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Cognitive Flexibility and Creativity in Children with Autism Spectrum Disorder: A Systematic Review

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Abstract

There are studies in the literature that examine cognitive flexibility and creativity in ASD either separately or in parallel within the same samples. In the typically developing population, the evidence generally suggests a positive association between cognitive flexibility and creativity, although the reported results are not entirely consistent. Regarding the investigation of this relationship in the population with ASD, the evidence is limited. Therefore, we aim to investigate the evidence regarding flexibility and creativity in individuals with ASD, how they are assessed together in studies involving individuals with ASD, and indications of a possible relationship between the two. Seven studies were included in this systematic review. The findings suggest considerable heterogeneity both in the conceptualization of flexibility and creativity and in their assessment among individuals with ASD. Although some studies provide indications of a possible relationship between flexibility and certain forms of creativity, the studies included in this review provide limited direct evidence of this relationship. Future studies are needed to simultaneously and directly assess these two constructs and the relationship between them.

Keywords: autism; cognitive flexibility; convergent thinking; creativity; divergent thinking; flexibility; executive functions

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1. Introduction

The American Psychiatric Association (APA, 2022) describes autism spectrum disorder as a neurodevelopmental condition involving persistent challenges in social communication and interactions, together with restricted and repetitive patterns of behavior, interests, or activities. In addition, children with ASD exhibit a distinct cognitive profile that encompasses both strengths and a range of difficulties across various domains. Among these, creativity and executive functions have received substantial attention in research due to their role in problem-solving, learning, and adaptive functioning (Diamond, 2013; Gregory et al., 2013; Sternberg & Lubart, 1998).

Executive functions refer to a group of cognitive processes that contribute to regulating how a person thinks and behaves (Miyake & Friedman, 2012). In the literature, this set includes planning, cognitive flexibility, inhibition, working memory, as well as self-regulation, initiation, and the monitoring of action (Chan et al., 2007; Goldstein & Naglieri, 2013; Sadozai et al., 2024). Three essential functions are integrated into the main theoretical models: inhibition, working memory, and cognitive flexibility (Miyake et al., 2000; Diamond, 2013). Although they can be described as distinct functions, they are interconnected and share several common traits (Miyake et al., 2000).

Studies highlight that executive functions play a valuable role in academic achievement (St. Clair-Thompson & Gathercole, 2005). In a longitudinal study involving 322 typically developing adolescents, Samuels et al. (2016) found that the adolescents' scores on tests assessing executive functions predicted academic performance, specifically, current and future annual grades in all subjects analyzed. Furthermore, a recent study showed that increased difficulties with executive functions during childhood and adolescence predicted difficulties with adaptive skills in early adulthood (Fossum et al., 2024). In another recent study involving 28 individuals with autism, it was shown that executive function skills during childhood predicted their adaptive behavior in late adolescence (Kenny et al., 2018).

Executive functions also play a valuable role in emotional regulation skills. The association between executive functions and emotional regulation was investigated by Lantrip et al. (2015) in a study involving 70 typically developing adolescents. The study's findings revealed that well-developed executive functions support the use of healthy emotional regulation strategies, such as cognitive reappraisal, while reliance on suppression was linked to impaired executive functions. In the case of children with ASD, a recent meta-analysis involving 55 studies highlighted significantly greater difficulties in emotional regulation, related to both emotional regulation (ER) and emotional dysregulation (ED), compared to the group of typically developing children (Restoy et al., 2024).

Within autism spectrum disorder, cognitive flexibility has become one of the most intensively studied executive functions and represents an important pillar within the aforementioned theoretical models. Cognitive flexibility is the executive function that enables adaptation to changes in the environment (Gosling et al., 2025). It enables a person to respond to new challenges and capitalize on opportunities that arise unexpectedly (Diamond & Ling, 2015). Cognitive flexibility plays an essential role in adapting a person's behavior to the changing demands of the environment, facilitating a shift in perspective and detachment from previous tasks in order to generate new responses to be used in completing the current task (Dajani & Uddin, 2015). Cognitive characteristics related to cognitive flexibility in ASD include the persistence of repetitive behavioral patterns, difficulties in regulating motor actions, and difficulties in switching between cognitive or behavioral strategies when the context changes (Hill, 2003). The study by Yerys et al. (2009) showed that, although high-functioning children with ASD were able to complete cognitive set-shifting tasks similarly to the group of typically developing children, the number of errors they made was significantly higher during the reversal shifting stage. Furthermore, this number of errors was positively correlated with symptoms of

restricted interests and repetitive behaviors. Similarly, a meta-analysis conducted by Demetriou et al. (2017) supports these findings and highlights deficits in cognitive flexibility at various stages of development in individuals with ASD. The results revealed greater difficulties among individuals with ASD relative to control groups (Hedges' $g = 0.48$ (0.36-0.60); $p < 0.001$), based on 38 studies ($I^2 = 47.30\%$). Subgroup analyses revealed that these difficulties were present both in childhood (Hedges' $g = 0.60$ (0.35-0.85); $p < 0.001$) and in adulthood (Hedges' $g = 0.48$ (0.31-0.65); $p < 0.001$).

At the same time, the importance of cognitive flexibility is also supported by its association with various academic skills, such as reading ability, for example. Cartwright (2012) emphasizes that the ability to process information flexibly is associated with better development of reading comprehension. De Abreu et al. (2014) noted that certain components of executive functions predict individual differences in reading performance, and that poor cognitive flexibility may contribute to reading difficulties in the early school years. Furthermore, Genet and Siemer (2010) demonstrated in a study of a general population that cognitive flexibility is a predictor of resilience as a trait, suggesting that this ability contributes to some extent to adaptation in difficult situations.

