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Linguistic Markers of Autism Spectrum Disorder in Narrative Production: Evidence From the Monkey Cartoon Storytelling Task of the Autism Diagnostic Observation Schedule

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Abstract

Background and aims: The Autism Diagnostic Observation Schedule (ADOS-2) is considered a "gold standard" diagnostic instrument in the assessment of autism spectrum disorder (ASD). The Monkey Cartoon task is an optional pictured storytelling task in ADOS-2, which has been designed to assess gestural and verbal communication in autistic children while telling a story. It is well established that storytelling is challenging for autistic children, particularly for the content and coherent organization of the story, also known as narrative macrostructure. Existing evidence on the efficacy of the Monkey Cartoon task to pinpoint differences between autistic and neurotypical individuals in narrative macrostructure is scant. In this study, we used a version of the Monkey Cartoon task with modified scoring to analyze the narrative macrostructural skills of two groups of children with and without ASD. We also investigated the relations between narrative macrostructure and language ability in each group.

Methods: A group of 16 Greek-speaking autistic children and 16 age- and IQ-matched neurotypical children were administered the Monkey Cartoon storytelling task. Children's vocabulary and syntactic skills were also measured. Narratives were analyzed in terms of macrostructural features, including story completeness and story grammar, as well as units denoting the setting, internal responses and added details.

Results: The autistic children had lower scores in communicating the story content rather than story grammar. Moreover, the autistic group tended to include less information on the story's setting and more off-topic utterances than their neurotypical peers. Regarding the relations between narrative macrostructure and language ability, the two groups dissociated since the autistic children tended to rely on vocabulary at the expense of including irrelevant information in their narratives, while neurotypical children relied on both lexical and syntactic skills, especially when instantiating references to the story characters' mental states and the setting of the story, respectively.

Conclusions: The Monkey Cartoon storytelling task seems to be efficient at revealing pragmatic weaknesses mainly at the thematic content level in autistic children. Also, the frequent use of semantically- and pragmatically-irrelevant information in storytelling differentiated autistic from neurotypical children, and may thus be treated as a distinguishing feature of ASD in narrative production.

Implications: The findings demonstrate the viability of the Monkey Cartoon task in highlighting language markers of ASD in narrative macrostructure, with clinical implications for enhancing clinical practice in countries like Greece that face a shortage of narrative assessment tools for autistic children.

Keywords

Autism spectrum disorder, school-aged children, storytelling, macrostructure, monkey cartoon task, vocabulary, syntax

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Introduction

In the last 2 decades, research in autism spectrum disorder (ASD) has broadened its scope of inquiry in the narrative production performance of autistic individuals, highlighting narratives as a useful tool to assess language skills directly associated with core features of ASD, especially difficulties in pragmatics. Indeed, narration (storytelling) has been identified as an essential tool in studies of pragmatic skills in ASD, as it ecologically reveals both qualitative and quantitative differences in autistic narrators, such as difficulty with connecting narrated events within overarching psychologically and socially salient themes (known as macrostructure), even in those autistic individuals who still exhibit good structural skills or/and good expressive communication abilities (Geelhand et al., 2020; Manolitsi & Botting, 2011; Peristeri et al., 2017).

Oral narrative production research within the autistic population has so far used predominantly pictured story tasks to assess narrative performance. These tasks include wordless picture books, such as *Frog, Where Are You?* (Mayer, 1969), pictured stories specifically designed to measure storytelling abilities, such as the Edmonton Narrative Norms Instrument (Schneider et al., 2005), narrative production subtests of general language assessment batteries (e.g., Gagarina et al., 2012; Gillam & Pearson, 2004; Marini et al., 2015), or/and personal narratives (e.g., Bang et al., 2013; King et al., 2013; Mills et al., 2013). Previous research has employed various narrative elicitation tasks (e.g., picture-based story generation tasks vs. retellings of verbally presented stories), and differing task demands may have contributed to conflicting findings in the relevant literature. Though narrative studies in ASD have failed to provide converging evidence on the lexical or/and morphosyntactic abilities (also known as microstructure) of the autistic children as compared to typically developing (TD) peers (Losh & Capps, 2003; Norbury & Bishop, 2003; Norbury et al., 2014), results are more consistent across languages and metrics when macrostructure has been considered, thus, supporting the influence of a general pragmatic deficit on the narrative abilities of autistic children. Likely areas of vulnerability in narrative macrostructure in ASD include the use of referentially ambiguous expressions (Norbury et al., 2014; Peristeri et al., 2020; Suh et al., 2014), the frequent use of idiosyncratic or off-topic information (Losh & Gordon, 2014; Suh et al., 2014), and the omission of central story components such as events initiating a problem or/and lexical elements denoting the subjective viewpoint of the characters of a story (Diehl et al., 2006; Engberg-Pedersen & Christensen, 2017; Siller et al., 2014; Themistocleous et al., 2024; see Baixauli et al., 2016 for a meta-analysis).

