of inhibitory control tasks**

  Assess the sensitivity and specificity of inhibitory control measures in differentiating ASD from IDD and typically developing groups (H7).

4. ARTICLE 1

ARTICLE 1
Marques, L., Fernandes. C., Barbirato, F., Krahe, T., Charchat-Fichman. (2025). Inhibitory Control Profile in Clinical and Control Groups: A Preliminary Study of Stroop and Go/No-Go Paradigms. *Psicologia Clínica*, *37*, e001. https://doi.org/10.33208/pc1980-5438v037e001

Title: Inhibitory control profile in clinical and control groups: A preliminary study of Stroop and Go/No-Go paradigms

Abstract

The assessment of inhibitory control, notably through the Stroop and Go/No-Go paradigms, is crucial for understanding the cognitive, behavioral, and emotional profiles of children and adolescents. This study, involving 82 participants predominantly from an outpatient child and adolescent psychiatry clinic, aims to analyze the variability of inhibitory control between clinical and control groups. Participants were categorized into three groups: (1) Autism Spectrum Disorder (ASD); (2) Intellectual and Developmental Disabilities (IDD); and (3) typically developing (control group). No differences were identified between the ASD and control groups in the Stroop task, but discrepancies were observed between the ASD and IDD groups in the first card of the Stroop task (p = .016). In the Go/No-Go task, differences emerged between the ASD and control groups, while no distinction was found between the ASD and IDD groups. When comparing the effect of sociodemographic variables (sex and age group) on performance across the three groups, only the diagnostic group composed of both clinical groups showed a significant effect (F = 15.2692, $p < 0.001$). The results underscore the importance of considering task-specific demands when assessing inhibitory control, showing varying levels of demand with clinical implications, especially for autism.

Keywords: Neurodevelopmental Disorders; Autism Spectrum Disorder; Intellectual Disability; Executive Functions.

Introduction

In recent years, researchers have increasingly conducted empirical and theoretical studies to investigate cognitive and behavioral skills in children and adolescents (Dias et al., 2024; Gunnell et al., 2019). These efforts offer valuable insights into the multidimensional and intricate nature of cognitive development (Miyake & Pekrun, 2019). The development of executive functions has been shown to play a critical role in the academic, social, and emotional skills of children and adolescents (Best et al., 2011). Notably, executive function models have garnered attention for their link to behavior regulation, problem-solving, and decision-making (Diamond, 2013), skills that are crucial for adaptive functioning across various life domains (Zelazo, 2020; Zelazo & Carlson, 2020).

Executive functions encompass a range of mental abilities that enable individuals to organize and manage their actions according to personal goals and intentions (Diamond, 2013). A considerable debate exists regarding the components of executive functions. Adele Diamond's (2013) model highlights core cognitive processes such as inhibitory control, working memory, and cognitive flexibility, alongside higher-level functions like reasoning, problem-solving, and planning. However, other models emphasize executive processes like monitoring, self-regulation, and classification (Lezak et al., 2012). Findings indicate that adequate development of executive functions is related to improved academic performance, social skills, self-management, and mental health (Blair & Razza, 2007; Diamond, 2013; Moffitt et al., 2011).

Among these core executive functions, inhibitory control is a central and predictive factor for executive and cognitive functioning (Nigg, 2001).

Inhibitory control refers to the ability to suppress distracting or irrelevant responses, manage the influence of internal and external interferences, and is linked to attention processes as well as emotional and behavioral regulation (Diamond, 2013). Inhibitory control can be divided into two main functions: interference control and response inhibition. Interference control involves resisting both proactive and retroactive interferences, aiding in the inhibition of cognitive stimuli, and primarily supporting attentional control.

Two widely used paradigms for assessing inhibitory control in clinical and research settings are the Stroop task (Scarpina & Tagini, 2017; Spreen & Strauss, 1998) and the Go/No-Go task (Kohls et al., 2013; Nigg, 2001; Putra et al., 2021). In the Go/No-Go task, participants must quickly respond (Go) to specific target stimuli while refraining from responding (No-Go) to others. There are several variations of the same task incorporating different stimuli like faces and emotions (Egner et al., 2008), food-related figures (Veling et al., 2017), and computerized visual stimuli (Tyburski et al., 2021). Thus, the expression of inhibitory control can be verbal or physical depending on which version is adopted. Moreover, performance in inhibitory control tasks strongly predicts general executive functioning, with deficits impacting cognitive and behavioral skills (Friedman & Robbins, 2022; Nigg, 2001).

It is important to consider the diversity of Go/No-Go versions. Research indicates that individuals with Autism Spectrum Disorder (ASD) often exhibit unique sensitivities to social stimuli (*e.g.*, faces), which can influence their inhibitory control. Studies exploring neural responses to social stimuli in individuals with ASD have identified differences in activation patterns during inhibitory control tasks, indicating the influence of social cues

on inhibitory processes in this population (D'Cruz et al., 2013). Conversely, non-social stimuli, such as food-related cues, may also elicit distinct responses in individuals with ASD, providing insights into impulse control relevant to dietary behaviors and health (Schienle et al., 2003). This acknowledges the variability in responses to different stimuli among individuals with ASD.

Discrepancies in inhibitory control skills and impairments emerge based on neuropsychological paradigms (Hill, 2004). Individuals with ASD show minimal deficits in tasks like the Stroop test, similar to non-clinical groups (Adams & Jarrold, 2012). However, they encounter greater difficulties in Go/No-Go tasks (Kohls et al., 2013; Putra et al., 2021), likely due to challenges with irrelevant distractors (Adams & Jarrold, 2012). Research on inhibitory control in children and adolescents with Intellectual Development Disorder (IDD) is limited, but generally, IDD cases show significant declines in executive performance, especially in inhibitory control tasks compared to their peers (Spaniol & Danielsson, 2022). Therefore, while both ASD and IDD groups have inhibitory control impairments, the extent varies by task type. Comparing inhibitory control in ASD and IDD is essential for understanding cognitive profiles and needs (Kenworthy et al., 2008), particularly how IQ impacts performance on these tasks and the ability to understand instructions or inhibit responses (Scheuffgen et al., 2000). Sociodemographic factors like gender, age, and IQ also influence performance (Sadeghi et al., 2022; Yücel et al., 2012).

A key consideration is the intricate relationship between cognitive ability and inhibitory control—processes like attention, working memory, and

cognitive flexibility are closely tied to inhibitory control (Diamond, 2013). Individuals with comorbid ASD and IDD often exhibit lower IQ scores, which can significantly impact their task comprehension and response adaptation. Indeed, Kenworthy and colleagues (2008) found that children with lower IQ scores faced more challenges in inhibitory control tasks, such as a higher error rate. For this reason, understanding the influences of the task format and the different levels of the constructs evaluated becomes crucial when evaluating inhibitory control, as these tasks demand precise adherence and response inhibition—lower cognitive abilities can lead to difficulties in comprehending complex instructions, potentially hindering task performance (Scheuffgen et al., 2000).

A critical consideration in cognitive psychology is the impact of cognitive ability on inhibitory control, with research highlighting nuanced relationships influenced by assessment paradigms. Diamond (2013) emphasizes the intertwined nature of cognitive functions such as attention and working memory with inhibitory control processes. Studies such as Kenworthy et al. (2008) underscore how lower IQ scores in children correlate with poorer inhibitory control, manifested in increased error rates during tasks. The choice of assessment tools further complicates this relationship; Miyake and Friedman (2012) note that while measures like the Wechsler scales may reflect executive impairments affecting inhibitory tasks, assessments like the Raven's Matrices show greater independence from such influences. This variability prompts a critical examination of paradigms used in inhibitory control research. Task formats requiring precise adherence and response inhibition may disproportionately challenge individuals with lower

cognitive abilities (Scheuffgen et al., 2000), potentially skewing interpretations of inhibitory control deficits. Therefore, researchers must carefully select paradigms that align with the cognitive profiles of their study populations to accurately evaluate inhibitory control and its implications across varying levels of cognitive ability and task contexts.

Given the similar features of ASD and IDD in cognitive and behavioral functioning, the present study aims to dissect the peculiarities of the Stroop and Go/No-Go paradigms for the assessment of inhibitory control. Thus, the present study has three primary objectives: (1) evaluate and compare the performance of clinical (ASD and IDD) and control groups in both the Stroop and Go/No-Go tasks; (2) identify potential differences between the ASD and IDD groups in inhibitory control by comparing them separately to controls; and (3) examine potential influences of gender, age, and IQ in task performance. Based on previous studies by Adams and Jarrold (2009, 2012), we expected that the autism group would exhibit performance similar to that of the control group on the Stroop task. Conversely, due to more global deficits in inhibitory control in the current study, it was anticipated that the group with Intellectual Developmental Disorder (IDD) would perform worse compared to the autism group on both the Go/No-Go and Stroop tasks. In the Go/No-Go task, it is hypothesized that the autism group will have performance levels closer to the IDD group, given the higher number of visual distractors involved in this task.

Methods

Participants

The study involved a total sample of 89 participants aged between 6 and 15 years (M age = 9.24, SD = 2.13). Most participants attended the fifth grade at an elementary school in Rio de Janeiro. Recruitment took place in two specific institutions: a public school and an Outpatient Psychiatry Clinic for Children and Adolescents in Rio de Janeiro. The sample was categorized into three groups based on specific characteristics:

Autism Spectrum Disorder Group (ASDG): This group consisted of children and adolescents previously diagnosed with autism spectrum disorder after undergoing neuropsychological and psychiatric assessments. The analysis included individuals exclusively from the Level 1 support group, most of whom did not have an intellectual disability. Participants with an IQ below 70, as determined by the Wechsler Abbreviated Scale of Intelligence (WASI), were excluded to avoid confounding variables and to focus on participants without cognitive impairment. This IQ cutoff is consistent with the DSM-5-TR criteria for Intellectual Development Disorder (American Psychiatric Association, 2023). All participants were literate.

Intellectual Development Disorder Group (IDDG): Children and adolescents who exhibited a cognitive profile with an IQ above 70 but compatible with Intellectual Development Disorder based on the neuropsychological and psychiatric assessments were included in this group. Individuals with an IQ below 70, along with impairments in adaptive behavior and/or functional difficulties in daily life, were part of the IDD group. All participants were literate.

Control Group (CG): This group comprises children and adolescents without clinically significant cognitive or behavioral changes. Participants

were recruited from a public school in Rio de Janeiro using the same assessment protocol applied to the clinical groups. Participants with IQs below 70 were excluded from the analyses.

Inclusion criteria encompassed participants under 16 years old who willingly agreed to participate and, for clinical groups, had undergone psychiatric evaluation. Data from individuals who had an ASD diagnosis with an IQ below 70 or coexisting intellectual impairment, or lacked a diagnosis confirmed by the psychiatric team, were not included in the analysis. In specific cases (e.g., suspected neurodevelopmental disorder), individuals were referred to for neuropsychological evaluation or psychological monitoring in outpatient clinics.

Among the three analyzed groups, the control group comprised 48 participants (62%), with a majority being females (40.2%). The age range of this group was from 7 to 12 years old (M = 8.96, SD = 1.56). In total, there were 34 participants within the clinical sample, with one group diagnosed with autism spectrum disorder (ASD) (22.0%) and another group exhibiting intellectual and developmental disability (IDD) profiles (19.5%). The ASD group had an average age of 8 years and was predominantly composed of males. In contrast, participants in the IDD group were generally older (M = 10.27, SD = 2.99).

Instruments

Initially, participants' parents provided information about developmental milestones, social and behavioral complaints, and details regarding previous treatments and diagnoses. Subsequently, during

assessment sessions, standardized instruments and tasks were administered. To assess potential differences in inhibitory control development and IQ in children and adolescents, the following paradigms were analyzed:

Stroop-Vitória paradigm (Oliveira et al., 2016; Spreen & Strauss, 1998): This test assesses individuals' susceptibility to interference. It consists of three parts in which participants name colored squares under different conditions. In the first part, they name the colors of the squares. In the second part, they name colors again. In the third part, they name colors while being presented with the names of colors. Execution times are measured and converted into z-scores. Inhibitory control is particularly engaged in the third stage, which requires the inhibition of a prepotent response (reading the written color). In a literature review covering 2020-2022, Martins et al. (2023) identified that 85% of Brazilian studies using the Stroop task utilized the Stroop-Vitória paradigm. The version employed was standardized in 2016 by Oliveira and colleagues, who reported satisfactory results in construct validity through cluster analysis and internal consistency assessments.

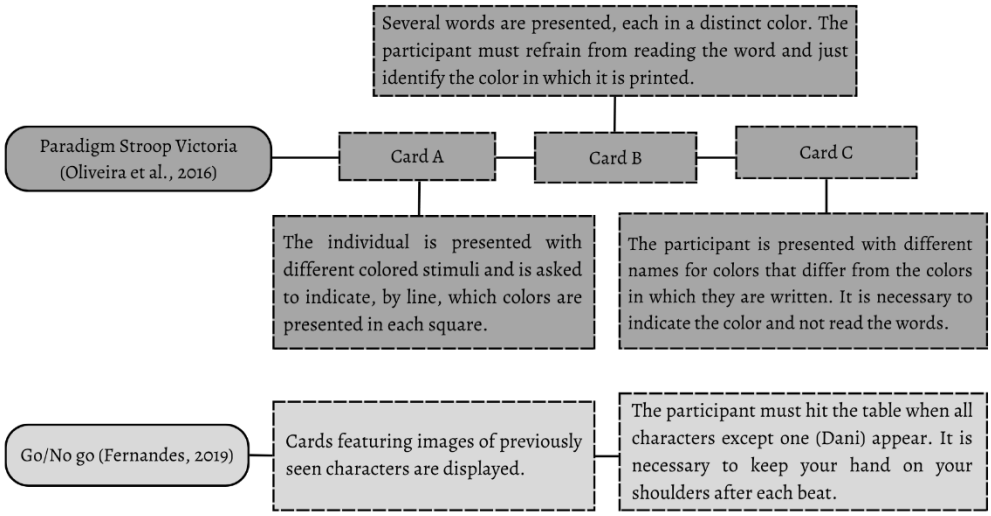
Go/No-Go paradigm (Fernandes, 2019): A part of the Theory of Mind Battery (BToM), this task introduces four characters to the child. During the Go/No-Go task, participants are instructed to perform a hand movement (knock on the table) when any character except Dani appears. For the Dani character, participants must keep their hands on their shoulders. Similar to other versions, this task involves inhibiting a prepotent response (performing the movement). More impulsive individuals or those with inhibition difficulties are expected to make more errors. The task measures the number of correct answers. The task measures the number of correct answers. The

version used in the current study was developed by Fernandes (2019), who presented satisfactory results in content validity findings with Intraclass Correlation Coefficient (ICC) analyses by expert review and construct validity with hierarchical cluster analysis.

Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 2014): This is a concise tool for assessing intelligence across a wide age range from 6 to 89 years old. This assessment provides insights into various cognitive aspects, including verbal knowledge, visual information processing, spatial and non-verbal reasoning, as well as fluid and crystallized intelligence. It is based on four subtests and provides information on Total IQ, Performance IQ, and Verbal IQ, as well as the Vocabulary and Similarities subtests, Block Design, and Matrix Reasoning. Studies have demonstrated WASI's strong psychometric properties, including high reliability and validity in measuring intellectual abilities across different populations (Abu-Hilal et al., 2011; Irby & Floyd, 2013; Wagner et al., 2014).

Figure 1.

Descriptions of versions of the stroop paradigms (Card A, B and C) and Go/No-Go



Ethical Procedures

The current study is a sample of the results obtained from a project previously conducted in Plataforma Brasil (CAEE: 41590720.4.0000.5257). Its primary objective within the context of neuropsychological assessment is to investigate the characteristics of the neuropsychological, socio-emotional, and behavioral profiles of children with ASD. Participants in the clinical groups were recruited and participated in research through the psiquiatric institution in Rio de Janeiro following a psychiatric evaluation. The control group was selected from schools in Rio de Janeiro. Both groups initiated the neuropsychological assessment process after accepting and signing an Informed Consent Form, which outlined the project's purpose and its potential future use in research. Participation was voluntary, and the participants' guardians were informed that they could withdraw from the assessment process at any time.

Data Analysis

Data were checked for inconsistencies, coding errors, and potential outliers using SPSS software (IBM Corp, 2023). Descriptive analyses were conducted to present the demographic characteristics of the sample, including means, standard deviations, and percentages. To ensure data accuracy, a filter was applied post-processing based on participants' IQs. Those diagnosed with ASD and an IQ below 70 were excluded from the analysis. While participants with IQs below 70 (without ASD) were included in the IDD group, a cutoff point used in previous studies analyzing inhibitory control tasks in ASD groups (Cruz et al., 2022; Panerai et al., 2014) to differentiate IDD groups. After processing and addressing potential inconsistencies, and after the analyses of normality of the distribution and homogeneity of variance, Welch's t-test was employed to assess group differences with Cohen's d to assess effect sizes. For the simultaneous analysis of the two dependent variables (Go/No-Go and Stroop C), a multivariate analysis of variance model (MANOVA) was applied. In this study, only the Stroop final card (Stroop C) was used because it assesses inhibitory control more accurately compared to other stages and requires participants to override their automatic reading response in favor of naming the ink color, which directly measures their ability to inhibit cognitive interference. Research by MacLeod (1991) highlights that this stage is particularly effective at measuring inhibitory control because it involves a high level of cognitive conflict and demands substantial executive function resources.

All analyses were conducted using R and the RStudio environment (RStudio Team, 2023), with the following packages: tidyverse, mirt, psych,

janitor, summarytools, MANOVA.RM, tidyr, and ggplot2. Code and outputs are accessible at https://osf.io/nu7jg/.

Results

Potential differences in sociodemographic characteristics between the groups were examined. This analysis aimed to pair individuals and verified possible outliers. It was observed that only the gender variable showed a significant difference ($p < 0.003$) between the clinical groups and the control group. Consequently, a bootstrap technique was applied with 1000 repetitions to obtain a paired data sample using the gender variable as a stratification factor. Table 1 presents an overview of the participant characteristics within the two clinical groups and the control group after implementing the bootstrap.

Table 1.

Characteristics of the Groups (Post-Stratification)

	Characteristics	CG (N = 48)	ASDG (N = 18)	IDDG (N = 16)
Sociodemographic	Age	8.96 (1.56)	8.61 (2.00)	10.81 (2.99)
	Sex			
	Female	33 (68.8%)	1 (5.6%)	7 (43.8%)
	Male	15 (31.2%)	17 (94.4%)	9 (56.2%)
	Scholarity			
	1st year of elementary school	5.1% (n =4)	1.3% (n = 1)	1.3% (n = 1)
	2nd year of elementary school	16.5% (n = 13)	8.9% (n = 7)	3.8% (n = 3)
	3rd year of elementary school	3.8% (n = 5)	7.6% (n = 6)	-

	4th year of elementary school	7.6% (n = 6)	2.5% (n = 2)	1.3% (n = 1)
	5th year of elementary school	17.7 (n = 14)	-	2.5% (n = 2)
	6th year of elementary school	7.6% (n = 6)	-	-
	7th year of elementary school	-	1.3% (n = 1)	2.5% (n = 2)
	8th year of elementary school	-	-	-
	9th year of elementary school	-	-	-
	1st year of high school	-	-	-
	2nd year of high school	-	1.3% (n = 1)	3.8% (n = 3)
	3rd year of high school	-	-	-
WASI	IQ	95.02 (12.70)	84.47 (15.98)	61.62 (9.76)
	Verbal Index	98.34 (15.51)	81.67 (18.43)	62.25 (10.09)
	Performance Index	93.60 (10.68)	90.73 (15.38)	68.38 (9.16)

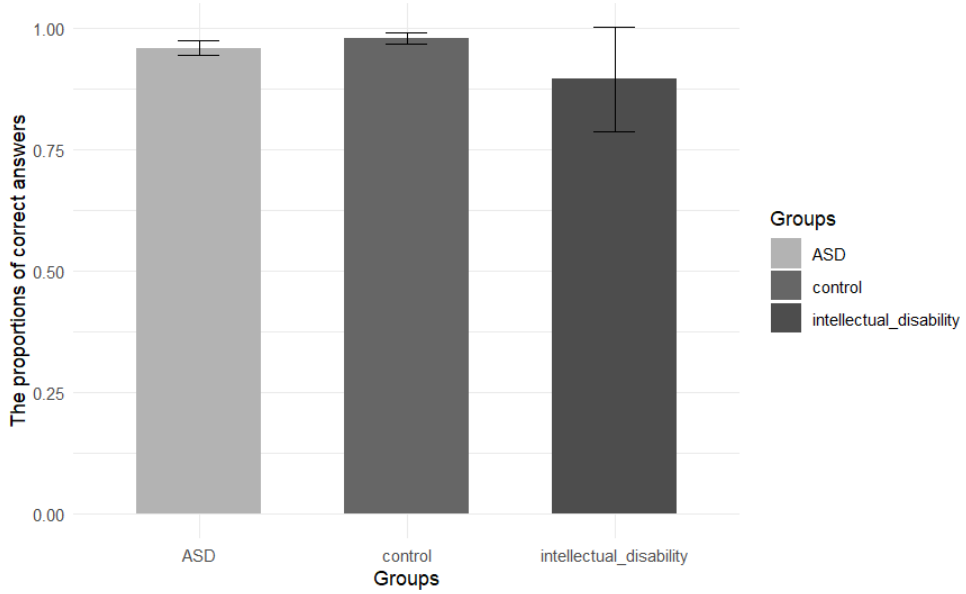
Note: IQ (Intelligence Quotient) obtained in the calculation of the global functioning index in WASI.

Go/No-Go Task

In the Go/No-Go task, participants in the control group (CG) achieved higher scores (M = 0.97, SD = 0.03). This result can be associated with the number of errors made by this group, which was substantially lower compared to the clinical groups. Figure 2 illustrates these results. It was observed that the clinical groups had the highest overall error rates in the Go/No-Go test. The group with intellectual disabilities made the most mistakes (10%), followed by the ASD group (4%) and the control group (2%) with fewer errors.

Figure 2.

Proportions of Correct Answers on the Go/No-Go Task with Standard Deviation Bars for the ASD Group, Intellectual Disability Group, and Control Group

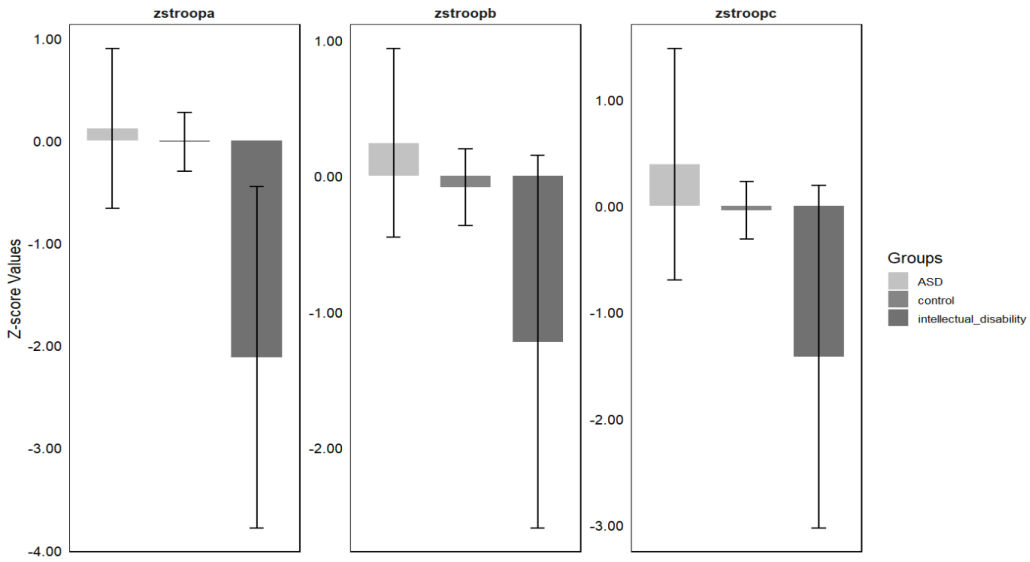


Stroop Task

In the Stroop task, the estimated time to complete the three-step task and z-scores were calculated. To assist in the clinical interpretation of the scores, especially considering the time necessary to complete the task, the punctuation sign (negative or positive) was standardized such that results with time above expectations obtained standard deviations with negative signs (below 0). In general, it was noted that the ASD group completed the task faster than the other participants in the three Stroop cards. It was observed that the IDD group had a standard deviation above 2. Figure 3 illustrates these results.

Figure 3.

Time Comparison by Groups (ASD, IDD, and Control) in the Stroop Task Represented by Z-Score (Time Used – Expected Time / SD)



Note. This figure compares the time taken by the ASD, IDD, and Control groups to complete the Stroop task, represented by z-scores. Negative values indicate faster completion times than expected.

Hypothesis Testing

Two hypothesis tests were conducted: first, to verify possible differences between the performance of the ASD group and the IDD group in the Go/No-Go task, and second, to compare the ASD group with the control group in the same task. The t-test results indicate that there is no significant difference in the means between the ASD group *(M* = 0.96, *SD* = 0.03) and the IDD group (*M* = 0.90, *SD* = 0.20), with a *p*-value of .222. However, when comparing the ASD group (*M* = 0.96, *SD* = 0.03) with the control group (*M* = 0.98, *SD* = 0.04) in the same Go/No-Go task, a significant difference was observed (*p* = .045).

When the performances of the experimental groups in the Stroop task were compared (Table 2), an initial t-test was conducted between the ASD group and the IDD group. Comparing the means of these two clinical groups revealed a significant difference specifically in card A (t (17.4) = 2.65, p = .016). Upon analyzing the outcomes related to cards B (t (18.4) = 2.08, p = .052) and C (t (20.8) = 2.04, p = .054), no statistically significant differences were observed between the groups. The autism group showed better performance considering the z-scores: A (M = 0.12, SD = 1.02), B (M = 0.24, SD = 0.97), and C of the Stroop task (M = 0.39, SD = 1.52) compared to the scores obtained by the IDD group in Stroop A (M = -2.12, SD = 2.89), Stroop B (M = -1.22, SD = 2.38), and Stroop C (M = 1.42, SD = 2.79). Although statistically significant differences were not observed for cards B and C, the calculated Cohen's coefficients indicate that the disparities between the groups are substantial in magnitude. When comparing the performance of the control group (Stroop A: M = -0.01, SD = 0.92; Stroop B: M = -0.08, SD = 0.91; Stroop C: M = -0.04, SD = 0.86) with the ASD group, no significant differences were observed across the three stages of the Stroop test. In terms of effect size, only small effect sizes were observed for the ASD group on Stroop performance (see Table 2).

Table 2

Comparison between Groups in the Stroop Cards

Groups	Variable	t	df	*p*	Mean difference	Standard difference error	CI	*d*
ASDG X IDDG	Stroop A	2.65	17.4	.016*	2.24	.843	[.461 -4.01]	1.033
	Stroop B	2.08	18.4	.052	1.46	.706	[.706 – -.016]	.807
	Stroop C	2.04	20.8	.054	1.81	.888	[.88 - -.037]	.805
ASDG X CG	Stroop A	-.360	11.0	.725	-.132	.367	[-.940 - .676]	-.136
	Stroop B	-.967	13.0	.351	-.327	.338	[-1.05 – .404]	-.347
	Stroop C	-.869	10.4	.404	-.434	.499	[-1.54 – 0.67]	-.351

Note: * p value ≤ 0.05

Multivariate Analysis of Variance (MANOVA)

The results of a MANOVA model indicate significant differences in the means of the dependent variables Go/No-Go and Stroop between the clinical groups (ASD and IDD) and the control group. The Pillai test (V) yielded a significant and relatively high value ($V = 0.32$, $p < 0.001$), indicating a significant effect of diagnostic condition on the skills assessed by Go/No-Go and the Stroop C. However, when examining the independent variables individually, only the "diagnosis" factor reached statistical significance ($F = 15.26$, $p < .001$). This suggests that the performances on the Go/No-Go task and the Stroop C card were primarily influenced by the diagnosis (ASD and IDD), while gender and age did not exhibit significant effects on these abilities.

Discussion

Inhibitory control skills, encompassing the capacity to suppress improper stimuli and responses, are vital for everyday development and performance. However, neurodevelopmental conditions such as ASD and IDD may impair these abilities, affecting the quality of life of children and adolescents. Despite this, only a limited number of Brazilian studies have explored inhibitory control differences between clinical and control groups. This study examined the performances of the ASD, IDD, and control groups, resulting in the following findings: No notable distinction between the ASD and control groups in the Stroop test; The ASD group outperformed the IDD group in the Stroop test; The ASD group differed from the control group in the Go/No-Go test but not from the IDD group. Clinical groups significantly influenced Go/No-Go and Stroop C, showing overall poorer performance than children with typical development.

This study observed performance disparities in the Stroop and Go/No-Go paradigms within the two clinical groups with neurodevelopmental disorders. It is crucial to understand that the inhibition skills required by these paradigms, though aimed at restraining automated responses, fluctuate in intensity and correlation with other cognitive functions. The Victoria Stroop paradigm engages attention, language (in the final stages), and the suppression of dominant automatic responses (Scarpina & Tagini, 2017). In this Stroop variant, the primary factor causing interference is the ability to read and comprehend semantic phrases (MacLeod, 1991). Conversely, in Go/No-Go tasks, the focus is on restraining automatic motor responses rather than impulsive reactions to non-target stimuli (Littman & Takács, 2017).