In addition to the valuable implications frequently studied in the literature, cognitive flexibility also appears to be an important mechanism involved in creative processes. It allows for shifting from one perspective to another and facilitates tackling complex tasks and identifying new solutions that are adaptable to contextual changes; it is considered a process potentially relevant to creativity (Ionescu, 2011). Creativity is defined in the scientific literature as the capacity to produce creations that are both innovative and appropriate (Lubart, 2022). Subsequently, to better understand this ability, some researchers have proposed a modified version that adds a third criterion-surprise-to novelty and utility. In this regard, Simonton (2012) supports the idea that, to contribute to creative value, an idea must be at once new, useful, and surprising (non-obvious).

Creativity is recognized as a useful skill both in everyday life, when we need to solve certain problems, and at the societal level, where it contributes to progress by facilitating technological innovations or the development of social initiatives (Sternberg & Lubart, 1998). In the field of education, studies highlight creativity as a skill that helps students adapt to the demands of a constantly changing world and, at the same time, emphasize the essential role it plays in problem-solving, as every field relies on generating creative ideas to produce innovative solutions (Kanematsu & Barry, 2015).

Regarding research on creativity in autism spectrum disorder, the literature shows inconsistent results. The findings of a recent study involving 352 participants diagnosed with ASD and typically developing participants revealed no differences in divergent thinking tasks. The differences reported by the participants were not sustained after ADHD diagnosis was taken into account (Taylor et al., 2025). On the other hand, several studies reveal specific strengths in the creativity profile of individuals with ASD. For example, in their study involving 94 participants, Cancer et al. (2023) observed greater linguistic originality among participants with ASD compared to the group of typically developing participants. Similarly, a study conducted by Kasirer and Mashal in 2014 highlighted greater creativity among participants in the ASD group, as evidenced by the higher number of creative metaphors they were able to generate compared to the control group, suggesting superior performance in certain aspects of creativity.

In contrast, other studies have reported difficulties with creativity in creative performance as measured by standardized tests (Craig & Baron-Cohen, 1999), and Pennisi et al. (2020) describe a mixed profile characterized, on the one hand, by deficits in creative performance, cognitive flexibility, and fluency, and, on the other hand, by increased originality and attention to detail. Overall, these results suggest that the manifestation of creativity is not uniform and may depend on the dimension being assessed, the instruments used for assessment, participant characteristics, and comorbidities. In this regard, Taylor et al. (2025) showed that the differences

in creativity observed between participants with ASD and those with typical development in their study were no longer significant after controlling for ADHD symptoms, suggesting that the presence of this comorbidity may explain, at least in part, the differences in creativity.

The literature often distinguishes between two components of creativity: divergent thinking and convergent thinking. The former contributes to the generation of a multitude of different ideas in a short period of time. The latter is a type of thinking aimed at narrowing down the number of alternatives in order to select the most feasible solution (Hennessey & Amabile, 2009). Regarding the first component, divergent thinking, tests that assess this ability focus on the presence of four cognitive processes that are components of creativity: originality, fluency, flexibility, and elaboration. Originality involves the capacity to produce unusual, rare, yet relevant ideas; fluency refers to the ability to generate a large number of ideas or responses; elaboration describes the ability to develop and add details to enrich and refine an idea; and flexibility, in this context, refers to the capacity to generate ideas that belong to different categories or to switch between perspectives and response strategies (Almeida et al., 2008).

These two constructs are often analyzed separately. There are studies conducted on typically developing populations that investigate the relationship between cognitive flexibility and creativity. Many of these studies provide consistent evidence regarding this relationship in the adult population (Nijstad et al., 2010; De Dreu et al., 2010; İnci & Türkeli, 2026), whereas in children, this relationship has been investigated more recently, and methodological heterogeneity is greater, highlighting the need for additional studies dedicated to this population. In this regard, a recent review (Kalaivanan et al., 2026) synthesized the literature and concluded that in 9 of the 14 studies analyzed, a significant positive association was identified between cognitive flexibility and creativity. Furthermore, the authors noted that these findings were particularly evident in situations where flexibility was assessed using instruments that allowed for a comprehensive evaluation as a multidimensional construct, and creativity was assessed using established standardized tests.

Thus, the literature on the general population generally emphasizes the existence of a positive association between cognitive flexibility and creativity, although the reported results are not entirely consistent, as studies differ in several respects, both in terms of conceptualization and the type of tasks used to measure the two constructs (Pasarín-Lavín et al., 2023; Kalaivanan et al., 2026). However, as far as we know, there are no studies specifically investigating this relationship in individuals with ASD. Rather, these studies examine the two constructs in isolation, either separately or in parallel within the same samples. There is research that studies, on the one hand, cognitive flexibility (Zacharov et al., 2021; Lacroix, Torja et al., 2024; Van Eylen et al., 2011) on the one hand, and research focusing on creativity in ASD (Smees et al., 2024) on the other, but without directly investigating the link between them.

