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Linking cognitive flexibility, planning, and autistic traits: The mediating role of cognitive abilities

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A B S T R A C T

Autistic children often face cognitive challenges, particularly in executive functions (EFs). Previous research has explored the relationship between EFs and autistic traits, including social abilities and restricted and repetitive behaviours (RRBs). While some consistencies emerge from ecologically valid ratings, results from performance-based measures and studies combining lab tasks with parent reports remain inconsistent. This study investigated associations between EFs and autistic traits, focusing on the mediating role of cognitive abilities. We assessed 110 autistic participants aged 4–17 years (33 with IQ <85; 77 with IQ ≥ 85) using a comprehensive neuropsychological battery, including the Weschler Intelligence Scale for Children (WISC-IV), performance-based EF tasks (WCST, TOL), clinician ratings (ADOS-2), and parent-reported measures (SRS-2). Results showed significant links between cognitive flexibility and clinician-observed RRBs, and between planning skills and parent-reported autistic traits. Notably, cognitive abilities mediated the relationships of cognitive flexibility and planning with clinician-rated social-communication skills. Lower IQ participants performed worse on most EF measures, except for errors in shifting and planning task timing. Clinicians reported lower social scores only in the lower IQ group. These findings reveal inconsistencies in convergence between performance-based EF measures and autistic traits from parent and clinician reports. Importantly, cognitive abilities play a significant role in clinical assessments of EF and socio-communication, highlighting the need for more sensitive and ecologically valid neuropsychological tools. Conversely, cognitive skills did not influence clinician-rated RRBs or parent reports, suggesting these behaviours may be independent of broader cognitive abilities.

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1. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterised by differences in social communication and interaction, alongside restrictive and repetitive behaviours (American Psychiatric Association, 2022). Autistic children often show cognitive challenges from early development, particularly in executive functions (EFs), a set of higher-order cognitive skills essential for goal-directed behaviour and everyday functioning (Christoforou et al., 2023; Diamond, 2013).

Despite strong evidence linking EF difficulties to autistic traits, including social-communicative challenges (Leung et al., 2016; Tsermentseli et al., 2018; Torske et al., 2018) and restricted behaviours (Faja & Nelson Darling, 2019; Iversen & Lewis, 2021; Van Eylen et al., 2015), results are often inconsistent. A key factor is the measurement method: informant-report tools, such as parent questionnaires, which tend to reflect real-world executive difficulties or autistic traits, are often not linked with performance-based tasks (Leung et al., 2016; Jones et al., 2018). This gap between performance and report remains relatively understudied but has important implications for both research and practice. Moreover, existing studies typically focus on core EF domains (inhibition, flexibility), while higher-order functions like planning and problem-solving are less frequently examined, despite their relevance for daily functioning. To address these gaps, the current study investigates how EF components, assessed through performance-based tasks, relate to autistic traits in a neurodiverse sample of children. These traits are measured through a structured observation and a parent report, allowing for examining EF-trait associations across contexts. We also explore the role of cognitive abilities (Intelligence Quotient, IQ) in shaping these relationships. Cognitive profiles may obscure or amplify EF-related difficulties, particularly in studies relying solely on lab-based measures. Moreover, while IQ is often statistically controlled for in cognitive research, its use in autistic samples, especially young or minimally verbal children, has been criticised due to developmental inappropriateness and cultural bias (Courchesne et al., 2022; Mottron, 2021). Although cognitive ability is known to influence both EF (Campbell et al., 2017; Gardiner et al., 2017; Larson et al., 2021) and socio-communicative functioning (Itskovich et al., 2021; Joseph et al., 2002; Syriopoulou-Delli et al., 2018), its moderating effect in autism remains poorly understood.