Therefore, both tasks involve processing visual stimuli, but their content and required response diverge, leading to distinct cognitive demands. The Stroop-Victoria paradigm stimulates attention, semantic processing, and interference resolution skills alongside the suppression of automatic responses (Scarpina & Tagini, 2017). In contrast, the Stroop Victoria paradigm focuses on suppressing verbal responses and semantic interference, while the Go/No-Go task emphasizes restraining impulsive motor reactions. These cognitive differences might manifest in distinct patterns of brain activity during execution (Rubia et al., 2001).

Some researchers point out the limitations of these tasks, especially when reaction time is not measured. For example, in a study of individuals with autism, results suggested that the Stroop task may not be as sensitive for assessing inhibitory control in this population (Joseph & Tager–Flusberg, 2004). Conversely, the study by Cissne et al. (2022) employed eye movement identification technology to track the reaction time of children with ASD in an inhibition task and switching between demands. The authors also noted a substantial correlation between this task's performance and the prevalence of repetitive behaviors. Similarly, when applying other tasks involving reaction time and inhibition, such as resisting a distracting stimulus (stop-signal response inhibition task) (Jones et al., 2021) or mapping a stimulus and its stop (controlled responses) involving attentional aspects (Raud et al., 2020; Verbruggen & Logan, 2008), individuals with ASD show inhibitory impairments. Verbruggen and Logan (2008) indicate that such impairments in inhibition in controlled processes observed in clinical groups may over time interfere with previously preserved automatic inhibition demands.

Besides assessing individual reaction times and task completion durations, the specific type of inhibition required could predict the performance of clinical groups in inhibitory control tasks, especially among those with ASD. Christ and colleagues (2007) conducted a study involving 28 children on the autism spectrum, evaluating their ability to resist proactive interference and inhibit prepotent responses, as seen in tasks like the Stroop test. However, these children displayed significant impairments in a visual flanker task, which required resisting interference from visual distractors. This study observed similar differences in inhibitory demands compared to the Stroop tasks. This evidence underscores the importance of assessing reaction times in inhibitory control tasks for individuals with ASD and adopting various approaches and measures for a comprehensive assessment of executive functions in clinical settings. In a previous review of studies on executive dysfunction and ASD, Geurts et al. (2014) highlighted that a few portions of individuals with ASD have significant deficits in inhibitory control. When observing these deficits, this group has more difficulty inhibiting irrelevant distractors but not preponderant automatic responses (Adams & Jarrold, 2009, 2012).

Studies of individuals with IDD indicate that children and adolescents with this condition experience a significant decrease in executive functioning, particularly in planning skills and inhibitory control (Sesma et al., 2009). Similar impairments were observed in a study by Gligorović and Buha (2014), which examined the performance of 56 children with moderate-severity IDD in the Stroop (day-night version) and Go/No-Go paradigms. It was found that in the Go/No-Go task, there were a significant number of

errors, indicating difficulty in preventing or postponing a motor response. The authors noted that performance on this task exhibited a significant relationship with planning, suggesting that impairments in inhibitory control in this clinical group can be associated with difficulties in problem-solving. In other studies, it was observed that children with ASD performed similarly to control groups in the Stroop task (Christ et al., 2007; Hill, 2004; Parsons & Carlew, 2016). This can be attributed to certain cognitive characteristics of ASD. For example, individuals with ASD tend to engage in more detailed and less automatic processing of information, facilitating the identification of ink color while ignoring the semantic meaning of words (Baron-Cohen et al., 2001).

Regarding the level of support linked to the ASD diagnosis, it's crucial to highlight that the actual study predominantly included individuals with level 1 support, indicating autism without intellectual or language impairments. Given the diversity of symptom experiences and variations in executive dysfunction, acknowledging this diagnostic distinction is vital for interpreting inhibitory control task performance. In this context, Lai et al. (2017) conducted a meta-analysis examining executive dysfunctions in ASD children and adolescents without intellectual disabilities, analyzing studies from 1978 to 2015. They identified impairments in most tasks across seven types, including inhibitory control. It's important to consider that the current study utilizes a sample of children and adolescents with ASD without intellectual disabilities and without language impairments. Previous research has shown that intellectual disabilities and language impairments significantly affect performance in inhibitory control tasks (Hopkins et al.,

2017; Tonizzi et al., 2022). Recognizing the different clinical presentations within ASD and IDD is essential for properly interpreting the study results. Furthermore, a more in-depth analysis of inhibitory control impairments is necessary to fully understand the executive dysfunctions in these populations.

Prior studies have linked Stroop performance with verbal fluency and vocabulary knowledge (Laws & Bishop, 2003; Scarpina & Tagini, 2017). This suggests that individuals with IDD, who might struggle with language and verbal processing, could encounter challenges during Stroop tasks, particularly in steps involving reading and word processing. Children with IDD may also exhibit specific deficits in language aspects like word comprehension, impacting how words are processed and interpreted in the Stroop paradigm. Previous research has highlighted such deficits (Laws & Bishop, 2003; Viviani et al., 2023).

This research highlights noteworthy limitations that warrant further attention in future studies. Firstly, the sample size for both clinical groups was smaller than anticipated based on the power calculation. Currently, data collection is ongoing with the aim of expanding the sample size. Secondly, a limitation pertains to the autism-diagnosed group, primarily comprising children without intellectual disability. Future studies aim to encompass a broader range of symptomatic levels within this group to enhance the generalizability of findings. Another limitation of the study pertains to the heterogeneity of the sample, which necessitated the use of the bootstrap technique. However, even with this technique, differences were still observed when considering the sex of the participants. This characteristic should be considered when interpreting the results and in future studies. By employing

new recruitment and selection techniques, the number of girls with ASD in the sample can be expanded.

No significant effect of sociodemographic variables was found on inhibitory performance, revealing only an effect of having a neuropsychological condition that impairs performance in the Stroop task (which requires high inhibitory and attentional capabilities) and the Go/No-Go task. The present study indicates that research with more representative samples should be conducted to evaluate the neuropsychological profile in ASD using different measures of the same constructs. Lastly, given the varying severity and symptom experiences in both clinical groups (ASD and IDD), our current study focused on a collective comparison, emphasizing the need for individualized analyses as recommended by Geurts et al. (2014). This approach can provide deeper insights into the interplay between specific group characteristics and inhibitory control functioning.

Conclusion

The study revealed no significant difference between the control group and the ASD group in the Stroop paradigm. However, the IDD group performed worse on this task compared to both the control and ASD groups. In the Go/No-Go paradigm, there was no observable difference in performance between the ASD and IDD groups, suggesting similar performance within these clinical groups. Notably, the ASD group encountered greater difficulty in the Go/No-Go task compared to the Stroop task. No significant effect of sociodemographic variables was found on inhibitory performance, revealing just an effect of having a neuropsychological condition that impairs performance in the Stroop task

(which requires high inhibitory and attentional capabilities) and the Go/No-Go task. The present study indicates that research with more representative samples should be conducted to evaluate the neuropsychological profile in ASD using different measures of the same constructs. This is because ASD is a heterogeneous condition with variations in the level of inhibition required as described in traditional paradigms of inhibitory control presented in the literature. When examining the inhibitory control profile of IDD children and adolescents, it is essential to consider the link between intellectual skills, verbal skills, and motor skills. Furthermore, the importance of conducting future research that explores potential variations among individuals with different diagnostic subtypes and phenotypes and the possible impact of these circumstances on performance in both paradigms is emphasized.

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5. ARTICLE 2

ARTICLE 2

Marques, L., Fernandes. C., Barbirato, F;. Charchat-Fichman, H. Identifying inhibitory control profiles in children with Autism Spectrum Disorder: The role of task characteristics and clinical factors. *(In preparation)*.

Title: Identifying inhibitory control profiles in children with Autism Spectrum Disorder: The role of task characteristics and clinical factors.

Abstract

Objective: This study aimed to explore inhibitory control profiles in children with Autism Spectrum Disorder (ASD) using tasks that assess interference control and response inhibition.

Method: A total of 97 participants (53 in the Autism Spectrum Disorder Group [ASDG] and 44 in the Non-Autism Spectrum Disorder Group [NASDG]) were evaluated using three inhibitory control tasks: (1) Victoria Stroop Test, which measures interference control by requiring participants to suppress the automatic reading of words and instead name the ink color; (2) Go/No-Go Task, which assesses response inhibition by instructing participants to respond to target stimuli (*Go*) while withholding responses to non-target stimuli (No-Go); and (3) Five-Digit Test (FDT), which evaluates inhibitory control, cognitive flexibility, and processing speed through a number-based task requiring rule-switching and controlled responses. Latent profile analysis was conducted to identify subgroups within the ASD sample based on their inhibitory control performance.

Results: Three distinct inhibitory control profiles were identified within the ASDG: Low Average, Below Average, and Average. Significant group differences were observed in FDT - Reading ($p = 0.01$, $\eta^2 = 0.07$) and Stroop - Interference ($p = 0.01$, $\eta^2 = 0.07$). Age and educational level influenced performance across multiple measures. ROC analysis demonstrated the diagnostic utility of Stroop B (*AUC* = 0.69, *sensitivity* = 0.82, *accuracy* = 0.67) and FDT - Shifting (Errors) (*AUC* = 0.61, *sensitivity* = 0.60, *accuracy* = 0.70) in distinguishing ASD from the non-clinical group. Additionally,

behavioral complaints were most prevalent in the Below Average profile (78%), which also exhibited greater inhibitory control deficits.

Conclusion: These findings highlight the heterogeneity of inhibitory control in ASD, the influence of comorbidities and medication use, and the need for tailored assessment tools and interventions that consider individual cognitive profiles.

Keywords: Executive function; Inhibitory control; Assessment; Autism Spectrum Disorder.

Introduction

Executive functions encompass a set of higher-order cognitive processes essential for goal-directed behavior, including working memory, cognitive flexibility, and inhibitory control. These functions are crucial for managing thoughts, emotions, and actions, forming the foundation for problem-solving, decision-making, and maintaining focus (Diamond, 2013; Dias et al., 2024). Consequently, they play a pivotal role in academic achievement, social interactions, and emotional well-being (Diamond & Ling, 2019). Among these components, inhibitory control is particularly significant as it enables individuals to suppress automatic responses and resist distractions, allowing them to navigate daily challenges effectively (Li et al., 2020).

Delays in developing inhibitory control can profoundly affect children's daily lives, contributing to difficulties in social interactions, impulse control, and emotional regulation (Kang et al., 2022). Such deficits are often linked to behavioral complaints, including hyperactivity, attention difficulties, and challenges in adapting to social and educational environments (Zeytinoglu et al., 2023). Additionally, impaired inhibitory control can adversely impact academic performance by hindering skills such as attention focus, instruction-following, and task-switching, which are essential for learning and classroom engagement (Privitera et al., 2023).

In neurodevelopmental disorders, inhibitory control impairments are complex and may serve as diagnostic differentiators. However, their manifestations vary significantly across disorders, necessitating in-depth

evaluations (Cremone-Caira et al., 2021). For instance, 30% to 80% of children with ASD also exhibit symptoms of attention-deficit/hyperactivity disorder (ADHD), complicating the clinical picture and underscoring the need for thorough assessments (Rommelse et al., 2010). This behavioral profile may be linked to response inhibition difficulties, underscoring the importance of thoroughly investigating these symptoms (Cremone-Caira et al., 2021). Despite both ASD and ADHD involving inhibitory control deficits, literature highlights two distinctions in ASD: (1) different patterns of brain activation, particularly in frontoparietal regions, during inhibitory tasks (Albajara Sáenz et al., 2020) e (2) some authors argue that other core executive functions (as cognitive flexibility) may be more determinant in ASD, suggesting that inhibitory control deficits are more pronounced in ADHD. When assessing inhibitory control in children with ASD, it's essential to consider not only one type of inhibition response, but also what are the task demands, format (direct and indirect), support levels, and coexisting cognitive impairments (Tonizzi et al., 2022).

Recent studies emphasize the need for comprehensive evaluations that account for these factors to accurately understand inhibitory control challenges in ASD, especially because of the heterogeneity in the performance of different inhibitory control tasks (Torenvliet et al., 2023; Zhou & Wilson, 2022). The format of the tasks used to assess inhibitory control plays a pivotal role in this context. Adams et al. (2009) highlighted that tasks with higher cognitive flexibility demands may reveal distinct inhibitory control impairments not captured by simpler tasks, such as the Stroop. In a second study, Adams et al. (2012) observed a difference in performance between children with ASD and their typically developing peers. The children with ASD showed greater difficulty with tasks involving resistance to visual distractors, while their performance on prepotent response inhibition tasks was similar to that of their peers. Together, these studies underscore the importance of carefully selecting and designing assessment tools to capture the nuances of inhibitory control in ASD.

In general, when considering such differences in format, when investigating inhibitory control profiles in children with ASD, heterogeneous

profiles are presented. Inhibitory control in ASD is marked by variability that reflects the interplay of task demands, co-occurring conditions, and individual neurodevelopmental differences (Torenvliet et al., 2023). For instance, impairments in response inhibition—such as difficulty suppressing prepotent motor responses—are frequently observed in tasks like the Go/No-Go paradigm, especially when the tasks require rapid and automatic response suppression (Fabre & Lúcio, 2021). Such a response pattern may be associated with the presence of impulsiveness and could manifest in repetitive behaviors or, for example, in aggressive behaviors. Notably, profiles of inhibitory control deficits also vary depending on co-occurring conditions. For example, children with ASD who also meet criteria for Attention-Deficit/Hyperactivity Disorder (ADHD) tend to exhibit pronounced impulsivity and hyperactivity, further complicating their ability to inhibit inappropriate responses (Cremone-Caira et al., 2021). In contrast, children with ASD alone may show more subtle deficits in attentional control and resistance to distraction, particularly in tasks requiring sustained attention to visually or socially salient stimuli (Zhou & Wilson, 2022).

When comparing children with ASD to their non-clinical peers, studies have identified distinct patterns of performance in inhibitory control. Children with ASD often show specific deficits in certain aspects of inhibitory control, though not in all areas (Christ et al., 2007). For example, in tasks involving response inhibition, such as the Go/No-Go task, deficits tend to be more pronounced compared to tasks requiring interference control, like the Stroop test (Adams & Jarrold, 2012; Geurts et al., 2014; Tonizzi et al., 2022). Additionally, children with ASD and comorbid ADHD demonstrate greater difficulties in inhibiting behavioral responses compared to children with typical development (Cremone-Caira et al., 2021; Mirabella, 2023).

These differing profiles have significant clinical implications. Identifying distinct inhibitory control patterns allows clinicians to design individualized intervention strategies. For example, children with severe response inhibition difficulties may benefit from structured behavioral interventions targeting impulse control, while those with deficits in interference control might require training to enhance cognitive flexibility

and attention-switching abilities (Mecca & Júlio-Costa, 2024). Moreover, understanding these profiles can guide educators in creating classroom accommodations, such as reducing distracting stimuli or breaking down tasks into smaller, manageable steps, to support children with ASD more effectively. Additionally, parents can assist by increasing the level of external control and adult supervision, teaching a skill to compete with the response to be inhibited, creating strategies, and practicing controlled situations. (Mecca & Júlio-Costa, 2024; Steege, 2014). Such tailored approaches not only enhance daily functioning but also improve academic and social outcomes.