Consequently, although cognitive flexibility and creativity have been analyzed separately or in parallel within the same samples of individuals with ASD, the apparent lack of studies directly investigating the relationship between these two constructs limits our understanding of the cognitive mechanisms that may underpin creative thinking in children with ASD and highlights the need for future research focusing on the interaction between flexibility and creativity. Additionally, the heterogeneity in how flexibility is conceptualized across studies makes it important to examine both cognitive flexibility as an executive function, and flexibility as a component of creative, divergent thinking. In this regard, the present review aims to investigate what evidence exists regarding cognitive flexibility and creativity in individuals with ASD, to what extent creativity and cognitive flexibility are assessed together in studies involving individuals with ASD, and whether these studies provide indications of a relationship between the two.

This systematic review has the following specific objectives:

- to systematically identify and synthesize empirical studies that assess both flexibility and creativity in individuals with ASD, analyzing the characteristics and conclusions of the available evidence across different age groups and contexts in which they were studied.

- to analyze how these two concepts are defined conceptually and operationalized in the existing literature on ASD, including different forms of creativity as well as different conceptualizations of flexibility used in studies.

- to analyze the various methods used to assess flexibility and creativity in individuals with ASD, including the measures and tasks employed, as well as to examine differences in results between children and adults.

- to identify evidence that may provide insights into the potential relationship between flexibility and creativity in ASD, while also identifying gaps in the existing literature that could be addressed in future studies directly examining the association between the two constructs.

Based on these objectives, this systematic review aims to answer the following research questions:

RQ1: What is the existing empirical evidence regarding flexibility and creativity in individuals with ASD, and what findings are reported in the existing literature?

RQ2: How have flexibility and creativity been conceptualized, operationalized, and measured in individuals with ASD, and what methods and instruments have been used for each construct?

RQ3: What populations, age groups, and types of flexibility and creativity have been analyzed in the literature, and what differences in findings emerge between children and adults with ASD?

RQ4: What evidence regarding the coexistence or potential relationship between flexibility and creativity can be identified in the included studies, and what are the conceptual and methodological gaps that should form the basis for future studies directly examining the relationship between these two constructs?

2. Methodology

2.1. The Olweus bullying prevention program

We conducted a systematic search of nine databases (Science Direct, Springer Nature Link, Wiley, Emerald, Nature, Taylor and Francis, Scopus, ProQuest, EBSCO) to analyze and review the literature investigating flexibility and creativity in individuals with autism. The search was conducted between 14 May and 19 June 2026.

2.2. Search strategy and inclusion criteria

The inclusion criteria we established for this review are: the presence of a diagnosis of autism spectrum disorder; the inclusion of measures for both constructs (creativity, flexibility) or constructs potentially relevant to them. Flexibility was operationalized either as cognitive flexibility (executive functioning) or as flexibility derived from creative, divergent thinking tasks. Additionally, only studies in English were included. The search focused on studies published between 2002 and 2026 and was conducted in databases such as ScienceDirect, Springer Nature Link, Wiley, Emerald, Nature, Taylor & Francis, Scopus, ProQuest, and EBSCO. The search terms used were “cognitive flexibility and creativity in autism”, ”cognitive flexibility”, ”creativity”, ”autism’’, ”autism spectrum disorder”. We applied search filters for publication date (2002-2026), document type (articles and book chapters, where available), and publication language (English).

The database search identified a total of 12,043 records, including 634 from ScienceDirect, 1,068 from Springer Nature Link, 2,228 from Wiley, 906 from Emerald, 57 from Nature, 1,936 from Taylor & Francis, 7 from Scopus, 2,193 from ProQuest, and 3,014 from EBSCO. The

selection of studies took place in several phases. Following an initial selection of titles to identify potential studies relevant to the review's objectives and inclusion criteria, 11,489 records were excluded, and 554 abstracts were analyzed, of which 192 were from ScienceDirect, 320 from Springer Nature Link, 4 from Wiley, 4 from Emerald, 3 from Nature, 6 from Taylor & Francis, 4 from Scopus, 12 from ProQuest, and 9 from EBSCO. After reviewing the abstracts, 26 potentially relevant records were identified. Of these, 25 articles (of which one could not be accessed) were examined in detail to determine whether they met the eligibility criteria. Of the full-text articles evaluated based on the predefined eligibility criteria, 7 studies identified through the database search met all inclusion criteria and were included in the review.

2.3. Exclusion criteria

All studies that did not include individuals with ASD, or that did not measure both constructs or constructs potentially relevant to ASD, were excluded from the review. Additionally, review articles, studies focusing on interventions, and non-peer-reviewed studies were excluded.

2.4. Data screening and data extraction

After the data were collected, they were analyzed in accordance with the PRISMA guidelines (Page et al., 2021). Data from the 7 included studies were extracted and organized into a structured table that facilitated the comparison of study characteristics, the constructs measured, and the instruments used to assess them. The information included the study authors, the constructs measured, the instruments used to assess them, and the participants' characteristics. During data extraction, attention was paid to how creativity and flexibility were conceptualized and measured, both as components related to creative thinking and as components of executive functioning.

2.5. Study characteristics

Following the systematic search, seven empirical studies published between 2002 and 2026 were identified that met the predefined eligibility criteria. Six of these studies were based on cross-sectional designs comparing ASD and typically developing groups, while one study (Kasirer & Rozen, 2023) used mixed methods, combining quantitative and qualitative analyses. The samples included both children with ASD and adults. Four of the analyzed studies involved children as direct participants (57.1%), two focused on adults (28.6%), and one study examined educators' perceptions of mathematical creativity in activities involving children with ASD (14.3%). The ages of the child participants ranged from 5 to 13 years, while those of the adult participants ranged from 18 to 69 years.

