

Evaluation of Emotional Knowledge in Children with Autism Spectrum Disorder

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Abstract: Children with autism spectrum disorder face challenges in recognizing and understanding emotions, which affects their social interactions. This study investigated how impairments in emotional knowledge influence the behavior of autistic children. The sample consisted of 36 children aged 8 to 13 years diagnosed with mild to moderate autism. Data were collected using the Emotion Matching Task, the Child Behavior Checklist, Raven's Progressive Matrices, and sociodemographic questionnaires, applied during individual sessions lasting 40 to 50 minutes. Statistical analysis included Spearman's correlation and the Mann-Whitney test. The results showed that children with autism spectrum disorder had greater difficulty identifying emotional expressions and revealed an inverse correlation between emotional knowledge and social problems and aggressiveness. These findings suggest that interventions focused on enhancing emotional knowledge may improve social adaptation and reduce problematic behaviors in children with autism.

Keywords: autism spectrum disorder, emotional intelligence, behavioral symptoms

Avaliação do Conhecimento Emocional em Crianças com Transtorno do Espectro Autista

Resumo: Crianças com transtorno do espectro autista enfrentam desafios no reconhecimento e na compreensão de emoções, o que afeta suas interações sociais. Este estudo teve como objetivo investigar como os prejuízos no conhecimento emocional influenciam o comportamento de crianças autistas. A amostra foi composta por 36 crianças de 8 a 13 anos com diagnóstico de autismo leve a moderado. Para a coleta de dados, foram utilizados o Teste de Conhecimento Emocional, o *Child Behavior Checklist*, as Matrizes Progressivas de Raven e questionários sociodemográficos, aplicados em sessões individuais de 40 a 50 minutos. A análise estatística incluiu a correlação de Spearman e o teste de Mann-Whitney. Os resultados mostraram que as crianças com transtorno do espectro autista tiveram maior dificuldade na identificação de expressões emocionais e uma correlação inversa entre conhecimento emocional e problemas sociais e agressividade. Conclui-se que intervenções focadas no desenvolvimento do conhecimento emocional podem favorecer a adaptação social e reduzir comportamentos problemáticos em crianças com autismo.

Palavras-chave: transtorno do espectro autista, inteligência emocional, sintomas comportamentais

Evaluación del Conocimiento Emocional en Niños con Trastorno del Espectro Autista

Resumen: Los niños con trastorno del espectro autista enfrentan desafíos en el reconocimiento y la comprensión de emociones, lo que afecta sus interacciones sociales. Este estudio investigó cómo las dificultades en el conocimiento emocional influyen en el comportamiento de los niños autistas. La muestra estuvo compuesta por 36 niños de 8 a 13 años con diagnóstico de autismo leve a moderado. Para la recolección de datos, se utilizaron el Test de Conocimiento Emocional, el *Child Behavior Checklist*, las Matrizes Progresivas de Raven y cuestionarios sociodemográficos, aplicados en sesiones individuales de 40 a 50 minutos. El análisis estadístico incluyó la correlación de Spearman y la prueba de Mann-Whitney. Los resultados mostraron que los niños autistas tuvieron mayor dificultad en la identificación de expresiones emocionales y una correlación inversa entre conocimiento emocional y problemas sociales y agresividad. Se concluye que intervenciones centradas en el desarrollo del conocimiento emocional pueden favorecer la adaptación social y reducir comportamientos problemáticos en niños con autismo.

Palabras clave: trastorno del espectro autista, inteligencia emocional, síntomas conductuales

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Understanding mental states and emotional expressions is crucial for social interaction and interpersonal communication, playing a fundamental role in human life. This knowledge contributes to the establishment and maintenance of dialogues, enabling individuals to recognize and respond appropriately to emotions in themselves and others. The ability to correctly interpret these emotions is essential for developing healthy social relationships and adapting to the environment (Denham, 2019).

Emotions are complex phenomena that arise from personal appraisals of relevant situations, influencing physiological, cognitive, experiential and behavioral changes that facilitate communication and social interactions (A. A. Andrade et al., 2015; Gross, 2013). From birth, infants exhibit the ability to respond to the emotions of their caregivers; typically developing children begin to distinguish fundamental emotional expressions, such as anger and joy, as early as 4 months of age (Donadon et al., 2019). However, children with autism spectrum disorder (ASD) face significant challenges in this process, which can negatively impact their social and behavioral skills (Yasuno et al., 2020).