1.1. *Executive functions in Autism: from core to higher-order processes*

EFs are organised hierarchically, with foundational abilities (cognitive flexibility, working memory, and inhibition) supporting the development of second-level components like planning and problem-solving. Both levels of EF are frequently challenging for autistic children. Specifically, cognitive flexibility refers to the ability to deliberately shift one's thoughts and efficiently switch between tasks or mental sets in response to changing environmental conditions (Lage et al., 2024). This function is among the most challenging aspects for autistic children and adolescents, ranging from 5 to 18 years, as reported both by parents and by the individuals themselves in their daily activities (Granader et al., 2014; Kenworthy et al., 2022; Van Eylen et al., 2015). Research using performance-based measures has identified significant differences in cognitive flexibility between autistic and neurotypical children from early childhood (3–7 years; Gardiner et al., 2017) through school age (6–14 years; Panerai et al., 2014) and into adolescence (8–17 years; Robinson et al., 2009). These findings suggest that cognitive flexibility difficulties are persistent across development and evident in both structured assessments and real-world contexts. Although Robinson et al. (2009) suggested that autistic children, aged 8–17, exhibited increased perseverative errors on the Wisconsin Card Sorting Test (WCST), indicating that while their ability to shift between tasks was relatively intact, their capacity for self-monitoring and feedback-based responses was impaired. However, cognitive flexibility is not the only EF domain in which autistic individuals face challenges. Inhibitory control, which refers to the ability to suppress automatic or dominant responses in favour of contextually appropriate actions (Miyake et al., 2000), is also frequently challenged, particularly in childhood, from 6 to 8 years (Tschida & Yerys, 2022).

In addition to foundational EF domains, autistic individuals may also show difficulties in higher-order processes such as planning and problem-solving. These abilities involve selecting and implementing strategies for both novel and familiar situations, requiring the ability to observe, evaluate, and adjust behaviour to meet goals in novel or familiar situations (Olde Dubbelink & Geurts, 2017). Such challenges tend to become more evident during adolescence (11–18 years), when task complexity increases. Performance-based studies confirm that autistic children and adolescents (3–18 years) often performed worse in these domains compared to their neurotypical peers (Craig et al., 2016; Nicita et al., 2023; Unterrainer et al., 2016). For instance, autistic children typically require more time to complete tasks, which might reflect overlapping difficulties in cognitive flexibility (Craig et al., 2016; Unterrainer et al., 2016). However, at 6–13 years, performance improves when tasks demand less advanced planning (Unterrainer et al., 2016), suggesting that the challenge lies in the strategic implementation rather than basic execution. While impairments in core EFs are well-documented, the extent to which higher-order EF difficulties are uniquely associated with autistic traits, beyond general cognitive ability, remains underexplored.

1.2. *Linking Executive Functions to Core Autism Features*

Executive functions are thought to support not only learning and problem-solving, but also key behavioural domains in autism, including social communication and restricted, repetitive behaviours.

1.2.1. *Social-Communication Abilities and Executive Functions*

Autistic individuals often experience challenges in areas such as understanding nonverbal cues, engaging in reciprocal conversation, and maintaining relationships (American Psychiatric Association, 2022). These social-communication abilities require cognitive flexibility, inhibitory control, and metacognitive processes such as working memory and monitoring. Several studies have identified associations between EFs and social functioning in autistic children and adolescents (Torske et al., 2018). However, findings are inconsistent, likely due to differences in measurement methods. Faja and Dawson (2015) found that lower cognitive flexibility and inhibitory skills, as reported by parents, were associated with greater social difficulties observed during ADOS-2 assessments in children aged 6–7 years. Leung et al. (2016) similarly reported links between EFs and social functioning when both were measured through parent-report (BRIEF and SRS), but these associations disappeared when comparing BRIEF to ADOS scores in children aged 6–15. Likewise, Jones et al. (2018) found no relation between performance-based EF measures and SRS scores in adolescents aged 14–16. These discrepancies may reflect differences in the ecological validity of measurement tools. While clinician-based instruments like the ADOS capture observable behaviours in structured settings, parent-reported tools such as the SRS may better reflect day-to-day functioning. Across studies, cognitive flexibility consistently emerges as a key predictor: difficulties in shifting between tasks or perspectives may hinder the ability to adapt to dynamic social contexts (Panerai et al., 2014; Pugliese et al., 2016). In addition, stronger behavioural regulation skills, encompassing inhibition, shifting, and emotional control, have been linked to fewer social challenges in both autistic and neurotypical samples (Leung et al., 2016). Metacognitive EFs, including working memory and planning, have also been associated with social outcomes in autistic children (Tsermentseli et al., 2018). Overall, despite methodological variability, these findings suggest that executive functions, particularly flexibility and regulation compared to working memory or planning, play a critical role in supporting social-communicative abilities in autism.