Regarding how flexibility was conceptualized and operationalized, the included studies showed considerable variation. On the one hand, in four studies, flexibility was operationalized as a component of creative or divergent thinking (57.1%), while on the other hand, two studies (28.6%) directly examined cognitive flexibility as a distinct executive function. Another study examined generativity as a process associated with executive functioning, relevant to creative and imaginative performance, but did not directly assess cognitive flexibility. Similarly, the assessment of creativity encompassed several types, such as divergent thinking and divergent feeling, verbal and figural creativity, mathematical creativity, as well as generativity/imaginative performance. Overall, a high degree of heterogeneity was observed in how the two constructs were conceptualized and measured, particularly regarding the approach to flexibility- whether as a dimension of divergent thinking or as a distinct component of executive functions.

In Table 1, the characteristics of studies investigating flexibility and creativity in individuals with autism spectrum disorder are presented.

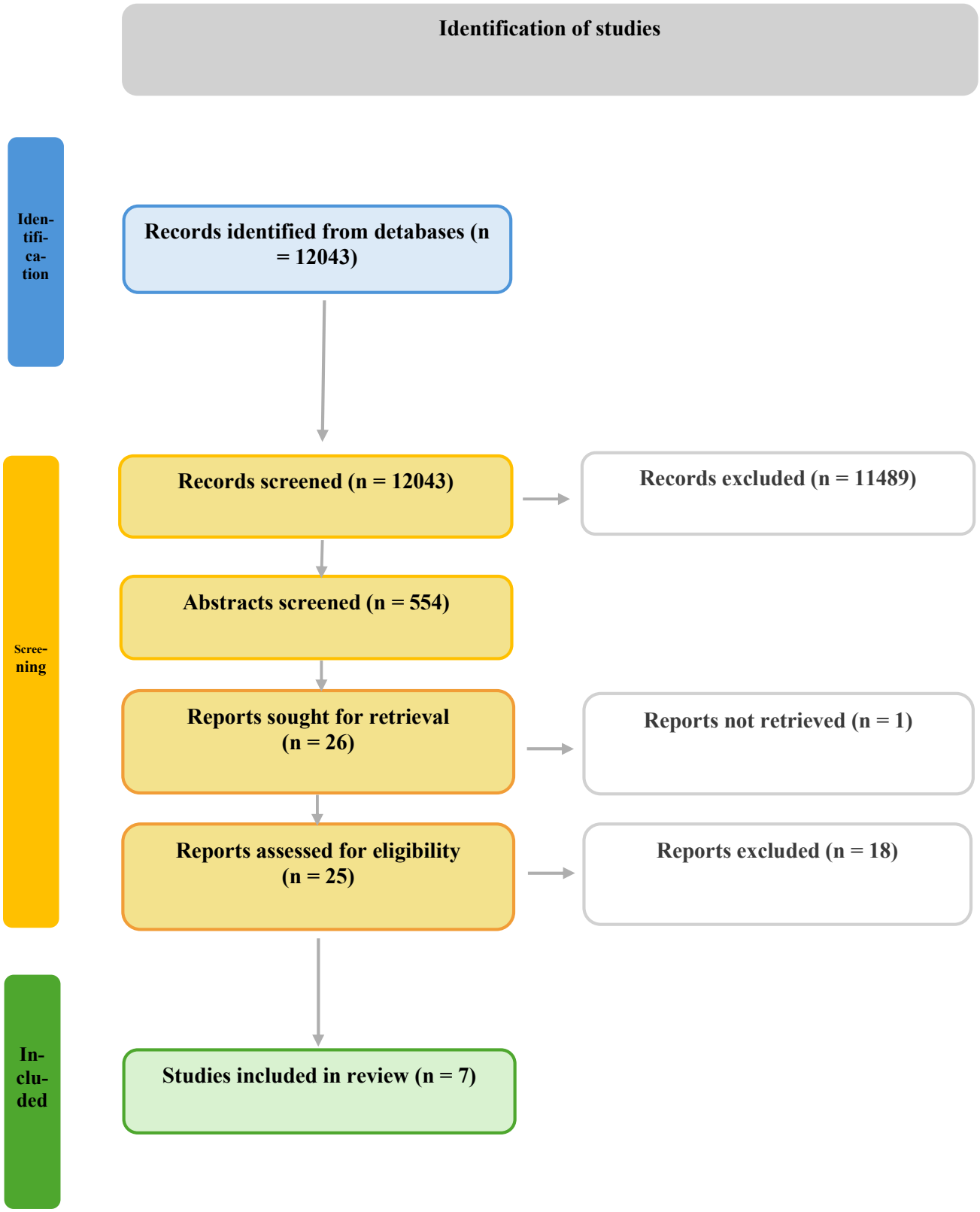


Figure 1. Prisma flowchart describing the selection of studies

Table 1. Characteristics of studies investigating flexibility and creativity in individuals with autism spectrum disorder