Emotional knowledge (EK), which includes the expression and understanding of emotions as well as social regulation, is crucial for the effective processing of emotional information. This set of skills enables children to understand and respond appropriately to their own emotions and those of others, playing a fundamental role in emotional development (Denham, 2019; Harrington et al., 2020). Nevertheless, children with ASD tend to use less effective emotion regulation strategies, which may delay the development of skills needed to regulate their own emotions independently (Cai et al., 2018).

Difficulties in emotion recognition and emotional regulation put children with ASD at risk of facing significant challenges in social interactions, which may lead to issues such as rejection and social isolation, as well as negatively impact learning and academic skills (Cooper et al., 2020; Denham, 2019). Although the literature has extensively discussed these aspects, few studies have investigated the specific correlation between EK and behavioral problems in children with ASD, especially in the Brazilian context.

This study aimed to investigate how impairments in emotional knowledge affect the behavior of autistic children. Specifically, the study proposed three hypotheses: (1) that children with ASD would exhibit significantly lower EK compared to much younger neurotypical children, aged 3 to 6 years; (2) that there would be a negative correlation between EK and behavioral problems, such as aggressiveness and defiance; and (3) that children with ASD between the ages of 8 and 12 would not show a progressive development in EK ability over time.

By understanding these associations, this study aimed to provide data that enable more effective interventions focused on emotional development in children with ASD, promoting better social integration and quality of life.

Method

Participants

The study included 36 children aged 8 to 13 years, residing in Salvador and nearby municipalities, diagnosed with mild to moderate ASD and preserved verbal language. The clinical diagnosis of ASD was conducted by a qualified multidisciplinary team consisting of a neurologist, a psychiatrist and a psychologist, following the criteria of the Diagnostic and Statistical Manual of Mental Disorders, DSM-5 (American Psychiatric Association [APA], 2013). Children with moderate to severe intellectual disability, identified through Raven's Colored Progressive Matrices test, or those with significant language impairments, were excluded from the study.

Instruments

The Child Behavior Checklist (CBCL) is an instrument that assesses social competencies and behavioral problems in children and adolescents based on information provided by parents or caregivers (Achenbach & Ruffle, 2000). The Brazilian version of the CBCL was adapted and validated for Brazil by Bordin et al. (1995). The questionnaire consists of 138 items, of which 20 assess social competencies and 118 evaluate behavioral aspects. Social competencies include the child's involvement in activities such as sports, play activities, group participation, interpersonal relationships, independence in activities, and academic performance. Behavioral items cover issues such as anxiety, depression, social problems, attention problems, and aggressive behavior.

The Raven's Colored Progressive Matrices test assesses logical reasoning in Brazilian children aged 5 to 11 years. It consists of 60 items divided into five series (A, B, C, D and E), with increasing difficulty. The test measures general intelligence (factor "g") and is based on theories such as Spearman's two-factor theory, Gestalt psychology, and cognitive development (Pasquali et al., 2002). The test score allows for the identification of potential cognitive deficits and was used as an exclusion criterion for children with moderate to severe intellectual disabilities.

The Emotion Matching Task (EMT) was developed by Morgan et al. (2010) and adapted for Brazilian culture by N. C. Andrade et al. (2014). The EMT assesses EK through its core psychological components. The test comprises four distinct tasks, each containing 12 items: (A) "Expression Matching", which evaluates receptive EK by asking the child to match two expressions of the same emotion; (B) "Emotion Situation Knowledge", which explores EK in emotional contexts by asking the child to match a verbal description of an emotional elicitor with one of four emotional expressions; (C) "Labeling Emotional Expressions", which measures expressive EK by asking the child to label emotional expressions; and (D) "Receptive Emotion Knowledge", which evaluates receptive EK by asking the child to match a verbal label with one of four emotional expressions.

Procedures

Data collection. For participant selection, children with a clinical diagnosis of ASD, conducted by a multidisciplinary team and in accordance with DSM-5 criteria (APA, 2013), were identified. Data collection with the selected children took place in the school environment and was carried out by a group of psychology students who were properly trained for this procedure.

The students' training had a total duration of 8 hours and was conducted in person in a reserved room, where the research instruments were presented, and a pilot application was carried out among the students and with children of the same age group as the study. The training was led by the principal author of this study, a psychologist with over five years of experience with ASD, under the supervision of a psychologist with more than 15 years of experience in psychological assessment and a psychiatrist with over 25 years of experience in autism.