Notably, none of the aforementioned pictured story tasks that have been used across studies have been originally designed to assess language in autistic children, whose visual information processing abilities have been shown to diverge considerably from TD children (see Dakin & Frith, 2005 for a review). Typical pictured stories tend to include lots of visual information to accommodate the representation of the inner world of the characters or the setting (time/place) of the unfolding story (Strouse et al., 2018). There are several lines of evidence showing that autistic children are sensitive to images with high perceptual complexity and sensory "noise" which may confuse them and, importantly, attenuate their urge to search around for meaningful information in a story (Andreou et al., 2025; Behrmann et al., 2006; Happé, 1996). Lian et al.'s (2023) recent eye-tracking study comparing autistic and TD children's fixations on typical picture books and researcher-designed books which were simplified in visual details, found that autistic children's fixations were lower, thus, their attention was significantly more reduced when reading the typical as compared to the less visually complex picture books, perhaps because their attention was distracted by the many visual details of the typical stories. This evidence implies that the narrative performance of autistic children may be confounded with extralinguistic factors, such as visual complexity, which has not been considered by picture-based narrative research in ASD so far.

In the current study, narrative macrostructure in autistic children has been assessed through the Monkey Cartoon task of the Autism Diagnostic Observation Schedule-Second Edition (ADOS-2; Lord et al., 2012). ADOS-2 is a "gold standard" instrument for the assessment of symptoms of ASD and for efficacy research to which many researchers adhere across cultures. Modules 3 and 4 of ADOS-2 include the Monkey Cartoon task, which is an optional task designed to assess autistic children's gestural communication and the integration of verbal and nonverbal communication while telling a story. The task comprises six black-and-white drawings depicting a story about two monkeys which the child is asked to view and narrate using both gestures and speech. According to the scoring scheme, the examiner rates the frequency of the spontaneous use of descriptive and empathic/emotional (natural, rhythmic "beats" that often accompany speech) gestures, with scores of 0-to-3 corresponding to scalable levels of severity of ASD-related symptoms. Verbal communication in the same task is assessed in terms of the degree of the stereotyped/idiosyncratic use of words or phrases in language production.

Though the Monkey Cartoon task (ADOS-2; Lord et al., 2012) has been designed to distinguish autistic from TD children in terms of their ability to integrate nonverbal/gestural and verbal communication skills (Braddock et al.,

2016), few studies exist that have used the ADOS-2 stimulus materials following a different scoring method to assess macrostructural dimensions of storytelling, that is, narrative abilities in terms of overall story content and hierarchical organization, in ASD. More specifically, Canfield et al.'s (2016) study found that the storytellings of English-speaking autistic adolescents were rated lower than their TD peers in terms of their cohesiveness, which was quantified by naïve observers who listened to the narrative output and were asked to rate the question of "How well were you able to follow this story?." Interestingly, the autistic adolescents did not significantly differ from their TD peers in any of the objective individual measurements of the quality of narrative macrostructure, including story completeness, goal-attempt-outcome sequences as a proxy for story grammar (Stein & Glenn, 1982), the use of internal state terms and off-topic details, but did differ in the overall Story Composite Score that comprised all the aforementioned macrostructural dimensions. According to Canfield et al. (2016), the specific finding supports the view that narrative macrostructure is not a monolithic process and favors accounts acknowledging that narrative production in ASD is affected by a constellation of slight impairments across several macrostructural components. In de Marchena and Eigsti's (2010) study, the naïve listeners that rated the stories produced by the autistic adolescents reported their narrations as being significantly harder to follow and less engaging than those produced by their TD peers.

The overall evidence so far, even if not ample, offers an estimate about the macrostructural narrative abilities of autistic individuals though the Monkey Cartoon task, and that the latter is sufficient to pinpoint differences in narrative quality measures between adolescents with and without ASD. Importantly, the pictures of the Monkey Cartoon task are black-and-white and content dense presenting two characters (the two monkeys) and two objects (coconuts, trees), thus, assumingly more sensitive to autistic cognitive characteristics, such as enhanced proneness to distraction by details and noisy background information (Happé, 1996).