1.2.2. Restricted and Repetitive Behaviours and Executive Functions

Restrictive and repetitive behaviours (RRBs) represent a second core domain of autism and include a wide range of behaviours. These are often divided into higher-order behaviours, such as insistence on sameness, ritualistic routines, and restricted interests, and lower-order behaviours, including stereotyped movements and sensory preoccupations (Faja & Nelson Darling, 2019). Several studies support a link between RRBs and specific EF domains, particularly cognitive flexibility and inhibitory control. For instance, poor cognitive flexibility has been associated with insistence on sameness across children and adolescents aged 8–18 (Van Eylen et al., 2015). In contrast, reduced inhibition and self-regulation have been linked to sensory-motor repetitive behaviours, suggesting that these EF domains may underlie difficulties in suppressing habitual or automatic actions (Lopez et al., 2005; Mostert-Kerckhoffs et al., 2015). Although planning is less frequently studied, some evidence points to a relationship between planning difficulties and increased RRBs (Bölte et al., 2011). Notably, Faja & Nelson Darling (2019) and Iversen & Lewis (2021) found these associations across a broad developmental range (ages 4–29), suggesting that EF-RRB links persist into adulthood. Although some patterns emerge, inconsistencies persist between performance-based EF tasks and real-life behavioural rigidity, likely reflecting differences between structured and ecological contexts. Clarifying how specific EF domains relate to RRB subtypes could guide more targeted interventions to improve flexibility and self-regulation in autistic individuals.

1.3. The influence of cognitive abilities

Executive functions do not operate in isolation; instead, they are often shaped by broader cognitive capacities, including general intelligence and verbal abilities. Gardiner et al. (2017) found no differences in EF performance between autistic and neurotypical preschoolers aged 3–7 years when matched for cognitive ability. Supporting this, Zacharov et al. (2021) reported that cognitive flexibility is influenced by non-verbal measures of cognitive abilities in preschoolers aged 3–6. Campbell et al. (2017) extended these findings, showing that non-verbal cognitive ability predicted better cognitive flexibility performance in autistic children aged 5–19, whereas verbal intelligence did not. Additionally, a meta-analysis found that while autistic children (5–18 years) underperformed on planning tasks, this was not significantly influenced by general cognitive ability. Such inconsistencies highlight the need to more precisely delineate the boundaries between executive and broader cognitive functioning in autism (Olde Dubbelink & Geurts, 2017). Similarly, autistic traits are influenced by cognitive abilities in autistic children aged 3–12 years (Itskovich et al., 2021). For example, lower non-verbal intelligence has been associated with greater difficulties in social abilities in both autistic children and adolescents (Joseph et al., 2002; Syriopoulou-Delli et al., 2018).

Additionally, previous studies have suggested that specific EFs, such as inhibition and cognitive flexibility, may mediate the association between autistic traits and behavioural regulation difficulties (Faja and Dawson, 2015). However, the potential mediating role of broader cognitive abilities, such as Intelligence Quotient (IQ), remains underexplored, particularly in autistic youth. Given the evidence linking both EF and autistic traits to general cognitive ability, this study investigates whether IQ serves as a mediator in the relationship between executive functioning and autistic traits. Exploring this question can clarify whether observed associations reflect specific executive deficits or a more general cognitive profile. This mediation approach provides novel insights into the cognitive architecture underlying EF difficulties in autism and their relation to social and behavioural characteristics.

1.4. The current study

To address these gaps, the current study examined relations between executive functions and autistic traits as reported by parent or clinician ratings, while also testing whether cognitive ability mediates these associations. Specifically, the research questions are:

RQ1 - Are EF performance tasks associated with parent and clinician ratings of autistic traits?