The principal author was also responsible for supervising the data collection phase with the parents. The children's caregivers completed the CBCL in a reserved room during an in-person group meeting held as part of a pedagogical meeting. The instrument was self-administered, allowing them to respond about their children's behavior.

The evaluation with the child was conducted at their own school in a reserved room during class time. The teacher was asked to release the student for testing at a time that would not cause academic disruption. The children were assessed individually, responding to the EMT and Raven's Test. The average duration of the evaluation for each child was 40 to 50 minutes. The scoring of the tests and data interpretation were carried out by the principal author of the study.

Data analysis. To achieve the research objectives, descriptive analyses were conducted, including the calculation of means (M) and standard deviations (SD) to characterize the sociodemographic and behavioral aspects of the participants. The analysis of clinically significant behavioral problems was performed using the CBCL, and the percentage of significant behavioral problems was calculated. The correlation between behavioral difficulties and EK was assessed using Bivariate Spearman Correlation, which is appropriate for nonparametric samples. Additionally, the Mann-Whitney test was used to compare independent groups, identifying significant differences between EK and behavioral problems. All data were processed using the JASP statistical software, version 0.16.2 (Intel).

Ethical Considerations

This study followed the guidelines of the Research Ethics Committee, in accordance with Resolution nº 510, dated April 7, 2016, which regulates research involving human subjects. The research protocol was approved by the Research Ethics Committee (REC) of the Escola Bahiana

de Medicina e Saúde Pública, under protocol CAAE No. 58233322.5.0000.5544.

Participation in the study was voluntary, and the objectives were explained to the children, who signed the Informed Assent Form (IAF), and to the parents/caregivers, who signed the Informed Consent Form (ICF). The confidentiality of the participants' identities was ensured, and the families received a report with the results obtained.

Results

The sample consisted of 36 children diagnosed with ASD, with a mean age of 10.2 years ($SD = 1.64$). The majority of participants were male (75%, $n = 27$). Regarding school attendance, 97% of the children attended school regularly. In terms of ethnicity/race, 52% of the participants self-identified as multiracial. Concerning parental education, 33% of mothers and 44% of fathers had completed high school. The socioeconomic level of the families, according to the "Brazilian Economic Classification Criteria" (*Critério de Classificação Econômica Brasil* - Associação Brasileira de Empresas de Pesquisa [ABEP], 2018), ranged from B1 to D-E, with the majority classified in categories C1 and C2 (75%). Additionally, 75% of families reported receiving benefits from government programs, such as the Continuous Cash Benefit (BPC, from its acronym in Portuguese), established by Law nº 8.742 (1993), known as the Organic Law on Social Assistance (LOAS, from its acronym in Portuguese).

Descriptive analyses showed differences in participants' performance across the four EMT tasks. Task A, which assesses receptive EK, had an average performance of 8.2 points, the lowest among the tasks. In contrast, Task D, which also evaluates receptive EK, had the highest average performance, with 10.9 points. These results indicate significant variations in children's performance on different aspects of EK (Table 1).

Table 1
Descriptive Data on EMT Performance

Emotion Matching Task – EMT ($N = 36$)	M (SD)	Mdn	$Min;Max$
Task A – Expression matching	8.2 (2.8)	9.0	1;12
Task B – Emotion situation knowledge	9.5 (1.9)	10.0	5;12
Task C – Labeling emotional expressions	10.1 (2.3)	11.0	1;12
Task D – Receptive emotion knowledge	10.9 (1.6)	11.0	4;12

Note. SD = standard deviation; Max = Maximum; M = Mean; Mdn = Median; Min = Minimum; N = total value in absolute number.

The mean percentage performance on the Raven's Colored Progressive Matrices test was 27%. This result