Impairments in inhibitory control in children with ASD are intricately linked to deficits in other foundational executive functions, such as working memory and cognitive flexibility. For instance, the ability to suppress automatic responses often relies on working memory to maintain task-relevant rules and goals (Rabiee et al., 2020). Deficits in inhibitory control can therefore cascade into difficulties in switching attention between tasks or adapting to novel situations, core aspects of cognitive flexibility and results in repetitive behaviors and restricted patterns (Faja & Nelson Darling, 2019; Lage et al., 2024). Moreover, impairments in inhibitory control may exacerbate broader cognitive challenges in ASD, including difficulties with information processing and sustained attention, as well as heightened sensitivity to sensory input. These deficits create a compounded effect, making it harder for children with ASD to regulate their emotions, manage social interactions, and adapt to dynamic environments (Pugliese et al., 2015).

Despite significant advances, gaps remain in understanding subgroups of inhibitory control deficits in ASD and their relationships with clinical, behavioral, and cognitive factors. Current research often treats inhibitory impairments as homogeneous, overlooking the variability in inhibitory profiles across individuals with ASD (Tonizzi et al., 2022). For example, while some children with ASD may primarily struggle with motor inhibition, others may show greater difficulty in managing cognitive interference or attentional control. Little is known about how these subgroups relate to clinical variables such as symptom severity, comorbidities like ADHD, or

behavioral traits like repetitive behaviors and emotional dysregulation. Additionally, cognitive factors, such as verbal abilities and processing speed, may interact differently across these subgroups, further complicating the picture (Wilson, 2024). Addressing this gap is crucial not only for refining theoretical models of executive functioning in ASD but also for developing targeted interventions that account for individual differences.

The main objective of this study was to identify distinct inhibitory control profiles in children with ASD, considering performance across different task formats. Additionally, the study aimed to explore secondary objectives, including: (a) comparing the inhibitory control profiles of the ASD group with those of a non-ASD group; (b) examining the relationship between inhibitory control profiles and behavioral complaints; (c) as well as the use of medication targeting attention and impulsivity. Lastly, the study sought to (d) the study aimed to assess the discriminatory and sensitivity levels of the selected inhibitory control tasks, to evaluate how effectively they differentiate between the two groups and detect variations in inhibitory control performance.

Methods

Participants

A total of 97 participants were included in the study, comprising 53 from the ASD group (ASDG) and 44 from the non-Autism Spectrum Disorder group (NASDG). Participants were recruited from two distinct settings: a public school and two Child and Adolescent Psychiatry Outpatient Clinics located in Rio de Janeiro. Statistically significant differences were observed between the two groups in three sociodemographic variables: sex, age, and educational year. The ASDG had an average age of 10 years (SD = 2.49), while the NASDG consisted of younger children, with an average age of 8 years (SD = 1.36). Regarding sex, most participants in both groups were male.

Participants under the age of 16 who agreed to take part in the study and, for clinical groups, completed a psychiatric evaluation were included. Individuals without a confirmed diagnosis by the psychiatric team were excluded from the analysis.

Autism Spectrum Disorder group (ASDG): The ASD group consisted of children and adolescents diagnosed by a multidisciplinary team at a child and adolescent psychiatry outpatient clinic. The diagnostic process followed the DSM-5-TR criteria (APA, 2023) and was based on clinical history, standardized behavioral assessments, and psychiatric evaluation. The diagnostic assessment also considered reports from parents and teachers, as well as direct observation of social communication difficulties, restricted interests, and repetitive behaviors. Additionally, comorbidities such as ADHD, anxiety disorders, and language impairments were identified by the psychiatric team. Inclusion criteria for this group were: (1) Clinical diagnosis of ASD confirmed by the multidisciplinary team based on standardized assessment procedures and (2) Absence of neurological conditions or genetic syndromes that could explain the neurodevelopmental profile.

Non-Autism Spectrum Disorder group (NASDG): The group without autism was composed of children from a public school in the 1st to 5th grade in the city of Rio de Janeiro. Inclusion criteria were: (1) no formal diagnosis of any neurodevelopmental or mood disorder and (2) being over five years old at the time of the assessment. As this is an exploratory analysis, data from participants with global performance below the expected range for their age were also included. However, participants from the NASDG who did not complete the inhibitory control tasks or displayed behavioral alterations during the assessment were not included in the current study. Among the participants, 5% of the sample scored extremely low on the total IQ of the WASI.

In the NASDG cases where neurodevelopmental disorders were suspected, participants were referred for neuropsychological assessments or psychological follow-up at outpatient clinics. It is also important to highlight that the data from participants in the NASDG whose families and teachers confirmed a prior formal diagnosis of a neurodevelopmental disorder were not used as NASDG data. In these cases, only the data from children in the school who had a previous formal diagnosis of ASD were used in this research, making them part of the ASDG group.

Instruments

The assessment protocol included a standardized clinical interview, cognitive measures, and inhibitory control tasks.

Clinical Interview

The anamnesis interview was conducted with the participants' families and lasted approximately one hour. It collected detailed information on demographic and identification data, pregnancy and birth history, developmental milestones (motor and language skills), presence of sensory impairments (visual or auditory), academic challenges, behavioral concerns (attention, hyperactivity, emotional regulation), socialization and peer engagement, and restricted or repetitive behaviors. Additionally, family reports were cross-referenced with interviews previously conducted by the psychiatric team and data from participants' medical records to ensure diagnostic accuracy and consistency.

Global Cognitive Measures

To assess overall intellectual functioning, the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 2014) was administered. The WASI is a brief but reliable measure of cognitive abilities, consisting of four subtests: Vocabulary and Similarities (verbal abilities) and Block Design and Matrix Reasoning (non-verbal reasoning and problem-solving). These subtests generate scores for the Verbal Index, Performance Index, and Full-Scale IQ, providing a general estimate of cognitive abilities. The WASI was chosen for its efficiency and validity in clinical and research settings.

Additionally, two indices from the Wechsler Intelligence Scale for Children - Fourth Edition (WISC-IV) were included:

- **Working Memory Index (WMI):** Measures the ability to hold and manipulate information, essential for problem-solving, reasoning, and learning. It includes tasks such as recalling sequences of numbers or letters and mentally reordering them.
- **Processing Speed Index (PSI):** Evaluates speed and accuracy in visual scanning, attention, and motor coordination. It assesses how efficiently participants process simple or repetitive information.

Inhibitory control measures

Inhibitory control was assessed using three tasks: the Victoria Stroop Test, the Go/No-Go Task, and the Five-Digit Test (FDT).

The Victoria Stroop Test (Oliveira et al., 2016; Spreen & Strauss, 1998) evaluates interference control, requiring participants to suppress an automatic reading response and instead name the ink color of words. The task consists of three conditions: first, participants name colored squares (baseline condition); second, they name a sequence of colors (control condition); and third, they name the ink color of words that represent incongruent colors (interference condition). The final stage demands higher inhibitory control, as participants must suppress the automatic response of reading the word instead of naming the ink color. Performance is measured based on execution time and the number of errors committed, with results converted into z-scores adjusted for age.

The Go/No-Go Task (Fernandes, 2019) assesses motor response inhibition by requiring participants to inhibit a prepotent response when presented with a specific stimulus. In this task, four different characters are introduced. Participants must perform a hand movement (*e.g.,* knocking on the table) when any character appears except for "Dani". When "Dani" is displayed, they must withhold their response and keep their hands on their shoulders. Performance is evaluated based on the number of correct responses and errors, including impulsive errors (responding when they should not) and omission errors (failing to respond when required).

The Five-Digit Test (FDT) (Sedó et al., 2015) is a neuropsychological measure that assesses cognitive inhibition, cognitive flexibility, and processing speed. The task consists of four conditions: reading numbers aloud, counting the number of digits presented, inhibiting the reading response and counting the digits instead, and alternating between reading and counting according to task instructions. Performance is analyzed based on response accuracy, processing speed, and switching errors, with results converted into z-scores adjusted for age norms.

Ethical procedures

This research project is part of a larger study previously approved by the ethics committee through Plataforma Brasil (Protocol number: 41590720.4.0000.5257). Families in the ASD group (ASDG) were invited to participate in the study through two main channels: (1) after being referred by psychiatric professionals in the outpatient service, they were informed about the research objectives and presented with the Informed Consent Form during the neuropsychological assessment anamnesis session, or (2) during a neuropsychological evaluation at a second outpatient clinic, where they were similarly invited and presented with the Informed Consent Form. It was emphasized that participation was voluntary, and participants could withdraw from the study at any time. Additionally, a phone number and email address were provided for any questions.

Children and adolescents were also presented with a simplified consent form, which included an objective explanation of the research. Once consent was obtained from both the children and their families, the data was included in the study. If either the family or the child declined to sign the consent forms, their data were excluded from the study, though the neuropsychological evaluation itself was conducted in accordance with the research protocol. Families were also provided with a media release form and informed about the use of data from medical records, with assurances that participant identities would remain confidential.

Data collection for the ASDG was conducted by trained psychologists and undergraduate psychology students, all of whom underwent standardized training on the study's assessment battery. Weekly supervision sessions were held with a senior researcher (a PhD-level specialist in clinical neuropsychology) to address any questions. Following the neuropsychological assessments, two child and adolescent psychiatrists from the research team provided a diagnosis for each participant, allowing for differential diagnosis verification and identification of comorbidities. After this process, the data collection for the ASDG was systematically organized.

For the non-ASD group (NASDG), data collection was approved by the Rio de Janeiro Education Department as part of a voluntary partnership.

This phase was conducted by a psychologist with specialization in clinical neuropsychology and four undergraduate psychology students. Prior to data collection, the students underwent eight weeks of training, which included practical assessments. During parent meetings at the school, families were introduced to the research objectives and invited to participate. They were given copies of the Informed Consent Form and the Assent Form. Data collection only proceeded for children whose parents and the children themselves had signed the respective consent forms.

To ensure consistency, the undergraduate students received weekly supervision during the data collection period, addressing any questions related to the standardization of instrument application and scoring. Similar to the ASDG, NASDG participants were informed that participation was entirely voluntary.

Data Analyses

Initially, the data were computed and preprocessed into two separate datasets (NASDG and ASD group), considering the variables specific to each. During this stage, outliers and missing data were identified. A total of 24 cases of missing data were observed in variables related to the Five Digits Test (FDT) within the ASDG's dataset. Consequently, before conducting the analyses, a mean imputation model was applied using the "lapply" function in the R programming language within the RStudio environment (2023).

The imputation process was guided by established criteria, including considerations for potential biases, data type, and statistical power, as recommended by Alwateer (2024). Additionally, the method employed followed a similar approach to that described in the study by Silva et al. (2020). These measures ensured methodological rigor and minimized the potential impact of missing data on the subsequent analyses.

After preprocessing the datasets and performing data imputation, descriptive analyses were conducted to examine sociodemographic characteristics of the participants and their performance on inhibitory control and other cognitive tasks (using mean and standard deviation). To identify

different inhibitory control profiles in the two groups analyzed, exploratory analyses were performed, including a cluster analysis and a latent profile analysis (LPA) using z-score values for variables from the Stroop tasks, Go/No-Go tasks, and the inhibition phase of the FDT using R and Mplus 8 software.

Following the identification of three inhibitory control profiles among the children with ASD, additional descriptive analyses were conducted to examine their overall cognitive performance and core executive functions. These analyses also aimed to identify potential differences in clinical history, including medication use at the time of outpatient entry, behavioral complaints, and the presence of comorbidities. Subsequently, by calculating the frequency of these clinical history characteristics in the ASD group, graphical representations were created to analyze the distribution of these features.

Additionally, to examine potential differences between the identified profiles in each analyzed task, an Analysis of Variance (ANOVA) was conducted, focusing solely on the inhibitory control tasks. To identify the relationship between the ASD group's performance on inhibitory control tasks and their performance on other foundational executive function tasks (working memory and flexibility), a Pearson correlation analysis was applied.

Upon separate analysis of the NASDG data, similar descriptive and inferential experimental analyses were conducted as those performed for the ASD group. An Analysis of Covariance (ANCOVA) was conducted because differences were observed in the age, sex and school years of the participants. Therefore, this analysis was conducted to control for potential effects by including group, sex, age, school years, and IQ as covariates. The effect size of the variance in the tasks was assessed by calculating eta squared (η^2). In order to compare the profiles of a group with ASD and the NASDG, also a graph was created to analyze the distribution of results for each task based on standard deviation.

To further assess the discriminatory capacity of the tasks between the ASDG and NASDG, Receiver Operating Characteristic (ROC) curve analysis was employed. This analysis was used to evaluate the ability of each task to distinguish between the groups by measuring the Area Under the Curve (AUC), which reflects the accuracy of the task in correctly classifying group. In this study the AUC results were interpreted using the cut off above 0.80 was generally useful and above this value as limited, as recommended by Çorbacıoğlu and Aksel (2023). Sensitivity and specificity values were also calculated to identify the extent to which each task could correctly detect IC deficits (sensitivity) and exclude individuals without such deficits (specificity).

For curve ROC analysis, raw scores were used, and individuals from the NASDG group with IQ scores below 70 were excluded (n = 4). The ASDG group consisted of children with ASD who exhibited preserved cognitive abilities but had inhibitory control difficulties, excluding those with comorbidities, which reduced the group size from 28 to 23. ROC analysis is widely regarded as a robust method for evaluating diagnostic test performance (Zweig & Campbell, 1993). All analyses were performed in R, using the RStudio environment (RStudio Team, 2023) and the code and outputs are accessible at https://osf.io/5hq4c/.

Results

Sample characteristics

When comparing the two groups, significant differences were observed in age, sex distribution, and educational level. Participants in the ASDG were, on average, older than those in the NASDG, reflecting the clinical sample's broader age range. The ASDG had a higher proportion of male participants, consistent with the well-documented male predominance in ASD diagnoses. Regarding educational level, the NASDG had a greater concentration of students in the early years of elementary school, while the ASDG showed a more dispersed distribution across different school years.

In terms of cognitive performance, a significant difference was found in the information processing index, where the NASDG outperformed the

ASDG, suggesting differences in cognitive processing efficiency between the groups. However, no significant differences were observed in other cognitive measures. Table 1 summarizes these sociodemographic and cognitive characteristics.

Table 1.