Study	What does the study measure?	Flexibility Measure-ment type	Flexibility Instruments	Creativity Measure-ment type	Creativity Instruments	Popula-tion	Age	Diagnostic
Liu et al. (2010)	Fluency, Openness, Flexibility, Originality, Elaboration (Divergent Thinking); Risk-taking, Curiosity, Imagination, Complexity (Divergent feeling)	Direct measurement-the creativity test included a flexibility score (as a measure of divergent thinking).	A creativity assessment packet (CAP) (Williams, 1980)-Flexibility	Direct measurement	A creativity assessment packet (CAP) (Williams, 1980)	16 children with Asperger's + 42 typically developing children	About 9-13 years	Asperger's Syndrome
Kasirer and Rozen (2023)	Fluency, Flexibility, Originality (Elements of mathematical creativity)	Indirect measurement-flexibility was measured as a dimension of mathematical creativity, based on reports from the teachers.	Semi-structured interview	Indirect measurement	Semi-structured interview	31 preschool teachers	Preschool teachers: Ages 25–50 Children: Pre-schoolers	ASD
Low et al. (2009)	VMA and receptive language ability; Executive function (Generativity, uses of objects and pattern meanings tasks); Visuospatial planning; Central Coherence	It was not measured directly. Generativity is examined in the context of executive functions and is discussed in relation to representational flexibility.	-	Direct measurement-imagination/ generativity are measured as aspects that may be relevant to creativity/ flexibility; creativity itself was not directly assessed.	Uses of objects task, Pattern meanings tasks (Turner, 1999); Karmiloff-Smith's (1990) drawing task	27 children with ASD, 27 typically develop-ping children	5.25–13.08 years (M=8,26 years; SD= 2,17)	ASD
Cancer et al. (2023)	Verbal divergent thinking; Figural creativity; Attitudes towards creativity	Direct measurement-flexibility is measured as part of divergent thinking.	Alternative uses task (AUT) (Guilford, 1967)-Flexibility	Direct measurement Indirect measurement	Alternative uses task (AUT): Fluency, Flexibility, Originality (Guilford, 1967); Triangle task (TT) (Pizzingrilli & Antonietti, 2010): Shape comparison, Orientation comparison, Elaboration,	94 adults (TSA group and neurotypical control group)	Adults: 19-69 years	ASD

					Originality; What I think about creativity (WTC) (Pizzingrilli & Antonietti, 2010)			
Hetzroni et al. (2019)	General creativity: Mathematical creativity	Direct measurement-flexibility is measured as a dimension of creativity.	Pictorial Multiple Solutions (PMS) Task (Leikin, 2013)-Flexibility; Creating Equal Number (CEN) Task (Tsamir et al., 2009)-Flexibility	Direct measurement	Pictorial Multiple Solutions (PMS) Task (Leikin, 2013) Fluency, Flexibility, Originality, Creativity; Creating Equal Number (CEN) Task (Tsamir et al., 2009) Fluency, Flexibility, Originality, Creativity	20 typically developing children, 20 children with ASD	9-11 years	ASD
Kasirer and Mashal (2014)	Comprehension of conventional metaphors and novel metaphors; Metaphor generation; Creativity; Executive functions	Direct measurement-cognitive flexibility is assessed.	Trail Making Test (Reitanand Davison, 1974); Ambiguous Word Meaning Generation Test (Mashal & Kasirer, 2011)	Direct measurement	Metaphor comprehension questionnaire (conventional and novel metaphors) (Mashal & Kasirer, 2011); Sentence completion questionnaire (metaphor and simile generation)	17 adults with ASD, 17 with typical development	18-27 years (the ASD group)	High-functioning ASD
Tzuriel and Groman (2017)	Metaphorical construction; Executive functions (cognitive flexibility-rule shifting)	Direct measurement-cognitive flexibility is assessed.	Rule Shift Card Test (RSC) (Wilson et al., 1996)	Direct measurement-directly measures the metaphorical structure that may be a relevant aspect of verbal creativity, rather than creativity itself.	Children's Metaphorical Construction Test (CMCT) Tzuriel et al., 2008)	32 children with high-functioning autism, 32 children with typical development	5-11 years	ASD (High-Functioning Autism HFA)

3. Results

3.1. Conceptualization and Measurement of Flexibility

Flexibility as a Component of Divergent/Creative Thinking

In the first category of studies, flexibility was approached as a component of divergent thinking and was included in the assessment of creative performance. In this regard, Liu et al. (2010) assessed flexibility using the Creativity Assessment Packet (CAP) (Williams, 1980), which measured participants' ability to generate responses from different categories. Similarly, Hetzroni et al. (2019) investigated flexibility as part of creative thinking through two tasks: the Pictorial Multiple Solutions (PMS) Task (Leikin, 2013) and the Creating Equal Number (CEN) Task (Tsamir et al., 2009), through which they assessed flexibility, fluency, originality, and creativity. Cancer et al. (2023) included measures of flexibility alongside fluency and originality in their study. The assessment of flexibility focused on the participants' ability to generate varied ideas that belonged to different semantic categories. In this study, flexibility was operationalized through the diversity of strategies and methods used in problem-solving. The score reflected the degree to which the generated solutions differed; solutions that belonged to distinct groups received higher scores, while solutions that did not differ significantly from previous ones (by the same participant) received lower scores. Kasirer and Rozen (2023) investigated flexibility as a dimension of mathematical creativity through activities described by preschool educators; these activities were designed to assess the mathematical creativity of children with ASD, with flexibility measured by the number of distinct activity ideas. Thus, across the four studies, a variety of assessment tools were noted; however, flexibility was not assessed as a distinct executive function, but rather as an indicator of creative performance, specifically, the diversity of creative responses provided by the participants.