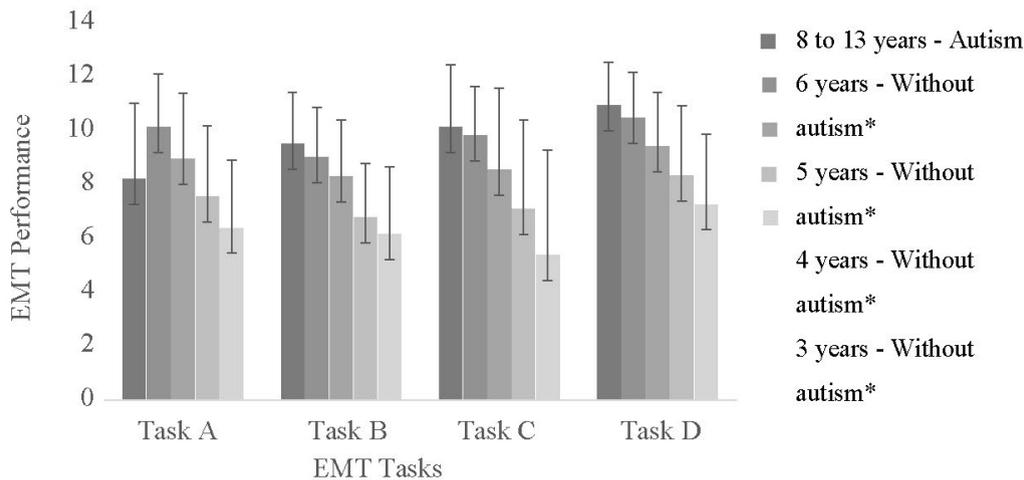
suggests that although the average Intelligence Quotient (IQ) of the participants was below average (IQ of 85), it still falls within the range considered normal for the general population.

Figure 1 compares the performance of children with ASD to typically developing children, based on normative data from N. C. Andrade et al. (2013). Overall, children with ASD, aged 8 to 13, performed worse on the EMT

tasks compared to neurotypical children aged 5 to 6. For example, in Task A, children with ASD had an average score of 8.2 points, while typically developing children aged 5 and 6 scored 8.95 and 10.1 points, respectively. However, in tasks such as Tasks B and C, children with ASD outperformed younger neurotypical children, suggesting that EK, in certain areas, may be preserved or even superior in some situations.

Figure 1

Comparison by Age Group – Children without Autism and with Autism, Using the Normative Group from the Study by N. C. Andrade et al. (2013) as Reference



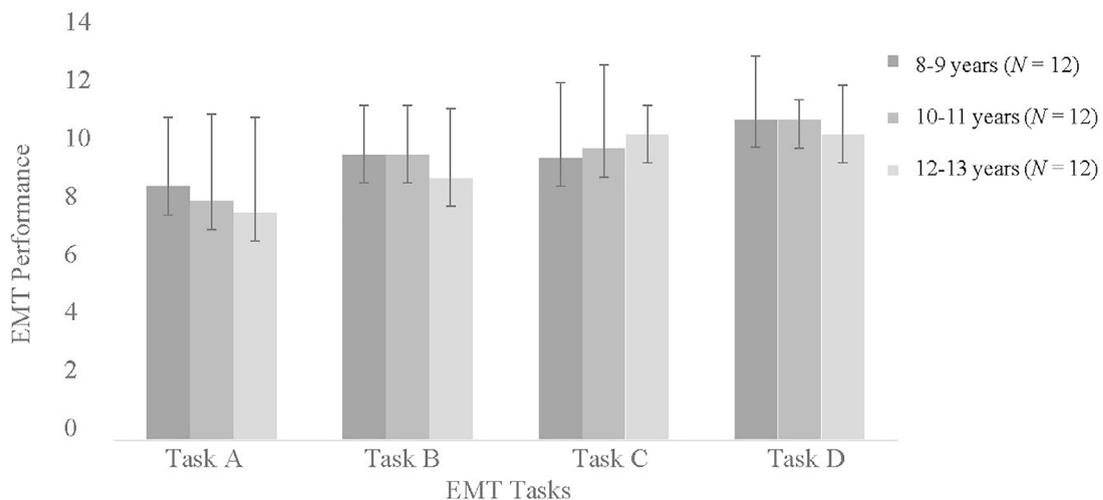
Note. EMT: Emotion Matching Task; *Normative group from the study by N. C. Andrade et al. (2013).

Figure 2 presents a comparative analysis of performance on the EMT tasks across different age groups within the ASD group. Although there were minor variations, the differences in performance between age groups were not significant. For example, in Task A, children aged 8-9 years ($M=8.7$) performed

slightly better than children aged 12-13 years ($M=7.8$). In Task C, children aged 12-13 years ($M=10.5$) outperformed those in other age groups. Overall, the differences between age groups do not suggest a progressive development of EK over time, which may indicate ongoing difficulties in acquiring these skills.

Figure 2

Comparison by Age Group – Children with Autism



Note. Research data. EMT: Emotion Matching Task; N = total value in absolute number.