Sociodemographic and cognitive characteristics of the two groups

Characteristics	**ASDG (n = 53)**		**NASDG (n = 44)**		***p*-value**
	Mean (SD)	Freq (%)	Mean (SD)	Freq (%)	
Age	M = 10.0 (SD = 2.49)	-	M = 8.30 (SD = 1.34)	-	< .001***
Sex					
Femine	-	11 (20.8%)	-	18 (40.9%%)	.031*
Masculine	-	42 (79.2%)	-	26 (59.1%)	
Educational level					
1st year of elementary school	-	2 (4.0%)	-	9 (20.5%)	
2nd year of elementary school	-	12 (24.0%)	-	10 (22.7%)	
3rd year of elementary school	-	6 (12.0%)	-	10 (22.7%)	
4th year of elementary school	-	4 (8.0%)	-	13 (29.5%)	
5th year of elementary school	-	7 (14.0%)	-	2 (4.5%)	< .001***
6th year of elementary school	-	5 (10.0%)	-	0 (0.0%)	
7th year of elementary school	-	6 (12.0%)	-	0 (0.0%)	
8th year of elementary school	-	2 (4.0%)	-	0 (0.0%)	
9th year of elementary school	-	5 (10.0%)	-	0 (0.0%)	
1st year of high school	-	1 (2.0%)	-	0 (0.0%)	

Note. ASDG = Autism Spectrum Disorder Group; NCG = non-clinical group; M = Mean; SD = Standard deviation; Asterisks denote statistical significance levels: $p < 0.05$ (*), $p < 0.01$ (**), $p < 0.001$ (***).

The cognitive assessment revealed no significant differences between groups in Full-Scale IQ, Verbal Index, Performance Index, and Working Memory Index. However, a significant difference was observed in the Processing Speed Index ($p < .001$), with the ASDG showing higher mean scores than the NASDG, as shown in Table 2.

Table 2.

Cognitive results by groups

Characteristics	ASDG (n = 53)	NASDG (n = 44)	*p*-value
Full-Scale IQ	M = 86.23 (SD = 17.34)	M = 88.30 (SD = 14.59)	.534
Verbal Index	M = 84.43 (SD = 18.59)	M = 82.47 (SD = 17.29)	.614
Performance Index	M = 91.20 (SD =16.49)	M = 94.71 (SD = 14.30)	.296
Working Memory Index	M = 91.00 (SD = 13.00)	M = 87.74 (SD =21.47)	.101
Processing Speed Index	M = 100.48 (SD = 12.57)	M = 98.25 (SD = 17.07)	< .001***

Note. ASDG = Autism Spectrum Disorder Group; NCG = non-clinical group; M = Mean; SD = Standard deviation; IQ = Intelligence quotient; Asterisks denote statistical significance levels: $p < 0.05$ (*), $p < 0.01$ (**), $p < 0.001$ (***).

In addition to the sociodemographic characteristics, the ASDG group was analyzed in terms of final diagnosis and, consequently, the presence of comorbidities; medication class used; and behavioral complaints recorded in their medical records. Using data collected by psychiatrists from medical records, behavioral complaints were identified and categorized into the following groups: psychomotor agitation, irritability, impulsiveness, inattention, verbal and physical aggression, restricted patterns, behavioral inflexibility, repetitive behaviors, social difficulties, language delay, and symptoms of depression and anxiety. Additionally, the medications prescribed

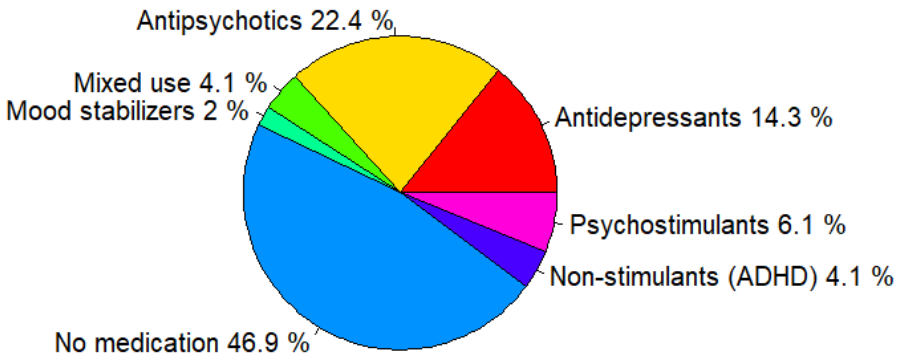
at the start of outpatient follow-up were identified and classified into seven categories: antidepressants (Fluoxetine, Sertraline, Daforin, Escitalopram); antipsychotics (Risperdal, Risperidone, Pericyazine and Methotrimeprazine); mood stabilizers (Topiramate); psychostimulants (Ritalin); non-stimulants for ADHD (Atentah); no medication and combined use (Risperidone + Escitalopram; and Risperidone + Quetiapine).

It was observed that most participants were diagnosed with autism without comorbidities (71.7%) and that the majority were not using medication when first seen at the clinic (46.9%). Regarding behavioral complaints and aspects of development and mood, based on the identification of psychiatric conditions and family reports, the following symptoms were mapped: psychomotor agitation; irritability; inattention; verbal and physical aggression; difficulty with frustration; presence of restricted and repetitive patterns; behavioral inflexibility; social difficulties; history of language acquisition delay; symptoms of depression and anxiety.

Most participants (71.7%) were diagnosed with autism without comorbidities, and nearly half (46.9%) were not using any medication when first seen at the clinic. Among those using medication, the most common categories were antipsychotics (22.4%), followed by antidepressants (14.3%), psychostimulants (6.1%), mood stabilizers (4.1%), and mixed-use medications (4.1%). The distribution of medications is visually represented in Figure 1.

Figure 1.

Distribution of medication classes in the ASD



Behavioral complaints and developmental and mood-related symptoms were identified based on psychiatric evaluations and family reports. The most frequently reported issues included inattention (68.3%), irritability (63.4%), psychomotor agitation (58.5%), verbal and physical aggression (43.9%), difficulty managing frustration (41.5%), restricted and repetitive patterns (39%), behavioral inflexibility (36.6%), social difficulties (31.7%), symptoms of depression (24.4%) and anxiety (22%), and a history of language acquisition delays (17.1%).

Comparing the performance of the ASD group with a non-ASD group

The ANCOVA results revealed significant effects for certain covariates while group differences remained limited across tasks. In the Go/No-Go task, age significantly influenced performance ($p = .00$, $\eta^2 = .07$), with older children demonstrating better inhibitory control. However, no significant differences were observed between the ASDG and NASDG groups ($p = .19$, $\eta^2 = .04$). Regarding the Stroop tasks, significant effects were found for sex on Stroop C - Time ($p = .00$, $\eta^2 = .09$), highlighting performance differences between boys and girls. In Stroop B - Errors, age ($p = .02$, $\eta^2 = .04$) and education level ($p = .02$, $\eta^2 = .17$) significantly contributed to performance, suggesting their role in modulating error rates. For the FDT Reading task, a significant group difference was identified ($p = .01$, $\eta^2 = .07$), with the NASDG group ($M = -2.02$, $SD = 2.73$) performing in a time longer than expected than the ASDG group ($M = -1.19$, $SD = 1.47$).

Similarly, in the Stroop Interference task, the ASDG group (M = 1.99, SD = .85) exhibited higher interference scores compared to the NASDG group (M = 1.58, SD = .72), with significant effects for group (p = .01, η^2 = .07) and sex (p = .00, η^2 = .07). These findings suggest that while group effects were limited to specific tasks, covariates such as age, sex, and education level significantly influenced task performance (Table 3).

Table 3.A

Analysis of variance for executive function tasks by demographic variables and group

Variable	Covariate	F	*p*-value	η²
Go No Go	Group	1.691	.19	.04
	IQ	0.037	.84	.00
	Age	9.769	**.00****	**.07****
	Education Level	1.341	.22	.09
	Sex	0.222	.63	.00
Stroop				
Card A - Time	Group	0.714	.40	.01
	IQ	0.438	.51	.00
	Age	1.558	.21	.00
	Education Level	0.976	.46	.09
	Sex	0.900	.34	.00
Card A - Errors	Group	0.26	.60	.04
	IQ	0.01	.90	.00
	Age	11.42	**.00****	.00
	Education Level	1.56	.13	.11
	Sex	3.29	.07	.00
Card B - Time	Group	0.264	.60	.00
	IQ	0.238	.62	.00
	Age	0.024	.87	.00
	Education Level	1.161	.33	.11
	Sex	1.705	.19	.01

Note. F = F-value; η² = Eta squared.

Table 3.B

Analysis of variance for executive function tasks by demographic variables and group

Variable	Covariate	F	*p*-value	η^2
	Group	1.16	.28	.00
	IQ	0.58	.44	.00
Card B - Errors	Age	5.56	**.02***	.04
	Education Level	2.27	**.02***	**.17***
	Sex	1.53	.21	.01
	Group	0.431	.51	.01
	IQ	0.053	.81	.00
Card C - Time	Age	2.301	.13	.00
	Education Level	1.143	.34	.10
	Sex	10.570	**.00****	**.09****
	Group	0.46	.49	.10
	IQ	0.00	.96	.01
Card C - Errors	Age	10.56	**.00****	**.04****
	Education Level	1.26	.26	.11
	Sex	0.12	.72	.00
	Group	6.06	**.01***	.07
	IQ	0.59	.44	.00
Interference	Age	2.49	.11	.00
	Education Level	1.00	.44	.06
	Sex	8.43	**.00****	**.07****
Five Digits Test (FDT)				
	Group	6.06	**.01***	**.07****
	IQ	0.59	.44	.00
Reading	Age	2.49	.11	.00
	Education Level	1.00	.44	.06
	Sex	8.43	**.00****	.77
	Group	0.59	.44	.00
	IQ	4.34	**.40***	**.04***
Counting	Age	5.06	**.02***	.00
	Education Level	0.86	.55	.06
	Sex	3.17	.07	.03

Note. F = F-value; η^2 = Eta squared.

Table 3.C

Analysis of variance for executive function tasks by demographic variables and group

Variable	Covariate	F	*p*-value	η^2
Choosing	Group	0.01	.89	.00
	IQ	3.99	**.04***	**.04***
	Age	6.41	**.01***	**.00***
	Education Level	0.56	.82	.05
	Sex	1.51	.22	.01
Shifting	Group	0.61	.43	.00
	IQ	1.62	.20	.01
	Age	5.36	**.02***	**.00***
	Education Level	2.22	**.02***	**.17***
	Sex	4.65	**.03***	**.04***
Inhibition	Group	0.007	.93	.00
	IQ	1.858	.17	.03
	Age	3.198	.077	.00
	Education Level	1.033	.42	.09
	Sex	1.163	.28	.01
Flexibility	Group	0.00	.95	.05
	IQ	0.53	.46	.00
	Age	4.88	**.03***	**.00***
	Education Level	1.55	.14	.14
	Sex	2.61	.11	.02

Note. F = F-value; η^2 = Eta squared.

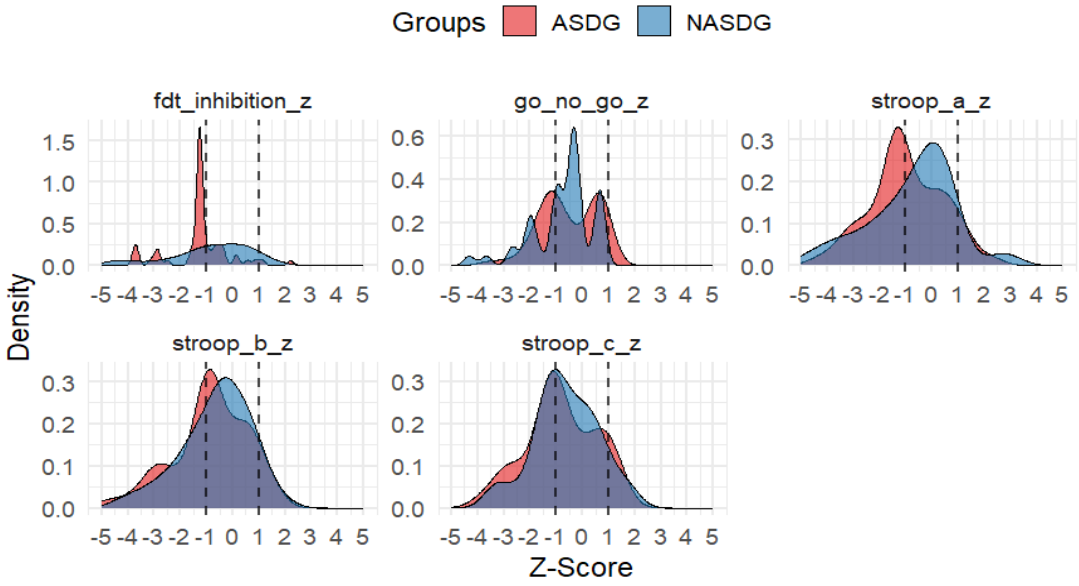
Figure 2 presents the distribution of performance in inhibitory control tasks between the ASDG and the NASDG. The results highlight distinct patterns of variability between the groups. While the NASDG displayed relatively consistent performance near the normative mean across all tasks, the ASDG exhibited a wider range of outcomes, reflecting the heterogeneity of inhibitory control abilities within this group. Specifically, the ASDG performance distribution underscores the presence of distinct subgroups, previously identified in the latent profile analysis as “Low Average,” “Below Average,” and “Average” profiles.

These differences were particularly pronounced in tasks that required higher level of inhibition of prepotent response, such as the Stroop test (particularly Stroop C) and the inhibition phase of the Five Digits Test (FDT). The ASDG subgroup with “Below Average” performance demonstrated the most significant deficits in these tasks, with performance markedly below the mean, while the “Average” subgroup performed closer to or slightly above

the normative range, approaching the NASDG results. Figure 2 also reflects the impact of task complexity on group performance. For example, inhibitory control tasks that required suppressing automatic responses (*e.g.*, Go/No-Go) revealed more significant challenges for the ASDG compared to simpler tasks, such as Stroop A.

Figure 2.

Distribution of the performance in tasks of inhibitory control between groups



When analyzed the distribution of the classification of the raw scores the performance on inhibitory control tasks revealed distinct patterns between the ASDG and NASDG groups. In the Go/No-Go task, most participants in both groups performed at an “Average” level (ASDG: 62.3%; NASDG: 75.0%), with smaller proportions classified as “Low Average” (ASDG: 20.8%; NASDG: 13.6%) and “Inferior” (ASDG: 17.0%; NASDG: 11.4%). For Stroop A, the majority of ASDG participants were classified as “Low Average” (32.1%) or “Inferior” (26.4%), while most NASDG participants fell into the “Average” (58.7%) category. Similar trends were observed for Stroop B, with the ASDG showing greater variability across classifications. In Stroop C, “Low Average” was the predominant category for both groups (ASDG: 41.5%; NASDG: 30.4%), though the NASDG group displayed more participants in the “Average"” classification (47.8%).

In the Five Digits Test (FDT), the ASDG group exhibited higher proportions in the "Average" classification for the Reading task (83.0%), while the NASDG group showed slightly lower consistency (73.3%). However, in the Choosing and Inhibition phases, the NASDG group had more participants in the "Superior" classification, reflecting better performance on more complex tasks. Overall, the NASDG demonstrated more consistent performance across tasks, while the ASDG exhibited greater variability, highlighting heterogeneity in inhibitory control abilities within the groups.