To date, no study has utilized the Monkey Cartoon task to examine narrative performance in young, school-aged autistic children. The current study aims at investigating narrative performance in a group of 9-to-12-year-old autistic children along with age- and IQ-matched TD children through the Monkey Cartoon task in ADOS-2, to elucidate whether the specific storytelling test may distinguish between autistic and TD children in the particular age range in terms of their narrative macrostructural abilities. Extending the Monkey Cartoon task to narrative macrostructural assessment would hold promise for addressing possible limitations of previous narrative studies whose findings may have been susceptible to the confounding effect of visual complexity. To assess how well the Monkey Cartoon task can detect narrative macrostructural deficits and measure variables of interest to narrative production research in ASD, we have analyzed the narrative data obtained from two groups of 9-to-12-year-old children with and without ASD, following the macrostructural coding scheme of Canfield et al.'s (2016) study. We have also investigated whether the children's narrative performance in the task would relate to their lexical and syntactic skills.

Table 1. Children's Age and Nonverbal IQ Scores (Means, Standard Deviations, Ranges).

Group	Age	Raven
Autistic children	10.6 (0.9)	93.7 (6.3)
	9; 1–12; 0	85.7–100
TD children	10.4 (1.2)	96.5 (4.8)
	9; 0–12; 2	85.7–100

Note. TD: typically developing.

Method

Participants

The study included 16 autistic children (nine boys) and 16 age-matched TD children (nine boys) recruited from the geographical region of Attica and Thessaly, Greece. The autistic children were referred by Centers for Differential Diagnosis, Assessment, Counseling and Evaluation (KEDASY) that constitute the official state centers responsible for the diagnosis and assessment of autism in Greece. All children received a formal clinical diagnosis of autism (and no co-occurring psychiatric or/and learning difficulty condition) at preschool age at KEDASY on the basis of the Diagnostic and statistical manual of mental disorders fifth edition, and *ICD-10* criteria (American Psychiatric Association, 2013; World Health Organization, 1993). The autistic children were all verbally able and attended mainstream classes in public schools. All TD children attended public mainstream schools in Attica and Thessaly, Greece, and had no history of learning disabilities, developmental, neurological, or psychiatric disorder, as confirmed by parental and teachers' reports. All the children had normal vision. Both autistic and TD children's nonverbal IQ was measured through the Raven's Colored Progressive Matrices Test (Raven et al., 1995). Table 1 includes information about the two groups' age and IQ percentile scores. The two groups did not differ significantly in either age, $X^2 = .24$, $p = .626$, or nonverbal IQ scores, $X^2 = 1.93$, $p = .18$. Parents or/and legal guardians of all children released their written informed consent for their participation in the study and the treatment of the data in accordance with the Declaration of Helsinki. The study was approved by the Institutional Review Board (or Ethics Committee) of the National and Kapodistrian University of

Athens (protocol code: 63164/27.6.2022, 34/2022; date of approval: 14/7/2022).

Materials and Procedures

All children completed the Monkey Cartoon storytelling task (ADOS-2; Lord et al., 2000). The same children were also assessed on receptive vocabulary measured through the Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn & Dunn, 1981; adapted to Greek by Simos et al., 2011), and syntactic comprehension measured through a sentence-picture matching task (Varlokosta et al., 2015, 2023). The tests were administered in two sessions that took place on different days at the children's home, school or private practice center. Session 1 included the storytelling task, and Session 2 included the receptive vocabulary and syntactic comprehension task. Sessions 1 and 2 had a mean duration of approximately 10–15 min and 20–25 min, respectively.

Storytelling Task

The Monkey Cartoon task of the ADOS-2 (Lord et al., 2012) has been administered following the steps in Canfield et al.'s (2016) study. The stimuli of the task comprise six separate black and white picture cards depicting a story about two monkeys and coconuts. Specifically, the examiners (second and third authors) laid out each of the six picture cards at a time in the proper sequence. Children were informed by the examiner that she has never seen or heard the story before, and were then instructed to tell the story shown in the picture cards. The pictures were visible to the children while telling the story and were only removed after the child finished speaking. Children received no prompts from the examiners and there was no time limit set. Children's storytellings were digitally recorded on an Olympus DS-30 Digital Stereo Voice Recorder. The narratives varied in length from 2 to 5 min.

Narrative transcription and coding. Narratives were manually transcribed at the word level by the first and fourth author. All transcripts were then checked by the first author reaching high interrater reliability ($r = .97$). Transcripts were next segmented into verb clauses as a proxy for narrative length. Narrative macrostructure was evaluated following Canfield et al.'s (2016) and Lê et al.'s (2011) coding scheme, which has been implemented on T-units, that is, main clauses and any attached or embedded dependent clauses, and included the following measurements: *Story completeness*, which referred to the number of the core events included in the story (maximum score: 6; see Canfield et al., 2016 for the full list of events; the score was binary (0/1) depending on whether the children included the specific events in their narratives, or not); *Story grammar*, operationalized as the number of problems (initiating events), attempts at solving the problem, and consequences/outcomes (see examples 1–3, respectively), which were then divided by the total number of verb clauses in each child's narrative to control for narrative length; *Setting*, including information about the time or/location of the events (see Example 4); *Internal response*, including information about the characters' mental state (see Example 5); and *Added/invented detail*, that referred to off-topic information in the child's narrative (see examples 6–8). The scores for Story grammar, Setting, Internal response, and Added/invented detail were based on the number of occurrences (per category) in the children's narrative production.