Clinical-level behavioral problems were identified in 37% ($n = 13$) of participants who had difficulties following rules and in 33% ($n = 12$) who exhibited aggressive behavior. Thought problems were observed in 32% ($n =$

12) of the children. These findings suggest that, while some participants experience significant difficulties, not all reach clinical levels of impairment, which aligns with the existing literature (Table 2).

Table 2

Percentage of Clinical-Level Behavioral Problems Assessed by the CBCL

Child Behavior Checklist - CBCL	Values expressed as a percentage ($N = 36$)
Clinical-level behavioral problems	% (N)
Anxious/Depressed	26% (9)
Withdrawn	14% (5)
Somatic Complaints	10% (4)
Social Problems	22% (8)
Thought Problems	32% (12)
Attention Problems	21% (8)
Rule-Breaking Behavior	37% (13)
Aggressive Behavior	33% (12)

Note. N = total value in absolute number.

The correlations between performance on the EMT tasks and the CBCL subscales indicated a significant negative correlation between social problems and performance on Task C ($r = -.35; p \leq .05$), as well as between attention problems and Task C ($r = -.33; p \leq .05$). In contrast, there was a significant positive correlation between aggressive behavior and Task C ($r = .33; p \leq .05$). These results suggest that expressive EK,

measured by Task C, is related to both behavioral problems and difficulties in attention and social interactions.

The analysis of the correlations between performance on the EMT tasks and the percentile score on the Raven's Test showed a moderate correlation. This may suggest that EK could act as a moderating variable between intelligence and behavioral problems (Table 3).

Table 3

Bivariate Spearman Correlation Between EMT Scores, CBCL Subscales, and Raven's Colored Progressive Matrices Test

CBCL / EMT	Task A	Task B	Task C	Task D	Total EMT
Anxious/Depressed	.15	-.06	-.30	.21	.02
Withdrawn	-.08	-.11	-.30	-.17	-.15
Somatic Complaints	-.21	-.19	.19	-.05	-.25
Social Problems	-.05	-.30	-.35*	-.06	-.22
Thought Problems	.06	-.15	-.28	-.06	.04
Attention Problems	.01	-.19	-.33*	.11	-.13
Rule-Breaking Behavior	-.01	-.16	-.31	-.07	-.13
Aggressive Behavior	.03	-.12	.33*	.16	-.05
Internalizing Problems	.05	-.07	-.30	.17	-.05
Externalizing Problems	-.02	-.17	-.31*	.10	-.11
RAVEN Percentile	.54**	.48**	.25	.43**	.58**

Note. Task A: Matching two expressions of the same emotion; Task B: Matching a verbal description of an emotional elicitor with one of four emotional expressions; Task C: Labeling emotional expressions; Task D: Matching a verbal label with one of four emotional expressions. * $p \leq .05$; ** $p \leq .01$.

Discussion

This study aimed to assess EK in children with ASD and investigate its relationship with behavioral problems. The results indicate that children with ASD face significant challenges in recognizing and processing emotions compared to their neurotypical peers, especially in tasks requiring facial expression matching (Task A of the EMT). These findings confirm the presence of persistent socio-emotional deficits, even in older children with ASD, highlighting the ongoing need for targeted interventions for this population.

The main practical implication of this study is the need to incorporate interventions focused on the emotional development of children with ASD, particularly in areas where deficits are more pronounced, such as facial expression recognition. The difficulty in identifying and appropriately responding to emotions is a factor that can hinder social interactions, increasing the risk of social isolation and academic difficulties. These findings align with existing literature, which highlights the negative impact of a lack of emotional skills on the social and educational lives of children with ASD (Denham, 2019). Interventions that enhance EK may potentially reduce behavioral problems, even in children with varying levels of intelligence.

The findings of this study are in line with previous research, such as the study by Huggins et al. (2021), which observed persistent difficulties in emotional self-awareness in individuals with ASD, particularly during adolescence. Although the present study focused on a younger age group, the lack of progression in EK development over time suggests that the identified difficulties may persist or even worsen in adolescence, as observed by Huggins et al. (2021).

The study conducted by Löytömäki et al. (2023) also explored socioemotional and behavioral difficulties in children with ASD, highlighting that impaired emotional discrimination skills are associated with behavioral challenges. Our findings reinforce the need for early interventions to minimize these negative impacts.