RQ2 - Do these relations vary across children with higher versus lower IQ scores?

RQ3 - Do general cognitive abilities mediate the relationship between executive functions and autistic traits?

RQ4 - Are there differences in EF performance, cognitive profile and autistic traits between IQ-defined subgroups?

We hypothesised that EFs and autistic traits would be strongly associated with cognitive abilities. In contrast, correlations between

EF measures and autistic traits would be weak and generally non-significant, especially with parent ratings. Moreover, we hypothesised that these associations would vary based on participants' IQ levels, with stronger associations expected in children with higher IQ. We also predicted that these patterns would differ by IQ level, with stronger EF performance and clearer trait associations emerging in children with higher IQ.

2. Methods

2.1. Participants

The study involved 110 autistic participants aged 4–17. Of these, 29 had previously undertaken a neuropsychological assessment, but with a temporal gap of at least 5 years, only 3 of them had completed the same task assessments before this study. Additional analyses were conducted by dividing the sample based on IQ score. We stratified the sample into children with *lower-IQ*, which means with borderline intellectual functioning or below average IQ score (IQ<85, $n = 33$) and *higher-IQ*, mean average or upper IQ score (IQ>85, $n = 77$), given the score obtained in the Wechsler Scales (Fancello & Cianchetti, 2008; Orsini & Pezzuti, 2013; Orsini et al., 2015; Saggino et al., 2019). Our analyses were based on neuropsychological assessments conducted as part of routine clinical practice at a specialised centre for the diagnosis of neurodevelopmental conditions. Importantly, we analysed existing clinical reports and did not administer any additional assessments. Furthermore, since the Wechsler Scales are the standard instruments for assessing intellectual functioning in children in Italy, we utilised this tool to stratify our sample accordingly. We included only the children who completed the Wechsler Scales assessment. Demographic information is reported in Table 1. No age differences were found between groups ($p = .33$).

2.2. Procedure

This study adhered to the ethical standards set forth by the Italian Association of Psychology (AIP), the Declaration of Helsinki (World Medical Association, 2013), the Ethics Committee of the University of Trento, and the Health Service of Trento (APSS). It analyses the clinical report of patients who have undergone a psychodiagnostic assessment by the Laboratory of Observation, Diagnosis and Education (ODFLab) in Rovereto from 2012 to 2024. The assessment must include the following neuropsychological tests: the Wechsler Intelligence scale, the Wisconsin Card Sorting Test (WCST), the Tower of London (TOL), the Autism Diagnostic Observation Schedule - Second Edition (ADOS-2), and the Social Responsiveness Scale - Second Edition (SRS-2).

2.3. Materials

Cognitive abilities were assessed using the Wechsler Scales (Fancello & Cianchetti, 2008; Orsini & Pezzuti, 2013; Orsini et al., 2015; Saggino et al., 2019). To measure socio-communicative skills and restricted and repetitive behaviours, which represent the two core domains of autistic traits, we employed both a semi-structured observational tool (ADOS-2: Autism Diagnostic Observation Schedule–2; Lord et al., 2012) and a parent-report questionnaire (SRS-2: Social Responsiveness Scale–2; Constantino & Gruber, 2005; Constantino, 2012). Executive functions were evaluated using two tasks: one assessing cognitive flexibility (WCST: Wisconsin Card Sorting Test; Fancello & Cianchetti, 2003; Hardoy et al., 2000) and another assessing planning and problem-solving (TOL: Tower of London Test; Fancello et al., 2006; Gugliotta, 2009). A full description of the materials used is provided in Supplementary Materials 1.

2.4. Statistical Analyses

The analysis was conducted using the software R-Studio (R Core Team, 2021). The threshold for assessing statistical significance was set at $\alpha = 0.05$. In **Table SM 2** (in Supplementary Materials 2) are reported descriptive analyses.