Flexibility as an Executive Function

In contrast, in two other studies, flexibility was investigated as an executive function. In the study published by Kasirer and Mashal (2014), the assessment tools used were the Trail Making Test (TMT) (Reitan & Davison, 1974) and the Ambiguous Word Meaning Generation Test (AMGT) (Mashal & Kasirer, 2011). These instruments were used to analyze the ability to switch between sets of stimuli, particularly in the case of TMT B, in which participants had to switch between numbers and letters, and to alternate between the various ambiguous meanings they had previously assigned to words in the Ambiguous Word Meaning Generation Test. Similarly, Tzuriel and Groman (2017) assessed cognitive flexibility using the Rule Shift Card Test (RSC) (Wilson et al., 1996). Flexibility was conceptualized as the capacity to change strategies, and the administered test measured participants' ability to switch from one rule to another.

Measures of cognitive processes relevant to flexibility

In contrast, Low et al. (2009) investigated generativity as an executive process relevant to imagination, linking difficulties in generating spontaneous hypothetical scenarios to deficits in representational flexibility, but without including direct measures to assess it. The instruments used to assess executive functions- more specifically, generativity include the "Uses of Objects" task and the "Pattern Meanings" tasks (Turner, 1999), which were used to measure the ability to generate new and diverse ideas.

3.2. Conceptualization and Measurement of Creativity

Creativity/Divergent Thinking

With regard to creativity, several studies have approached it from the perspective of divergent thinking. For example, Liu et al. (2010) assessed creativity using the Creativity Assessment Packet (CAP), which targeted indicators such as fluency, openness, flexibility,

originality, and elaboration, as well as indicators related to divergent thinking, such as risk-taking, curiosity, imagination, and complexity. Similarly, Cancer et al. (2023) assessed verbal divergent thinking using the Alternative Uses Task (AUT) (Guilford, 1967) with indicators for fluency, flexibility, and originality, and figural creativity using the Triangle Task (TT) (Pizzingrilli & Antonietti, 2010), with dimensions such as shape comparison, orientation comparison, elaboration, and originality; and attitudes toward creativity using a self-report questionnaire titled "What I Think About Creativity" (WTC) (Pizzingrilli & Antonietti, 2010).

Mathematical creativity

Another area of creativity that has been investigated is the field of mathematics. The study by Hetzroni et al. (2019) included, in addition to measures of general creativity for which they administered the Pictorial Multiple Solutions (PMS) Task, which assesses fluency, flexibility, originality, and creativity also direct measures of mathematical creativity assessed via the Creating Equal Number (CEN) Task, which included the components of fluency, flexibility, originality, and creativity. Similarly, Kasirer and Rozen (2023) assessed elements of mathematical creativity such as fluency, flexibility, and originality through an interview, in which the second part consisted of educators describing at least three activities they considered suitable for fostering mathematical creativity; the responses were analyzed based on three aspects from the specialized literature, one of which referred to the aforementioned elements of creativity.

Verbal/Metaphorical creativity

Another type of creativity that has been studied is verbal creativity. Kasirer and Mashal (2014) analyzed, on the one hand, the ability of adult participants with ASD to understand conventional and novel metaphors using a multiple-choice questionnaire, and, on the other hand, their ability to generate creative language was assessed using a sentence-completion questionnaire.

Assessment of skills relevant to creativity

Tzuriel and Groman (2017) used the Children's Metaphorical Construction Test (CMCT) (Tzuriel et al., 2008, cited in Tzuriel and Groman, 2017), a task designed to assess metaphorical construction, which may be relevant for investigating verbal/metaphorical creativity. In the study conducted by Low et al. (2009), the ability to generate new and diverse ideas was investigated using the "Uses of Objects" task and "Pattern Meanings" tasks (Turner), and imagination was assessed using Karmiloff-Smith's (1990) drawing task.

3.3. Results regarding flexibility

The results regarding the flexibility of participants with ASD are varied. For example, in the study by Liu et al. (2010), participants with Asperger's Syndrome scored significantly lower than the control group ($p < .001$), with flexibility assessed as one of the components of divergent thinking. The authors also noted that the drawings created by participants with Asperger's often focused on their areas of interest, interpreting the participants' specific and narrow areas of interest as potentially associated with poorer performance in flexibility. Kasirer and Rozen (2023) analyzed flexibility as a dimension of creativity in their study. The quantitative analysis examined the tasks previously described by educators, based on several elements including those related to creativity, and revealed that most ideas differed from one another. Regarding flexibility, educators associated this component of mathematical creativity with children's ability to solve a task in various ways. Low et al. (2009) found significantly lower scores in generativity compared to the control group (TSA: $M = 0.52$, $SD = 0.20$; control: $M = 0.62$, $SD = 0.16$; $F(1, 52) = 4.15$, $p < .05$). The authors discussed difficulties in spontaneously generating hypothetical scenarios in relation to deficits in representational flexibility, but did not include specific direct assessments of this in their study.

In the study by Cancer et al. (2023) conducted on adults with ASD, flexibility was assessed as part of divergent thinking using the Alternative Uses Task (AUT). Participants with ASD scored an average of 0.05 (SD = 0.98), compared to the typically developing group, which scored -0.5 (SD = 1.02). Statistically, the difference between the two groups was not significant (F = 0.21, p = .65), indicating that no significant differences in flexibility were found between participants with ASD and neurotypical participants. In the study by Hetzroni et al. (2019), two tasks were used to investigate flexibility as part of creative thinking: PMS and CEN. In the CEN task, on the flexibility subtest, children with ASD scored significantly higher than the control group (ASD: M = 37.6, SD = 7.90); control: M = 30.1, N = 10.31), while on the PMS task, the ASD group scored lower on average (M = 32.3, SD = 13.6) compared to the control group (M = 39.3, SD = 12.29), but the difference was not statistically significant (F = 2.95, p = .094, ηb = .072).