The lack of progress in EK across the studied age groups suggests that emotional development in children with ASD may not follow the pattern observed in neurotypical children, as indicated by Arnaud (2022). These findings may reflect stagnation in EK development, requiring specific approaches to promote emotional growth. Our results show that EK in children and adolescents with ASD, between 8 and 13 years old, did not exhibit a steady developmental progression over time. This contrasts with what would be expected in neurotypical children, whose EK tends to improve with age. The stagnation observed in our study suggests that emotional development in individuals with ASD may be more complex and less linear, reinforcing the need for targeted interventions to support these skills.

Our observations support the research by Yeung (2022), which suggests that factors such as age, intelligence, and level of autistic symptoms may not significantly influence EK ability in individuals with ASD. These findings indicate that

emotional development in ASD may not follow traditional patterns, requiring innovative and personalized approaches.

Another significant finding of this study was the lower performance of children with ASD in the “Expression Matching” task (Task A of the EMT) compared to other activities in the Emotion Matching Task. Previous research has already identified that children with ASD often struggle with emotion recognition, a crucial skill for socio-emotional reciprocity (Garcia-Garcia et al., 2022). Interpreting and regulating one’s own emotions, understanding others’ expressions, and identifying emotions based on facial expressions are well-documented challenges for individuals with ASD (Webster et al., 2021).

In an early study on imitation and facial expression of emotions, it was found that producing elicited emotional expressions was more challenging for individuals with ASD than for those with Down syndrome, even when compared by chronological age, mental age, and IQ (Webster et al., 2021). This suggests that children with ASD may experience greater difficulties in tasks requiring emotional expression matching, as opposed to tasks involving the identification of emotional situations or receptive emotion processing.

These difficulties in specific tasks can be attributed to the deficits in socio-emotional reciprocity inherent to ASD, as confirmed by additional studies (Lievore et al., 2023; Webster et al., 2021). Furthermore, this study identified a direct relationship between EK skills and variables such as social problems, attention deficits, and aggressive behavior. Individuals with well-developed socio-emotional competencies are better equipped to face daily challenges, build positive relationships, and make well-informed decisions (Vaiouli & Panayiotou, 2021). These skills are essential for managing emotions, establishing healthy relationships, and developing empathy. The literature suggests that the ability to decode emotional cues is correlated with internalizing and externalizing problems throughout the school year (Cooper et al., 2020).

The study by Kirst et al. (2022) examined the interaction between delays in emotion interpretation and hostile attribution bias in predicting aggressive behaviors in children with autism. The findings revealed that hostile attribution bias increased verbal and covert aggression but had no significant impact on physical aggression or bullying. However, dysfunctional emotional regulation influenced bullying, as well as verbal and covert aggression. Other studies confirm that children with externalizing behaviors have notable difficulties in recognizing facial emotional expressions (Cooper et al., 2020). These difficulties manifest in the inability to label emotional expressions and control impulses, leading to behaviors such as outbursts and physical aggression. In contrast, a systematic review by García-Sancho et al. (2014) found that higher emotional skills are associated with lower aggression, a pattern observed across various ages and cultures.

This study confirms that emotional recognition is a major challenge for children with ASD, especially in tasks involving facial expression matching. The key practical implication

of these findings is that intervention programs should be developed to specifically focus on enhancing these skills, possibly using approaches that involve assistive technology, such as digital games that simulate facial expressions in a safe and controlled environment. For education and mental health professionals, it is crucial that these programs be integrated into school curricula and therapeutic routines, aiming for a more holistic development of children with ASD.

Despite its valuable insights, this study has some limitations that should be considered. The lack of socioeconomic and geographical diversity in the sample may limit the generalizability of the results, although this limitation reflects the practical challenges of accessing a broader sample in studies on ASD. Future research could include more diverse samples to explore whether the findings remain consistent across different contexts.

From a methodological perspective, while the statistical analyses used were appropriate for the sample size, they could be complemented by more complex methods, such as structural equation modeling, to provide additional insights. The choice of simpler analyses aimed to ensure clarity and precision, given the exploratory nature of the study.

Another limitation is the exclusive use of quantitative measures of EK, which may not fully capture the nuances of emotional development in children with ASD. Future research could integrate qualitative approaches, such as interviews or observations, for a more in-depth understanding.

Finally, we suggest that future investigations explore the impact of EK-focused interventions across different settings and contexts to identify which strategies are most effective in the long term.

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