To explore potential relations between different measures, Spearman correlation tests were conducted. These tests were chosen due to the non-parametric nature of the data, which were checked through Shapiro-Wilk statistics between executive functions, autistic traits (social affect, RRBs, total score), cognitive abilities (verbal comprehension, visual-spatial skills, and intelligence quotient), and demographic information (age and sex). Due to the non-parametric distribution of the data and the violation of the homogeneity of variance assumption, we adopted non-parametric analytical approaches. This choice aimed to minimise the impact of potential outliers and to account for the imbalance in sample sizes between participants with lower and higher IQ scores. Additionally, to address potential limitations related to the relatively small sample size, we applied bootstrapping procedures with 1000 resamples to obtain robust estimates and confidence intervals. We first explored bivariate correlations within the total sample and subsequently within the subgroups. Based on the results of these correlational analyses, we conducted multiple regression analyses using generalised linear models (GLMs) with a Gaussian family to examine the contribution of covariates (age, sex, verbal comprehension, and visuospatial abilities) to the relationships between executive function scores (outcomes) and autistic traits (social affect and restricted and repetitive behaviours as predictors). Multicollinearity was assessed within each model, and no issues were detected, with variance inflation factors (VIFs) for all regressors remaining below the critical threshold of 10. Additionally, due to the significant associations observed between EFs and autistic traits with cognitive abilities, we conducted mediation analyses using generalised linear models (GLMs) to explore the potential mediating role of IQ, controlling for demographic variables (age and sex). To ensure the robustness of the estimates, given the relatively small sample size and the non-parametric distribution of the data, bootstrapping procedures with 1000 resamples were applied in all mediation analyses. Finally, Wilcoxon signed-rank tests were used to explore the differences

Table 1
Samples' demographic characteristics.

Characteristics	Overall sample					Lower IQ					Higher IQ				
	N	M	SD	Min	Max	N	M	SD	Min	Max	N	M	SD	Min	Max
Age (in years)	110	9.85	3.06	4	17	33	9.52	2.72	5	16	77	10	3.2	4	17
Cognitive abilities															
Intelligence quotient	110	95.3	19.82	53	146	33	71.67	9.15	53	84	77	105.43	13.48	86	146
Visual-spatial	110	105.36	18.56	67	148	33	87.06	12.03	67	113	77	113.21	15	82	148
Verbal comprehension	110	100.59	18.97	54	146	33	80.91	10.82	54	98	77	109.03	15.05	82	146
	N	**%**				**N**	**%**				**N**	**%**			
Sex															
Males	95	86.4				31	94				64	83			
Females	15	13.6				2	6				13	17			
Gravity level															
1	86	78.2				15	45				71	92			
2	24	21.8				18	55				6	8			
Intellectual level															
Without Intellectual Deficits	94	85.5				17	52				77	100			
With Intellectual Deficits	16	14.5				16	48				0	0			
Linguistic level															
Without Linguistic Deficits	108	98.2				32	97				76	99			
With Linguistic Deficits	2	1.8				1	3				1	1			
Comorbility															
Without comorbility	96	87.3				31	94				65	84			
With comorbility	14	12.7				2	6				12	16			
ADHD	2	14.3				0	0				2	16.7			
Motor tic	1	7.1				0	0				1	8.3			
Stammering	1	7.1				1	50				0	0			
Coordination	2	14.3				1	50				1	8.3			
Depression	1	7.1				0	0				1	8.3			
SLD	7	50				0	0				7	58.4			

Note.
ADHD = Attention Deficit Hyperactivity Disorder,
SLD = Specific Learning Disorders.

between lower and higher IQ groups in EF measures, autistic traits, and cognitive abilities.

3. Results

3.1. RQ1 - Are EF performance tasks associated with parent and clinician ratings of autistic traits?

Regarding the associations between EFs and autistic traits, we found small negative associations between categories and perseverative errors of WCST with social score and total score of ADOS-2. Moreover, results revealed a small positive correlation between rule violations of TOL and social affect and the total score of ADOS-2. Moreover, we found a small negative association between points and RRBs and total score. Points score of TOL is also positively moderately associated with social and total score of SRS-2, while small with RRB. See **Figure SM 3.1** and **Table SM 3.1** (in Supplementary Materials 3) for details.