Kasirer and Mashal (2014) assessed cognitive flexibility using the TMT-B and AMGT tests. For participants with ASD, the mean completion time was longer compared to the control group (ASD: M = 76.94, SD = 30.96; control: M = 59.00, SD = 16.01), revealing a statistically significant difference (t = -2.122, p < .05), which highlights lower performance in cognitive flexibility among the adults with ASD included in the study. Similarly, in the AMGT test, which assessed the ability to activate different meanings of words and switch between them, the results of participants with ASD revealed greater difficulties in cognitive flexibility. The scores obtained by participants with ASD were significantly lower compared to the neurotypical group (ASD: M = 16.88, SD = 4.04; control: M = 19.47, SD = 0.80; t = 2.588, p < .05). Additionally, Tzuriel and Groman (2017) assessed cognitive flexibility using the RSC test. The results showed that children with ASD scored significantly lower than the group with high-functioning autism.

3.4. Results regarding creativity

Concerning creativity, the study conducted by Liu et al. (2010) using the CAP instrument showed, on the one hand, that participants with Asperger's scored higher on originality (p < .01) and elaboration (p < .05) compared to the control group, while, on the other hand, they encountered difficulties on the openness task, as evidenced by lower scores compared to the control group. The study by Kasirer and Rozen (2023) investigated educators' perceptions of the mathematical creativity of children with ASD. In the quantitative analysis of the 103 activities described by the educators, elements of fluency (M = 5.23, SD = 1.73), flexibility, and originality (M = 1.53, SD = 0.99) were identified, while the qualitative analysis highlighted, on the one hand, the difficulties related to creativity that children with ASD face, as described by the educators difficulties that the educators attributed to specific cognitive traits related to rigidity and repetitiveness while, on the other hand, these traits were viewed by educators as potential facilitators of creativity, but without discussing specific skills that involve creative thinking. Thus, perceptions regarding the creative ability of children with ASD were not uniform. The study by Low et al. (2009) found significantly lower imaginative performance among the group of children with ASD compared to the group of typically developing children, as evidenced by a lower score on Imaginative Content (F(1.52) = 9.40, p < .01). The analysis also showed that the lower imaginative content in children with ASD was not due to a higher number of non-imaginative elements, as no significant differences were identified between the groups (F(1.52) = 0.42, p > .05).

Cancer et al. (2023) investigated the creative profile of adults with ASD compared to neurotypical adults in their study. The results of the AUT test revealed significantly higher scores on originality compared to the control group (ASD: M = 0.28, SD = 1.22; neurotypicals: M = -0.28, SD = 0.59; F(1.93) = 7.97, p = .006). In contrast, no significant differences were found between groups regarding fluency, nor were there any differences in elaboration or originality in the Triangle Test assessment. Regarding shape comparison (F(1.93) = 11.83, p = .001), the ASD group showed significantly higher scores compared to the control group, whereas no differences

were found in orientation comparison. The results of the self-assessment questionnaire revealed differences in the perception of one's own creativity, with participants with ASD rating themselves as more creative compared to the control group. Thus, the study highlights increased linguistic originality, good abilities to vary the outcomes of drawings in the figurative test, and, at the same time, higher self-assessments of creativity compared to the control group. Creative performance was also investigated in the study by Hetzroni et al., (2019) using the PMS and CEN tests; the authors reported similar overall results between the ASD group and the group of typically developing participants in both general creativity tasks and mathematical creativity tasks, which included components such as originality, flexibility, and speed. However, at the level of specific components, the CEN test revealed higher scores related to fluency ($F(1.38) = 4.42$, $p = .042$), whereas on the PMS test, typically developing children scored higher on fluency ($F(1.38) = 5.29$, $p = .027$) and originality ($F(1.38) = 5.56$, $p = .024$). Thus, the results highlight a distinct profile of creative performance depending on the type of task, with better performance on the convergent thinking task and poorer performance on the divergent thinking task among participants with ASD.

Similarly, Kasirer and Mashal (2014) reported comparable results regarding the comprehension of conventional and novel metaphors in both the group of adults with ASD and the group of typically developing adults, with better performance in understanding conventional metaphors than novel ones. Furthermore, regarding metaphor generation, it was noted that the ASD group was able to generate more creative metaphors ($M = 37.06\%$), providing a higher percentage of original responses compared to the control group ($M = 19.41\%$; $t(32) = -2.166$, $p < 0.05$). In contrast, Tzuriel and Groman (2017) highlighted greater difficulties in metaphorical construction among children with ASD, as evidenced by the CMCT instrument, compared to children in the control group.

3.5. The relationship between flexibility and creativity

Of the studies we included in this review, only some provide information regarding the relationship between flexibility and creativity or offer clues about it. For example, in the study by Kasirer and Mashal (2014), the TMT B test, which assesses cognitive flexibility, contributed to predicting the comprehension of new metaphors; the authors suggested that the ability to understand new metaphors is based on cognitive flexibility, specifically the ability to switch between the literal and metaphorical meanings present in the new expression. Low et al. (2009) provide indirect evidence regarding the relationship between flexibility and imagination. Although the authors did not include direct assessments of representational flexibility in their study, they suggest that difficulties in spontaneously generating hypothetical schemas may be relevant to deficits in representational flexibility. Another study offering insights into the relationship between the two constructs is the study by Liu et al. (2010), which revealed a creativity profile characterized, on the one hand, by higher scores on creativity, while, on the other hand, greater difficulties were observed in flexibility. The authors suggested that the narrow and specific interests of children with Asperger's syndrome might, on the one hand, contribute to these elevated levels of originality and, on the other hand, limit flexibility. Thus, these results provide clues regarding the possibility of a relationship between flexibility and creativity in children with ASD, but none of the studies directly investigated this relationship.