Identifying different inhibitory control profiles in children with ASD

An exploratory analysis was conducted to determine the optimal number of clusters for the ASDG data. The fit indices for the latent profile analysis (LPA) are summarized in Table 4. While the addition of clusters improved statistical fit, as indicated by decreasing AIC, BIC, and SABIC values, practical considerations guided the selection of the optimal model. The BLRT results were significant for all comparisons (p <0.001), confirming that each additional class contributed meaningfully to the model. However, the four-cluster solution exhibited considerable overlap, limiting its interpretability. Ultimately, the three-cluster solution was chosen, balancing statistical adequacy and clarity in distinguishing inhibitory control profiles. This model demonstrated strong classification accuracy, supported by an entropy value of 0.90, and provided a coherent framework.

Table 4.

Model fit indices for the latent profile analysis (LPA) exploring inhibitory control profiles in children with ASD

Classes	LL	AWE	AIC	BIC	SABIC	BLRT	*p* BLRT
1	-521.025	1.149.456	1.062.050	1.081.753	1.050.343	—	—
2	-497.086	1.167.413	1.026.172	1.057.697	1.007.441	47.876	< .001 ***
3	-478.468	1.195.823	1.000.936	1.044.282	975.180	37.236	< .001 ***
4	-460.328	1.225.098	976.656	1.031.824	943.876	36.280	< .001 ***

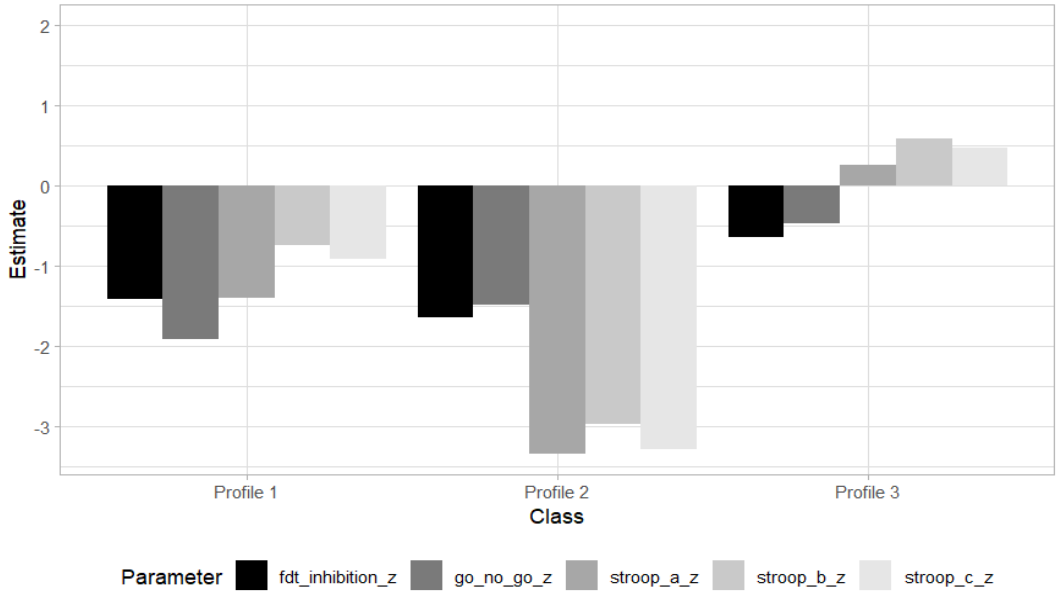
The LPA conducted on the ASDG identified a three-profile solution as the best fit for the data. Although a four-cluster model was initially

considered, the three-cluster solution demonstrated better interpretability and statistical adequacy. Model fit indices for the final three-profile model were as follows: Log-Likelihood = -489.864, AIC = 1023.728, BIC = 1067.074, Sample-Size Adjusted BIC = 997.972, and Entropy = 0.807, indicating good classification accuracy. The minimum class probability was 0.900, and the maximum class probability was 0.950, suggesting reliable profile assignment. The Bootstrapped Likelihood Ratio Test (BLRT) approached significance (p = .089), further supporting the three-profile solution.

The results of the Latent Profile Analysis (LPA) revealed three distinct inhibitory control profiles within the ASD group: Profile 1 (Low Average), Profile 2 (Below Average), and Profile 3 (Average). As shown in Figure 3, clear differences between the profiles were observed across all tasks, particularly in the Stroop tasks (A, B, and C) and the Go/No-Go task. Profiles 1 and 2 displayed lower performance estimates (negative z-scores) compared to Profile 3, which demonstrated estimates closer to or above the mean. Profile 2 exhibited the most pronounced impairments across tasks, while Profile 3 consistently showed better task performance.

Figure 3.

Inhibitory control profiles in z-score



A detailed summary of the means and standard deviations for each task and profile is presented in Table 5. Profile 1 showed moderate deficits across tasks, whereas Profile 2 exhibited the largest deviations, particularly in Stroop A, B, and C times. In contrast, Profile 3 demonstrated near-average performance across all tasks, with comparatively higher scores on the Go/No-Go task and the inhibition phase of the Five Digits Test (FDT). The table provides a comprehensive view of the quantitative differences across the profiles, complementing the visual representation in Figure 2.

Table 5.

ASD tasks perfomance by profiles

Variable	**Profile 1**		**Profile 2**		**Profile 3**	
	Low average (n =28)		*Below average (n = 11)*		*Average (n = 14)*	
	Raw score	Z-Score	Raw score	Z-Score	Raw score	Z-Score
Go/No-Go	M = 0.92 (SD = 0.09)	M = -1.94 (SD = 3.13)	M = 0.94 (SD = 0.08)	M = -1.43 (SD = 2.82)	M = 0.96 (SD = 0.02)	M = -0.50 (SD = 0.79)
Stroop A - Time	M = 31.69 (SD = 20.56)	M = -1.50 (SD = 1.39)	M = 48.64 (SD = 29.61)	M = -3.29 (SD = 2.97)	M = 17.50 (SD = 7.01)	M = 0.40 (SD = 0.96)
Stroop B - Time	M = 29.93 (SD = 7.84)	M = -0.76 (SD = 0.66)	M = 49.27 (SD = 15.05)	M = -3.01 (SD = 0.87)	M = 23.50 (SD = 7.08)	M = 0.63 (SD = 0.60)
Stroop C - Time	M = 46.42 (SD = 13.72)	M = -0.97 (SD = 0.92)	M = 77.18 (SD = 29.50)	M = -3.27 (SD = 1.70)	M = 30.50 (SD = 8.61)	M = 0.58 (SD = 0.68)
FDT - Inhibition	M = 53.39 (SD = 26.98)	M = -1.43 (SD = 1.18)	M = 66.45 (SD = 26.38)	M = -1.62 (SD = 1.10)	M = 47.00 (SD =17.36)	M = -0.64 (SD =1.02)

The subsequent table (Table 6) presents the statistical analysis of the results, including ANOVA and post-hoc comparisons, highlighting significant differences between profiles in Stroop A, B, and C times, as well as FDT. Profile 2 (Below average) showed the largest deficits, particularly in Stroop tasks, indicating slower response times and more difficulties with cognitive flexibility and inhibition. Profile 1 (Low average) demonstrated moderate deficits, while Profile 3 (Average) performed closest to the normative range. The FDT also revealed significant differences, with Profile 2 showing more pronounced inhibition deficits compared to Profiles 1 and 3. These findings

emphasize the cognitive differences across profiles in tasks involving processing speed, inhibition, and task-switching.

Table 6.

Inhibition tasks comparison considering different profiles

Variable	Df	SS	f	*p*	Mean Diff	Post-Hoc *p*-value	CI (Lower, Upper)
Go/No-Go	1	19.1	2.754	.10	-1.45	.10	(-2.18, -0.73)
Stroop A - Time	1	21.11	4.987	.03 *	-1.37	.03*	(-1.94, -0.80)
Stroop B - Time	1	8.54	4.452	.03 *	-0.861	.03*	(-1.24, -0.48)
Stroop C - Time	1	11.17	4.124	.04 *	-1.04	.04*	(-1.49, -0.59)
FDT - Inhibition	1	4.83	3.729	.05	-1.26	.05	(-1.58, -0.95)

Note. Asterisks denote statistical significance levels: $p < 0.05$ (*), $p < 0.01$ (**), $p < 0.001$ (***); df = degrees of freedom; SS: Sum of squares; Mean Diff = Mean difference; CI (Lower, Upper): Confidence interval for the mean difference.

What was the distribution of behavioral complaints and the use of medication considering the ASDG profiles?

Based on the division of profiles, it was possible to identify distinct sociodemographic, cognitive, and clinical characteristics for each group. Group 1 (Low-Average), which included 28 participants, had a mean age of 10.14 years and a male predominance (75%). This group exhibited relatively preserved cognitive functioning compared to Group 2, with an average IQ of 89.07 (*SD* = 19.51). Most participants (82.1%) were presented with an isolated diagnosis of ASD, and comorbidities were less frequent (17.9%). Although some behavioral complaints were present, such as restlessness (28.0%) and inattention (28.0%), the group displayed relatively fewer difficulties in behavioral flexibility and inhibition tasks. This suggests that while participants in Group 1 showed deficits in inhibitory control, their overall cognitive functioning remained closer to the lower end of the average range.

Group 2 (Below average), consisting of 11 participants, had the youngest mean age (8.91 years), with 72.7% of participants being male. This group stood out for presenting the lowest cognitive scores, with an average IQ of 83.00 (*SD* = 18.70), and particularly low performance in verbal index (79.73). Additionally, Group 2 had the highest prevalence of comorbidities (54.5%), and 45.5% of participants had a diagnosis of ASD combined with Intellectual Disability (IDD). Behaviorally, this group demonstrated more severe impairments in inhibitory control tasks, as evidenced by their Stroop test z-scores, which were significantly lower compared to the other groups. High rates of behavioral complaints, such as impulsiveness (27.3%) and behavioral inflexibility (18.2%), were also observed, which may reflect the significant challenges these participants face in adapting to task demands and regulating behavior.

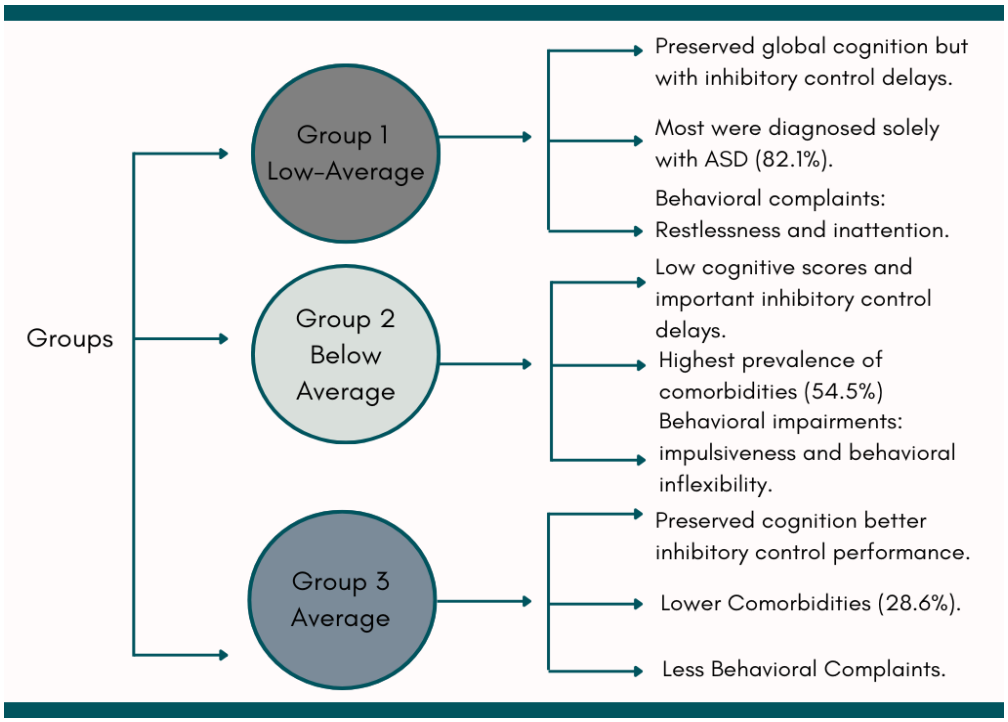
Group 3 (Average), with 14 participants, exhibited the most preserved cognitive and clinical characteristics. The mean age was 10.57 years, and this group showed the highest proportion of male participants (92.9%). Group 3 displayed IQ scores in the lower average range (*M* = 83.29, *SD* = 10.73), but their performance was notably better than Group 2 in inhibitory control tasks, such as the Stroop test and flexibility measures. This group also had the lowest frequency of comorbidities (28.6%) and fewer behavioral complaints. For example, inattention was entirely absent from this group, and impulsiveness was reported in only 9.1% of participants. These findings suggest that Group 3 participants, while presenting challenges typical of ASD, demonstrated greater cognitive flexibility and inhibitory control, which may help mitigate some behavioral difficulties commonly observed in the clinical population.

Although the *p*-value of .57 indicates that the differences in medication classes across the three groups are not statistically significant, there are still some interesting patterns worth noting. Group 1 (N=28) shows the highest proportion of individuals using antipsychotics (36.4%) and antidepressants (18.2%). While Group 2 (N=11) also has a relatively high use of antipsychotics (22.5%). Group 2 was the only group that used a combination of medications (7.4%) and did not use mood stabilizers. Group

3 (N=14) displays a higher percentage of individuals not using any medication (63.6%), with smaller proportions using antidepressants (9.1%), antipsychotics (9.1%), and non-stimulants for ADHD (9.1%). Figure 4 summarizes these findings.

Figure 4.