Further analyses were conducted to explore the associations between these two domains with cognitive abilities and demographic information (see Supplementary Materials 3).

Generalised linear models revealed a relation between the number of cards of WCST used and RRBs of ADOS-2, as well as between perseverative errors and social affect, controlling for demographic and cognitive abilities (see **Table SM 4.1** in Supplementary Materials 4). Moreover, points of TOL are related to social and RRB scores of SRS-2 (see **Table SM 4.2** in Supplementary Materials 4).

3.2. RQ2 - Do these relations vary across children with higher versus lower IQ scores?

In the group of children with lower IQ scores, we found a negative moderate-strong correlation with cards of WCST and social affect and total score of ADOS-2. No association with restrictive and repetitive behaviours was found. Finally, the social affect and total score of SRS-2 are only positive moderate associated with TOL points. See **Figure SM 3.2** and **Table SM 3.3** (in Supplementary Materials 3) for details.

Conversely, in the group of children with higher IQ values, we found positive small associations between the rule's violation of TOL and both social affect and total score of ADOS-2. Moreover, cards are positively small associated with RRBs of ADOS-2. While the social affect and total score of SRS-2 is positively moderate associated with points of TOL. See **Figure SM 3.3** and **Table SM 3.4** (in Supplementary Materials 3) for details.

Generalised linear models revealed that in the group of children with lower IQ levels, after controlling for cognitive and demographic information, a significant relation was found between cards of WCST and between rules violation of TOL both with social affect in ADOS-2. Full details are reported in the **Table SM 5.1** for WCST and **Table SM 5.2** (in Supplementary Materials 5) for TOL.

While, in the sample of children with higher IQ scores, GLMs revealed significant associations between categories achieved and perseverative errors with social affect of ADOS-2. Additionally, our analyses showed a significant association between the number of cards used and repetitive restrictive behaviours of ADOS-2 Furthermore, we found a significant association between violation of rules

Table 2
Differences in cognitive, EFs and autistic traits measures between subgroups.

	Lower IQ group	Higher IQ group	W	P^a
Wechsler Intelligence measure				
Visual-spatial	87.06 (12.03)	113.21 (15)	224	< .001***
Verbal comprehension	80.91 (10.82)	109.03 (15.05)	130.5	< .001***
ADOS				
Social affect	10.27 (2.81)	8.17 (2.59)	1795.5	.001**
RRB	2.27 (1.33)	1.87 (1.45)	1470.5	.18
Total score	12.58 (3.19)	10.04 (3.12)	1852.5	< .001***
SRS				
Social affect	73.88 (17.49)	75.33 (17.03)	766	.81
RRB	78.46 (19.78)	76.8 (18)	818.5	.82
Total score	75.92 (18.2)	76.7 (17.49)	779.5	.90
Wisconsin Card Sorting Test				
Categories	−0.98 (1.26)	−0.16 (1.24)	766.5	.003**
Cards	−0.44 (0.68)	0.04 (1.04)	849	.08
Correct responses	−1.37 (1.58)	−0.15 (1.14)	633	< .001***
Errors	−1.22 (1.22)	−0.09 (1.09)	601.5	< .001***
Perseverative errors	−2.13 (2.61)	−0.23 (1.36)	603	< .001***
Other errors	−0.04 (0.88)	0.15 (0.97)	1049.5	.23
Tower Of London				
Decision time	49.32 (5.79)	51.97 (10.45)	708.5	.41
Execution time	58.42 (13.66)	54.93 (13.32)	826	.19
Time	57.28 (11.99)	54.77 (12.92)	930.5	.24
Rules violation	93.36 (14.29)	79.81 (21.15)	1104	.003**
Points	−1.98 (1.38)	−0.69 (1.41)	515	< .001***

Note.
ADOS = Autism Diagnostic Observation Schedule, **SRS** = Social Responsiveness Scale, **RRB** = Restrictive and repetitive behaviour.
[a]Test significance *p < .05, **p < .01, ***p < .001.

and social affect of ADOS-2. Full details are reported in Table **SM 6.1** for WCST and **Table SM 6.2** (in Supplementary Materials 6) for TOL.