4. Discussion

The aim of this systematic review was to bring together studies on flexibility and creativity in individuals with ASD and to examine what the available evidence says about these two constructs. We identified seven studies, published between 2002 and 2026, with child and adult participants with ASD.

Results for both flexibility and creativity were inconsistent, and much of this inconsistency appears to follow from how each construct was conceptualized, defined, and measured. Flexibility was operationalized in two quite different ways. Four studies treated it as a dimension of divergent thinking, meaning the capacity to produce varied ideas that belong to different categories. Two studies treated it as an executive function and looked at switching between stimulus sets, changing strategies, and moving from one rule to another. Difficulties were clearer in this second group of studies, which fits earlier reports of reduced cognitive flexibility in adults with ASD (Wallace et al., 2015; Lage et al., 2023). Where flexibility was assessed as part of creativity, the picture was less clear. Some studies found poorer performance in the ASD group, while others found similar or even better performance compared with controls.

Creativity showed a similarly mixed profile, with weaknesses in some components and strengths in others. The strengths concerned mainly originality and certain forms of verbal or figurative creativity. Children in Liu et al. (2010) obtained higher scores on originality and elaboration. Adults in Cancer et al. (2023) showed greater linguistic originality and rated their own creativity more positively. Participants in Kasirer and Mashal (2014) performed well on metaphor generation. Difficulties appeared in openness, imagination, and metaphor construction, and in some components of divergent thinking, fluency in particular. Low et al. (2009), for example, found significantly lower imaginative performance in children with ASD than in controls. The educators in Kasirer and Rozen's (2023) study were divided. Some saw rigidity and repetitive behaviors as an obstacle to how children with ASD express mathematical creativity, while others regarded the same traits as an advantage. Overall, individuals with ASD appear able to produce original or unusual responses, but they may struggle when a task requires them to change strategy or switch to a new rule.

Although the review covered both children and adults, comparing the two age groups directly proved difficult because the measures differed so much. Studies with children mostly approached flexibility as a dimension of divergent thinking. Studies with adults assessed both cognitive flexibility and flexibility as part of divergent thinking. Creativity tasks were just as varied, ranging from divergent thinking and verbal creativity to mathematical creativity. Age ranges within the same group were also wide: Low et al. (2009) tested children aged 5 to 13, and Cancer et al. (2023) tested adults aged 19 to 69. Together with the differences in how the constructs were defined and measured, this makes it hard to examine differences between children and adults.

Finally, none of the included studies tested the relationship between flexibility and creativity directly, although some point to a possible link. Because this evidence is indirect, it does not allow firm conclusions about how the two constructs relate. In Kasirer and Mashal (2014), performance on the TMT-B, a task that requires switching between stimulus sets, helped predict comprehension of novel metaphors. Another study linked difficulties with generativity and imagination to the representational flexibility observed in ASD, but only on theoretical grounds; the association itself was not assessed. Liu et al. (2010) suggested that the narrow, specific interests of children with Asperger's syndrome could account both for their higher originality and for their difficulties with flexibility.

4.1. Limitations

One of the main limitations of this review is the small number of studies included. This limitation makes it difficult to generalize the findings and assess the reliability of the reported results. Thus, the small number of studies, combined with heterogeneity in the conceptualization and assessment of constructs, has limited the ability to systematically investigate factors that may increase the variability of results, such as participants' age, task types, and domains investigated. Therefore, the conclusions should be interpreted with caution, given the limitations regarding their generalizability to the general population with ASD.

Another limitation is that most studies employed a cross-sectional design, which does not allow for conclusions regarding the direction or nature of the relationship between the two constructs. Furthermore, in some studies, flexibility and creativity were not measured directly but rather through indirectly relevant constructs, such as imagination, generativity, or metaphorical construction. Although these constructs may contribute to the manifestation of flexibility/creativity, they are not equivalent, a fact that limits the comparability of the results to some extent.

Another limitation is that in some studies, flexibility was assessed as an executive function, while in others it was assessed as a component of creative, divergent thinking. Consequently, not all studies aimed to assess the same constructs, which calls for caution in interpreting findings regarding a possible relationship. Also, as part of the systematic review, we did not use a prospectively registered protocol, and no formal critical assessment of the quality of the included studies was conducted; this is acknowledged as a limitation of this review.

4.2. Future research

Future research would benefit from larger samples that are more homogeneous in age. This would make it possible to compare age groups and to see whether any relationship between the two constructs changes across developmental stages. Cognitive flexibility and creativity have both been studied in the general population, but much less is known about them in ASD, where very few studies have looked at both constructs together. Future studies should therefore include direct measures of both cognitive flexibility and creativity. This would allow a closer look at how each construct presents in individuals with ASD and at the relationship between them.

Conclusion

This review shows considerable heterogeneity in how flexibility and creativity have been conceptualized and assessed in individuals with ASD. Some studies point to difficulties with cognitive flexibility, and a few offer preliminary indications of a link between flexibility and certain forms of creativity. However, the relationship between the two constructs has not yet been examined directly in ASD and remains poorly documented.

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