Cognitive and clinical characteristics of the groups



When comparing cognitive performance across tasks, the results reveal subtle differences between the three groups, though no statistically significant findings were observed. In the Stroop tasks (A, B, and C errors), which assess cognitive flexibility and response inhibition, Group 1 (N=28) and Group 2 (N=11) displayed more pronounced errors compared to Group 3 (N=14), with Group 1 showing the least errors in the Stroop A task and Group 2 showing the most in the Stroop B task. However, these differences were not statistically significant (*p*-values ranging from 0.081 to 0.257), indicating that errors in these tasks were relatively similar across groups. A more notable trend was seen in the cognitive flexibility task (FDT), where Group 2 showed significantly more difficulties, as evidenced by a lower z-score (-1.75) compared to Group 1 and Group 3 (p = .016). Regarding working memory and processing speed indices, no significant group differences were observed

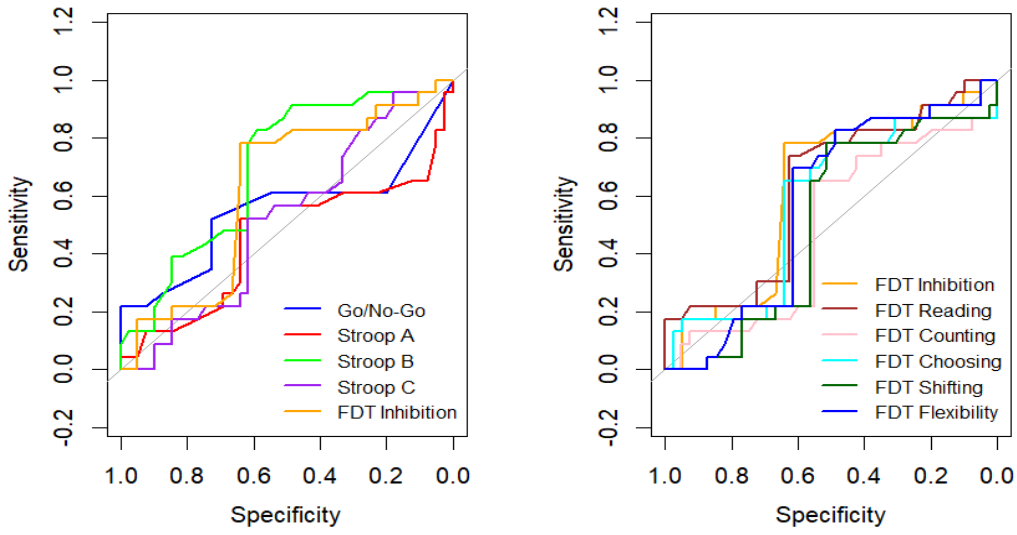
(p = .640 and p = .111, respectively), though Group 2 had lower performance scores in both domains. These cognitive results suggest that, while there are some trends, medication use, and group differences do not significantly impact cognitive task performance in these specific areas.

What is the discriminatory capacity between groups when applying the instruments used?

The ROC curves presented in Figure 5 provide a comprehensive visual representation of the discriminatory abilities of the tasks analyzed in distinguishing between ASDG and NASDG groups. These curves illustrate the balance between sensitivity and specificity, with tasks such as Stroop B, FDT - Reading (Errors), and FDT - Inhibition emerging as the most promising based on their moderate AUC values (0.69, 0.68, and 0.62, respectively). On the other hand, tasks like Go-No/Go and FDT - Counting (Time), with AUC values near chance levels (0.54 and 0.48), demonstrate limited utility for this purpose. This variability in task performance highlights the importance of focusing on measures that target cognitive processes relevant to group differentiation.

Figure 5.

ROC curves for inhibitory control tasks comparing ASDG and NASDG.



In terms of sensitivity, tasks like FDT - Shifting (Time) and FDT - Flexibility stand out, achieving values of 0.78 and 0.82, respectively, indicating their effectiveness in correctly identifying individuals in the ASDG group. Conversely, measures such as Stroop A and FDT - Reading (Errors) showed lower sensitivity, underscoring their limitations in capturing true positives. Tasks like Stroop B and FDT - Reading (Time), which balance sensitivity and specificity, show greater potential for broader diagnostic use, as reflected in their higher overall accuracy (0.67 and 0.66, respectively). These findings are further detailed in Table 7, which complements the insights from Figure 4 by providing a breakdown of AUC, sensitivity, specificity, thresholds, and accuracy for each task. For example, FDT - Shifting (Errors) demonstrates a strong balance with a sensitivity of 0.60, specificity of 0.76, and an accuracy of 0.70, further reinforcing the importance of error-monitoring tasks in distinguishing these groups.

Table 7.

Discriminatory capacity of inhibitory control tasks between ASDG and NASDG.

Measure	AUC	Sensitivity	Specificity	Threshold	Accuracy
Go-No/Go	0.54	0.52	0.72	0.94	0.65
Stroop A	0.45	0.52	0.64	31.23	0.59
Stroop B	0.69	**0.82**	0.58	33.50	0.67
Stroop C	0.51	0.52	0.61	48.30	0.58
FDT - Reading (Time)	0.62	0.73	0.62	40.55	0.66
FDT - Reading (Errors)	0.68	0.47	**0.92**	0.07	0.76
FDT - Counting (Time)	0.48	0.65	0.55	60.19	0.58
FDT - Counting (Errors)	0.55	0.60	0.65	0.20	0.63
FDT - Choosing (Time)	0.57	0.65	0.64	92.89	0.64
FDT - Choosing (Errors)	0.57	0.65	0.64	92.89	0.64
FDT - Shifting (Time)	0.50	0.78	0.51	104.50	0.61

FDT - Shifting (Errors)	0.61	0.60	0.76	3.20	0.70
FDT - Flexibility	0.57	**0.82**	0.48	53.00	0.61
FDT - Inhibition	0.62	0.78	0.64	48.50	0.69

Discussion

This study identified four key findings regarding inhibitory control in children with ASD: (1) significant group differences in inhibitory control performance, particularly in the FDT - Reading and Stroop - Interference tasks, with age as a key covariate influencing performance across multiple measures; (2) identification of three distinct inhibitory control profiles within the ASD group (Low Average, Below Average, and Average), reflecting significant variability in performance across tasks; (3) association between inhibitory control profiles and behavioral difficulties, with the Below Average profile exhibiting the most pronounced deficits and higher prevalence of comorbidities; and (4) the discriminatory power of specific inhibitory control tasks, as demonstrated through ROC curve analysis, highlighting the clinical utility of tasks such as FDT - Choosing and Stroop C in distinguishing ASD from non-clinical participants. These findings reinforce the heterogeneity of inhibitory control in ASD and its connection to broader cognitive and behavioral domains.

Group differences in inhibitory control performance

The ANCOVA results revealed significant group differences in tasks such as FDT - Reading and Stroop - Interference, with age emerging as a key covariate influencing performance across several measures. These results indicate that children with ASD exhibited more difficulty in interference control and cognitive flexibility compared to their typically developing peers, aligning with previous research emphasizing deficits in executive functioning in ASD (Diamond, 2013; Geurts et al., 2014).

The Go/No-Go task, which primarily measures reactive inhibition, requires participants to suppress a prepotent motor response, making it

particularly sensitive to deficits in impulse control and processing speed (Rubia et al., 2001; Zapparrata et al., 2023). Conversely, the Stroop task targets proactive inhibition by requiring the suppression of cognitive interference, engaging selective attention and cognitive flexibility to manage conflicting information (Diamond, 2013; Wildenberg et al., 2022). The FDT tasks expand on these dimensions by incorporating both time-based and error-monitoring measures, which assess interference control and effortful control, reflecting a blend of proactive and reactive inhibitory demands (Burca et al., 2021; Krishnamurthy et al., 2022).

Additionally, while the ASD group exhibited greater variability in performance, some children performed similarly to their typically developing peers, reinforcing the importance de individual differences within ASD (Adams & Jarrold, 2012). The findings align with studies suggesting that older children with ASD tend to show better inhibitory control, supporting the idea that inhibition improves with age due to ongoing maturation of the prefrontal cortex (Weiss et al., 2017).

Identification of inhibitory control profiles in ASD

The current study identified distinct inhibitory control profiles among children with ASD. Latent profile analysis revealed three subgroups within the ASD group: Low Average, Below Average, and Average. These profiles were determined based on performance across various inhibitory control tasks, revealing significant variability within the ASD group, particularly in the Stroop test and the Go/No-Go task. The Average profile demonstrated relatively intact inhibitory control, while the Low Average profile showed moderate deficits, especially in tasks requiring interference control (Stroop test). The Below Average profile exhibited the most pronounced inhibitory control impairments, with difficulties across all tasks, particularly in motor response inhibition (Go/No-Go task) and interference control (Stroop test).

These profile differences can be analyzed in two ways: (1) by examining the theoretical and clinical distinctions in inhibitory control demands and abilities assessed in each task, and (2) by discussing the influence of task format on performance. The FDT and Stroop tasks,

particularly in their different stages, align more with attentional or interference control (proactive inhibition), requiring the suppression of competing information as the model proposed by Wildenberg et al. (2022). In contrast, the Go/No-Go task predominantly reflects motor response inhibition (reactive inhibition), as it involves withholding prepotent motor responses to stimuli.

The presence of heterogeneous profiles within the ASD group suggests that inhibitory control impairments are not uniform and must be assessed at an individual level. The literature continues to debate the specific functions assessed by the Stroop task (Burca et al., 2021; Diamond, 2013; Keha & Kalanthroff, 2023), with alternative models of inhibitory control frequently being proposed. Furthermore, the terminology used in the literature, such as “response inhibition” and “attentional inhibition”, often refers to overlapping processes, as highlighted by Tiego et al. (2018).

Behavioral information associated with inhibitory control deficits

The findings also highlighted a relationship between these inhibitory control profiles and behavioral difficulties, with the Below Average profile exhibiting the most pronounced impairments in inhibitory control, presenting higher rates of comorbidities and behavioral complaints. The Below Average profile was associated with higher prevalence of behavioral difficulties (78%), particularly impulsivity, emotional dysregulation, and cognitive rigidity. These findings support prior research indicating that inhibitory control deficits are closely linked to self-regulation difficulties in ASD (Torenvliet et al., 2023).

The presence of comorbid conditions, such as ADHD, further exacerbated inhibitory control impairments, reinforcing studies that suggest that children with comorbid ASD+ADHD experience greater executive function deficits than those with ASD alone (Cremone-Caira et al., 2021). These children also exhibited higher use of antipsychotic medications, which are commonly prescribed to manage irritability and aggression in ASD (McCracken et al., 2002). However, the relationship between medication use and inhibitory control performance remains inconclusive, as some studies

indicate that atypical antipsychotics and stimulants may improve behavioral regulation but have variable cognitive effects in ASD (D'Alò et al., 2021; Kaplan & McCracken, 2012).

Discriminatory power of inhibitory control tasks

The ROC curve analysis further supported these findings by demonstrating the discriminatory power of specific tasks, such as FDT-Choosing and Stroop C, in differentiating the ASDG from the NASDG. The moderate sensitivity of the FDT Flexibility task (*AUC* = 0.57, *sensitivity* = 0.82) suggests its utility in identifying deficits related to cognitive flexibility and inhibitory control in children with ASD.

However, while inhibitory control tasks contribute to ASD assessment, they should not be used in isolation. Instead, a multimodal approach that incorporates cognitive flexibility, attentional control, and working memory measures is recommended to capture the full scope of executive function deficits (Cremone-Caira et al., 2021). These results reinforce the heterogeneity of inhibitory control in children with ASD and its connection to other cognitive and behavioral domains, highlighting the clinical utility of these tasks in identifying deficits.

Implications for Research and Clinical Practice

These findings have important clinical implications, reinforcing the heterogeneity of inhibitory control deficits in ASD and emphasizing the importance of multimodal assessment approaches. The presence of distinct inhibitory control profiles suggests that interventions should be personalized based on individual strengths and weaknesses. Children in the Below Average profile, characterized by more severe deficits and higher rates of comorbidities, may benefit from structured interventions targeting impulse control and behavioral inflexibility, such as cognitive-behavioral therapy (CBT) or Applied Behavior Analysis (ABA) techniques (Steege, 2014). In contrast, children in the Low Average profile might require interventions focused on flexibility and attention-switching, incorporating mindfulness-based strategies or executive function training (Diamond, 2013). Meanwhile, children in the Average profile, who demonstrate relatively preserved

inhibitory control, could benefit from strength-based approaches, including goal-setting and self-monitoring techniques, to further enhance executive functioning. Additionally, classroom accommodation, such as breaking tasks into smaller steps and minimizing distractions, can provide valuable support for children with ASD across different profiles, helping to optimize their learning and social engagement.

Limitations

Despite the contributions of this study, several limitations should be acknowledged. First, the sample size, particularly within the "Below Average" profile, was relatively small, limiting the generalizability of the findings. Additionally, the cross-sectional design precludes conclusions about developmental trajectories of inhibitory control in ASD. Longitudinal studies are needed to examine how inhibitory control evolves over time and interacts with other executive functions. The reliance on parental reports for behavioral complaints may also introduce bias, as these perceptions could be influenced by external factors such as stress or expectations. Finally, while the study considered medication use, it did not account for dosage, duration, or adherence, which could significantly impact the observed outcomes. Future research should incorporate more detailed medication data and explore interactions between pharmacological treatment and cognitive performance in ASD.

Conclusion

This study provides valuable insights into the heterogeneous nature of inhibitory control deficits in children with ASD, as well as comparisons with typically developing peers. By identifying distinct profiles of inhibitory control, it underscores the importance of individualized approaches to intervention and assessment tailored to each subgroup. The findings reveal that children without ASD performed better on tasks requiring inhibitory control, particularly on measures such as the Stroop and Go/No-Go tasks, where age and education level also played significant roles. Behavioral complaints and comorbid conditions further differentiated profiles, highlighting the interplay between cognitive, behavioral, and environmental

factors. Additionally, task complexity and format significantly influenced performance outcomes across both groups, emphasizing the need for careful task design in assessments.

While limitations such as sample size and cross-sectional design must be acknowledged, this study lays a foundation for future research to explore developmental trajectories of inhibitory control and refine intervention strategies for children with ASD. It also highlights the importance of using typically developing peers as benchmarks to better understand the specific challenges faced by children with ASD. Ultimately, addressing inhibitory control deficits through multimodal strategies can enhance cognitive, behavioral, and overall quality of life outcomes, benefiting not only children with ASD but also their families and support systems.

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6. DISCUSSION

The assessment of inhibitory control in children with ASD reveals a complex pattern of performance that varies significantly based on task demands and individual characteristics. Both studies demonstrated that while children with ASD may perform similarly to typically developing peers on certain inhibitory control tasks, they show marked difficulties in others, particularly those involving visual distractors or requiring sustained attention. This aligns with recent findings by Tonizzi et al. (2022), who through meta-analyses of both direct and indirect measures, found that inhibitory control deficits in ASD are highly task dependent. Furthermore, as observed in our findings and supported by Torenvliet et al. (2023), the presence of visual distractors particularly impacts performance in tasks like Go/No-Go, while performance on traditional Stroop paradigms often remains relatively preserved.

The identification of distinct inhibitory control profiles within the ASD population, as revealed in our second study, highlights the heterogeneous nature of executive function deficits in autism. The emergence of three profiles (Low Average, Below Average, and Average) demonstrates that inhibitory control impairments are not uniform across the spectrum. This variability appears to be influenced by factors such as age, cognitive ability,

and the presence of comorbidities, particularly ADHD. These findings align with recent work by Cremone-Caira et al. (2021), who found that children with comorbid ASD and ADHD show more pronounced difficulties in response inhibition compared to those with ASD alone. The Below Average profile, characterized by more severe inhibitory control deficits, was notably associated with higher rates of behavioral complaints and comorbidities.