3.3. RQ3 - Do cognitive abilities play a mediating role in the relationship between executive functions and autistic traits?

Mediation analyses revealed a mediator effect of cognitive quotient on the relation between WCST scores and social affect domain of ADOS-2. Moreover, there is a direct relation between number of cards used and RRBs of ADOS-2 (see **Table SM 7.1** and **SM 7.2** in Supplementary Materials 7).

Additionally, cognitive abilities mediated the relation between execution time, total time, rules violations, and points of TOL with the social domain of ADOS-2. Moreover, there are direct relations between points of TOL with social and RRB domains of SRS-2 (see **Table SM 7.1** and **SM 7.2** in Supplementary Materials 7).

3.4. RQ4 - Are there differences in EF performance, cognitive profile and autistic traits between IQ-defined subgroups?

Significant differences emerged in most of the scores in each domain (see Table 2). Specifically, better cognitive abilities are reported for the higher IQ group, as well as for the social affect and the total score of ADOS-2. No group-differences emerged in the RRB of ADOS-2 and in various SRS-2 scores. Regarding EF scores, better performance was observed in the group with higher IQ, but no differences in the number of cards used and other errors of WCST, nor in the TOL's time score.

4. Discussion

This study highlights a critical but often overlooked challenge in clinical assessment: the inconsistency between clinician-administered performance measures and parent-reported evaluations in autistic children. Consistent with prior research (Augé et al., 2024; Bednarz et al., 2020; Faja & Nelson Darling, 2019; Lopez et al., 2005), perseverative errors and card use on the Wisconsin Card Sorting Test were negatively associated with clinician-observed RRBs on the ADOS-2, suggesting links between higher RRBs, reduced inhibition, and weaker cognitive flexibility. By contrast, better performance in Tower of London was associated with higher parent-reported autistic traits on the SRS-2, a counterintuitive result aligning with evidence of limited convergence between lab-based EF measures and informant ratings (Jones et al., 2018; Leung et al., 2016). These discrepancies likely reflect differences between real-world behaviours captured by parent reports and structured performance in controlled settings.

Further nuance emerged when examining IQ-based subgroups. In the higher IQ group, cognitive flexibility was associated with RRBs and social affect, whereas in the lower IQ group, WCST card use was related only to the ADOS-2 social domain. Rule violations were linked to the ADOS-2 social domain across both groups. Notably, when stratified by IQ, associations emerged only within laboratory-based measures, not between task performance and parent ratings, underscoring the role of context. Higher IQ was further associated with stronger EF performance and fewer clinician-rated autistic traits, consistent with prior work (Campbell et al., 2017; Itskovich et al., 2021; Joseph et al., 2002; Syriopoulou-Delli et al., 2018). Yet, while clinicians reported social-communication differences across IQ groups, parents did not, suggesting cognitive resources influence lab-based and clinician ratings more than parent-reported everyday functioning.

Our mediation analyses further indicated that IQ significantly mediated the relationships between WCST (cognitive flexibility) and Tower of London (planning) scores with clinician-rated social-communication abilities, whereas no IQ effects were observed for RRBs in either clinician- or parent-reported measures, consistent with evidence that RRBs are relatively independent of general cognitive functioning (Olde Dubbelink & Geurts, 2017). Overall, these findings suggest that cognitive abilities strongly influence EF performance and clinician-rated social-communication traits in structured settings but have less impact on RRBs or parent-reported traits. This highlights the importance of considering context and informant when interpreting EF-autism associations and cautions against generalising laboratory-based EF performance to everyday functioning.

4.1. Clinical and educational implications

Our results suggest that cognitive abilities play a fundamental role in performance on laboratory-based measures, influencing both EFs and socio-communicative traits. This highlights the need for more sensitive and ecologically valid assessment tools that take individual cognitive profiles into account. Importantly, developing instruments that are less affected by an individual's cognitive level may help to capture their true abilities and challenges. These insights carry important clinical and educational implications, which are discussed in the manuscript.