A crucial finding across both studies was the significant impact of task format on performance outcomes. The differential performance between Stroop and Go/No-Go tasks suggests that children with ASD may have specific difficulties with certain types of inhibitory demands rather than a global inhibitory control deficit. This pattern is consistent with recent research by Zhou and Wilson (2022), who found that young children with ASD show particular difficulties in tasks requiring resistance to visual distractors while maintaining relatively intact performance on other inhibitory control measures. Additionally, Zapparrata et al. (2023) have highlighted how processing speed differences in ASD can significantly impact performance on time-sensitive inhibitory tasks, providing another potential explanation for the observed variability in task performance.

The relationship between inhibitory control deficits and behavioral manifestations in ASD emerged as a significant theme in both studies. The presence of behavioral inflexibility and repetitive patterns was more pronounced in groups showing greater inhibitory control impairments, particularly in the Below Average profile identified in the second study. This association between inhibitory deficits and behavioral challenges is supported by recent work from Mirabella (2023), who emphasized the critical role of inhibitory control in regulating repetitive behaviors and managing behavioral flexibility in ASD. Furthermore, these findings have important clinical implications, suggesting that inhibitory control assessments might serve as valuable indicators for identifying children who may require more intensive behavioral interventions.

Both studies highlighted the importance of considering developmental factors and cognitive abilities when assessing inhibitory control in ASD. The influence of age and education level on task performance, particularly evident

in the first study's comparison between clinical and control groups, suggests that inhibitory control abilities continue to develop throughout childhood and adolescence in ASD, albeit potentially at a different rate compared to typical development. This developmental perspective is supported by recent longitudinal research by Lage et al. (2024), who found that cognitive flexibility and inhibitory control follow distinct developmental trajectories in ASD compared to typically developing children. These findings emphasize the need for age-appropriate assessment tools and intervention strategies that account for both developmental stage and individual cognitive profiles.

These findings have significant clinical implications for the assessment and intervention of children and adolescents with ASD and IDD. The identification of different inhibitory control profiles suggests that neuropsychological evaluations should consider not only the diagnosis but also individual variations within clinical groups (Geurts et al., 2014; Kenworthy et al., 2008). The differences between the Stroop and Go/No-Go tasks indicate that task format can significantly influence results, reinforcing the need for an assessment protocol that includes multiple measures to better capture executive functioning (Adams & Jarrold, 2012; Diamond, 2013).

Furthermore, the difficulties observed in clinical groups in tasks requiring resistance to visual distractions and impulse control have direct implications for interventions. Therapeutic strategies emphasizing inhibitory control training and cognitive flexibility may be beneficial in improving the academic and social performance of these individuals (Spaniol & Danielsson, 2022; Zelazo & Carlson, 2020). Programs that use positive reinforcement and environmental adaptations to reduce distractions can be particularly beneficial for children with ASD, aiding in self-regulation and adaptation to structured contexts (Torenvliet et al., 2023; Zhou & Wilson, 2022).

Finally, the results highlight the importance of interdisciplinary approaches in the care of children with ASD and IDD. Collaboration between neuropsychologists, educators, and therapists can enable the creation of more effective support strategies, ensuring that inhibitory control difficulties are adequately addressed in both school and clinical settings (Diamond, 2013; Nigg, 2001). Further research could contribute to the development of new

diagnostic tools and more personalized intervention programs, promoting a positive impact on the quality of life of these individuals and their families.

Several limitations of these studies should be acknowledged. First, the sample size in both studies was relatively modest, particularly within specific subgroups such as the Below Average profile, which may limit the generalizability of findings. The clinical sample predominantly consisted of individuals with Level 1 ASD (requiring lower levels of support) and those with mild intellectual disabilities, potentially not capturing the full spectrum of autism presentations. Additionally, the gender distribution was notably skewed, with a predominance of male participants, reflecting a common limitation in autism research but potentially underrepresenting manifestations of inhibitory control deficits in females with ASD.

The cross-sectional nature of both studies also precluded the ability to track developmental trajectories of inhibitory control over time. Furthermore, while behavioral complaints and medication use were considered, detailed information about medication dosages, duration of use, and treatment adherence was not systematically collected, which could have provided valuable insights into their impact on cognitive performance. Future research would benefit from larger, more diverse samples including individuals across different support levels, severity of intellectual disabilities, and a more balanced gender representation, as well as longitudinal designs to better understand the developmental course of inhibitory control in ASD.

7. CONCLUSIONS

These two studies provide complementary insights into the complex nature of inhibitory control in ASD, highlighting both the heterogeneity of performance and the importance of considering task-specific demands in assessment. The first study's comparison between ASD, intellectual disability, and typically developing groups revealed distinct patterns of performance across different inhibitory paradigms, while the second study identified specific profiles of inhibitory control within the ASD population. Together, these findings emphasize that inhibitory control deficits in ASD are not

uniform but rather vary based on task demands, individual characteristics, and the presence of comorbidities.

The identification of distinct profiles has important clinical implications, suggesting the need for individualized intervention approaches that consider both cognitive abilities and behavioral manifestations. Furthermore, the influence of age, education level, and task format on performance underscores the importance of developmental considerations in assessment and intervention planning. Future research should focus on longitudinal investigations of inhibitory control development in ASD, with particular attention to how different profiles may respond to targeted interventions. These findings contribute to our understanding of executive function in ASD and provide valuable insights for developing more effective, personalized approaches to assessment and intervention in clinical practice.

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9. APPENDICES

1. Clinical interview with the familiars of the clinical groups

PUC-Rio Research Group
Coordinator: Helenice Charchat Fichman
Responsible: Conceição Fernandes

Socio-Demographic and Clinical Questionnaire

Child's Name:
Medical Record:
Child's Date of Birth: //_____ Age:
Guardians:
_____
_____
_____
_____
Guardians' Education Level:
_____
Family Income:
Child's Education Level:
School:
Contact Numbers:
Date of Completion:

About Birth

How many weeks was the child born at? Were there any complications during pregnancy or delivery?

Developmental Milestones

At what age did the child start speaking? If you believe there was a delay or difficulty, please briefly explain:

At what age did the child start walking? If you believe there was a delay or difficulty, please briefly explain:

How much time do you usually spend with your child throughout the day (e.g., playing, helping with homework, taking them to school)?

Hearing and Vision

Does your child have any hearing or vision problems?

Learning Difficulties

Does your child have difficulties in school?
( ) Grade retention
( ) Low grades. What is the average?
( ) Difficulty completing homework (needs a lot of help, gets lost, or confused?)
( ) Difficulty copying material during class
( ) Letter substitution or omission in reading and/or writing
( ) Difficulty reading or understanding texts
( ) Other:

Behavioral Concerns

Does your child have behavioral complaints?

( ) Does not follow instructions at home and/or school (does not obey parents and teachers)
( ) Does not follow routine rules at home and/or school, such as respecting schedules, responsibilities, taking a bath, getting ready for school, stopping play or games, going to sleep
( ) Talks too much or plays during class
( ) Frequently receives complaints from teachers. If yes, which ones?
( ) Plays excessively to the point of disturbing friends
( ) Shows hyperactivity (runs a lot, talks a lot, seems always "on")
( ) Other:

Social Concerns

Does your child have social difficulties?

( ) Hits or bites peers
( ) Does not play with other children of the same age
( ) Plays with other children but does not seem to understand the rules or just stays nearby
( ) Prefers to play alone or stay at home rather than engaging in outdoor activities or socializing
( ) Speaks very little
( ) Cannot describe how their day was

( ) Hides from people
( ) Runs around objects or places instead of playing
( ) Seems uninterested in conversations or playing with children of the same age
( ) Does not seem to hear when called
( ) Other:

2. Informed Consent Form

INFORMED CONSENT FORM

Dear Participant,

I invite you to take part in this research study. The objective is to identify cognitive (e.g., attention, memory, planning), socio-emotional (e.g., social interaction skills and social-emotional conflict resolution), behavioral, and neurophysiological (e.g., changes in heart rate) symptoms in children with Autism Spectrum Disorder (ASD).

Participation in this study will involve four sessions lasting approximately one hour each—one session with the guardians and three sessions with the child and at least one guardian. Data will be collected through tests, tasks, and scales, which will be used solely for scientific purposes. The schedule will be set by the institution in agreement with the participants. The test results will be provided afterward.

You and the child under your care are free to decline participation in the study or withdraw at any time, even after initially agreeing to participate. If you require further clarification about the research, you may contact the Psychiatry Service of Santa Casa de Misericórdia at (21) 2544-2951 or the research coordinator, Helenice Fichman, at (21) 99219-1293, at the following address: Rua Santa Luzia, 206, Centro, CEP: 20220324, Rio de Janeiro.

Participation in this research involves minimal risks, such as fatigue due to the duration of the sessions. If this occurs, you may stop at any time and resume later if you wish. We guarantee reimbursement for any possible expenses resulting from participation in the study. The results of this research will benefit the child and adolescent population.

All information collected in this study is strictly confidential. Only members of the research team will have access to individual data. The data obtained will be used exclusively for this research, and only general results may be published in scientific journals and presented at academic conferences.

You will not incur any expenses or receive any payment for participating in this study. Upon agreeing to participate, you will receive a signed copy of this consent form, while another copy will remain with the research team. You are guaranteed the right to seek compensation for damages resulting from the

research (CNS Resolution No. 510 of 2016, Article 18, §2; CNS Resolution No. 466 of 2012, Items IV.3 and V.7; and Civil Code, Law No. 10.406 of 2002, Articles 927 to 954, Chapters I "On the Obligation to Indemnify" and II "On Indemnification," Title IX "On Civil Liability").

If you have any concerns or questions regarding the ethical aspects of this research, please contact the Research Ethics Committee (CEP) of the Clementino Fraga Filho University Hospital/HUCFF/UFRJ, located at R. Prof. Rodolpho Paulo Rocco, No. 255, Cidade Universitária/Ilha do Fundão, 7th floor, Wing E, by phone at (21) 3938-2480 (Monday to Friday, from 8 AM to 4 PM) or via email at cep@hucff.ufrj.br. The Research Ethics Committee is responsible for overseeing ethical issues in research at UFRJ and plays a key role in protecting participants from any potential harm.

Having read and understood the above information, I freely and knowingly agree to participate in this research:

I, _____, consent to my child _____ participating in this study.

Contact phone number: _____

Signature: _____
Researcher's Signature: _____

Rio de Janeiro, ___ of _____, _____.

3. Child's Assent Form (Ages 6 to 13)

Pontifícia Universidade Católica do Rio de Janeiro

Hello!

You are invited to participate in the research study: "Neuropsychological, Socio-emotional, Behavioral, and Neurophysiological Profile of ASD", coordinated by Professor Helenice Fichman. Your parents have already allowed you to participate.

We want to understand how children grow, how they organize themselves, pay attention, solve problems with friends, and express their emotions. Your answers will help other children.

In this study, you will do some activities—some similar to school tasks and others where you will answer questions about different social situations. These activities will take place on three different days. Everyone participating is around your age (6 to 13 years old).

If you feel tired, you can stop whenever you want, and we can continue on another day if you prefer. You do not have to participate if you don't want to, and it's okay if you decide to stop at any time—there will be no problem, and no one will be upset with you.

No one will know that you are participating in the study, and we will not tell anyone. The results of the research will be shared in a way that explains how children develop, but without using your name. When the study is finished, we will tell you and your parents about the results.

If you have any questions, you can ask me. If you or your parents have any questions later, you can call me at (21) 2544-2951 or contact the research coordinator at (21) 99219-1293.

If you or your parents have any concerns about the ethics of the study, you can contact the Research Ethics Committee (CEP) at Clementino Fraga Filho University Hospital/HUCFF/UFRJ at R. Prof. Rodolpho Paulo Rocco, No. 255, Cidade Universitária/Ilha do Fundão, 7th floor, Wing E, by phone at (21) 3938-2480 (Monday to Friday, from 8 AM to 4 PM) or via email at cep@hucff.ufrj.br.

I, _____, agree to participate in the study "Neuropsychological, Socio-emotional, Behavioral, and Neurophysiological Profile of ASD."

I understand the good and bad things that might happen. I understand that I can say "yes" and participate, but that at any time, I can say "no" and stop, and no one will be upset with me.

The researchers answered my questions and talked to my parents or guardians. I received a signed copy of this assent form, and I have read and agree to participate in the study.

Child's Signature: _____
Parent/Guardian's Signature: _____
Researcher's Signature: _____

Rio de Janeiro, ___ of _____, _____.

4. Assent Form for Adolescents (14-17 years old)

Pontifícia Universidade Católica do Rio de Janeiro

Hello,

You are invited to participate in the research study: "Neuropsychological, Socioemotional, Behavioral, and Neurophysiological Profile of ASD," coordinated by Professor Helenice Fichman. Your parents have already given their permission for your participation.

We aim to understand how adolescents develop, how they pay attention, organize themselves, resolve social and emotional conflicts, and react in different social situations. Your responses will help other adolescents.

In this study, you will complete some activities—some similar to school tasks and others that involve answering questions about social situations. The study will take place over three different days. All participants will be between 14 and 17 years old.

You may feel tired during the tasks, and if you do, you can stop at any time and continue another day if you wish. Participation is voluntary, meaning you do not have to take part if you don't want to, and you can withdraw at any time without any consequences.

Your participation will remain confidential, and no one outside the research team will know that you are involved. The study results will be published in scientific journals, but your name will not be mentioned. Once the research is complete, we will share the results with you and your parents.

If you have any questions, you can ask me at any time. If you have further questions later, you or your parents can contact me at (21) 2544-2951 or the study coordinator at (21) 99219-1293.

If you or your parents have any ethical concerns about the study, you can contact the Research Ethics Committee (CEP) of Hospital Universitário Clementino Fraga Filho/HUCFF/UFRJ, at R. Prof. Rodolpho Paulo Rocco, n.° 255, Cidade Universitária/Ilha do Fundão, 7th floor, Wing E, by phone at 3938-2480 (Monday to Friday, from 8 AM to 4 PM), or by email at cep@hucff.ufrj.br.

Having read and understood the information provided, I freely agree to participate in this study.

I, _____, agree to participate in the research study "Neuropsychological, Socioemotional, Behavioral, and Neurophysiological Profile of ASD."

I understand that I can say “yes” and participate, but I can also say “no” and withdraw at any time, and no one will be upset with me. The researchers answered my questions and spoke with my parents.

I will receive a signed copy of this assent form, and the research team will keep another copy.

I have read and agree to participate in this study.

Participant's Signature: _____
Parent/Guardian's Signature: _____
Researcher's Signature: _____

Rio de Janeiro, ___ / ___ / _____

5. Authorization form for video recording

AUTHORIZATION FORM FOR VIDEO RECORDING

I, _____, authorize the video recording of my child, _____, to assist in the analysis of their performance during assessment sessions.

Additionally, I consent to the use of these recordings for clinical discussions, with the understanding that they will only be shown during supervision meetings attended by the supervising psychologist, Conceição Fernandes.

Rio de Janeiro, ____ / _____ / _____

_____
Parent/Guardian

_____
Psychologist