Firstly, these findings highlight the importance of cautious interpretation of EF test scores in autistic children with different cognitive profiles. For those with borderline intellectual functioning, standardised EF assessments may not fully reflect real-life abilities, and conclusions about daily functioning should be drawn carefully. Incorporating visual supports in testing and educational strategies may better capture abilities, reduce frustration, and promote engagement, with potential benefits for social motivation and learning (Neuhaus et al., 2021). Similar adaptations may also support autistic children with higher intellectual functioning, who often struggle to sustain attention during lengthy verbal tasks (Hume et al., 2014), and whose performance may improve when verbal and visual modalities are combined (Garcia-Molina & Clemente-Estevan, 2019). More broadly, interventions targeting cognitive flexibility and adherence to rules could foster social skills such as turn-taking and conversational adjustments (Kenworthy et al., 2022), while strengthening inhibitory control may help reduce RRBs and enhance persistence in learning tasks.

Secondly, the divergence between performance-based measures and parent ratings of both EFs and autistic traits, together with the stronger influence of cognitive abilities on laboratory tasks, raises concerns about the generalisation of neuropsychological findings to daily life. Structured testing environments may artificially enhance performance, particularly in children with higher cognitive resources, due to factors such as task familiarity, guidance, and reduced distractions (Jones et al., 2018; Lopez et al., 2005). However, real-world contexts are characterised by ambiguity and background stimuli that more strongly challenge EF skills (Jertberg et al., 2024; Kenworthy et al., 2008). This limits ecological validity and underscores the need for more sensitive assessment tools, which could benefit not only autistic children but also those with ADHD (Craig et al., 2016; Crisci et al., 2021) and specific learning disorders (Booth et al., 2010; Varvara et al., 2014). Such approaches may provide a more accurate understanding of children's functioning and better inform tailored clinical and educational interventions.

4.2. *Limitations and future directions*

Some limitations emerged from this study. From a methodological perspective, we did not include a control group to compare the results obtained, but we focused on the performance only on the autistic populations. Secondly, we used a verbal measure (the Wechsler Scale) to stratify our sample into lower-IQ and higher-IQ groups. Although this instrument has been widely criticised for its developmental limitations and cultural bias, future studies could replicate and extend our findings using non-verbal tools, such as the Leiter Scales, to stratify participants more equitably. However, given that our sample consisted of verbal autistic children without severe intellectual disabilities, we believe that the current IQ measure was appropriate and effective for differentiating groups within this context. Clinically, these children were able to complete the entire battery of tasks administered in the study. Third, our sample was relatively heterogeneous, ranging from 4 to 17 years of age. This period encompasses substantial developmental changes that could influence performance on the assessed abilities. Future studies should examine narrower age ranges to better capture developmental trends in autistic individuals, particularly during key transitional periods such as early adolescence (approximately 11–12 years old). Given the well-documented developmental shifts observed in neurotypical populations, further research should explore how these transitions manifest in neurodivergent individuals.

From a conceptual perspective, the measures we used aim to simplify complex phenomena, specifically executive functions, by focusing on specific cognitive processes. Future research should investigate these associations using a broader conceptualisation of EF tasks, such as the Working Memory Capacity framework. Additionally, our EF assessments were conducted exclusively in a structured and controlled environment using performance-based measures, without incorporating more ecological approaches like parent ratings. Future research should integrate both EF performance-based measures and parent/teacher/clinician ratings to provide a more comprehensive and realistic assessment and improve our understanding of which dimensions may be difficult to capture in different settings.

CRediT authorship contribution statement

Rebecca Barbieri: Writing – review & editing, Writing – original draft, Investigation. **Angela Pasqualotto:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Francesca Anderle:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Arianna Bentenuto:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization. **Paola Venuti:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ridd.2025.105136.

Data availability

Data will be made available on request.

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