Besides scores in each of the aforementioned individual categories, a Story Composite Score resulting from summing up scores from the categories of story completeness, problems/initiating events, attempts, consequences, setting, and internal response was computed per child as a proxy for overall narrative quality. Coding of categories (i.e., labeling story grammar elements) was done independently by two raters (first and final author) across all narrative productions (i.e., 284 T-units in total) and interrater agreement has reached 96% (i.e., agreement on 272 out of the 284 units).

1. i maimu rixni ena fruto
   "The monkey throws down a fruit." (*Problem/initiating event*)
2. pire tin kariða ki arçise na treçi (*Attempt*)
   "(The monkey) took the coconut and started running."
3. erikse mia kariða sti maimu (*Consequence*)
   "(The monkey on the tree) threw a coconut toward the other monkey."
4. itan mia maimu pano sto ðendro (*Setting*)
   "There was a monkey on the tree."
5. sceftice mia iðea (*Internal response*)
   "(The monkey) thought of an idea."
6. erikse stin kariða kati san piperi (*Added/invented detail*)
   "(The monkey) threw at the coconut something like pepper."
7. ke meta i kariða ekraɟice (*Added/invented detail*)
   "And then the coconut erupted."
8. eftase tin kariða apo to ðifilo praɣma (*Added/invented detail*)
   "(The monkey) reached the coconut from the two-leaved thing."

Receptive Vocabulary

Children's receptive vocabulary outcomes were assessed using the Greek version of the PPVT-R (Dunn & Dunn, 1981; adapted to Greek by Simos et al., 2011). In this task, children are shown drawings and are asked to select the appropriate picture (of four choices) in response to the

examiner's prompt. Percentiles have been used in the analyses.

Syntactic Comprehension

Children's syntactic comprehension was assessed with the sentence comprehension subtest of the Greek Lexical and Grammatical Aphasia Assessment Test—LexiGrAph (Varlokosta et al., 2015, 2023). The subtest assesses the comprehension of the following sentence types (a) canonical sentences: active, subject-extracted referential and nonreferential *wh*-questions, and subject relative clauses, 10 items per sentence type; (b) noncanonical sentences: topicalized OVS sentences, object-extracted referential and nonreferential *wh*-questions, and object relative clauses, 10 items per sentence type; (c) 10 sentences with pronominal clitics; and (d) 10 sentences that included verbs with nonactive morphology, such as reflexives. Children were shown two colored drawings while they heard a sentence, and were asked to choose the appropriate one. The task has no standardized scores, so raw scores have been used.

Results

Data analysis was completed in R (version 3.6.2; R Core Team, 2019). Normality assumptions were met for all narrative measures (Kolmogorov–Smirnov tests; $p > .05$) for each group, so we used one-way analyses of variance to compare narrative categories between the two matched groups. Table 2 presents the two groups' mean performance scores in receptive vocabulary and syntactic comprehension, mean narrative length, as well as mean scores in each of the narrative macrostructural measures obtained from the Monkey Cartoon task.

The ANOVA analyses with Group as the independent factor showed that the autistic children scored significantly lower than the TD group in both receptive vocabulary, $F(1, 30) = 5.246$, $p = .029$, $\eta^2 = .15$, and syntactic comprehension, $F(1, 30) = 8.521$, $p = .007$, $\eta^2 = .22$. The two groups did not differ in narrative length, $F(1, 30) = 2.514$, $p = .119$, $\eta^2 = .07$.

In narrative macrostructure, the autistic group scored lower than the TD group in Story completeness, $F(1, 30) = 13.931$, $p < .001$, $\eta^2 = .32$, the information units denoting Setting, $F(1, 30) = 27.179$, $p < .001$, $\eta^2 = .48$, and Added/invented detail, $F(1, 30) = 3.769$, $p = .048$, $\eta^2 = .12$, and finally in the Story Composite Score, $F(1, 30) = 20.485$, $p < .001$, $\eta^2 = .41$. The two groups did not differ either in Story grammar, $F(1, 30) = .747$, $p = .394$, $\eta^2 = .03$, or in Internal responses, $F(1, 30) = 2.455$, $p = .128$, $\eta^2 = .07$.

Table 3 presents the results of the correlations between each group's narrative macrostructural scores and their language ability operationalized through receptive vocabulary and syntactic comprehension. Follow-up Fisher r-to-z transformation was used to determine the magnitude of the relationships. For the autistic group, receptive vocabulary was significantly positively correlated with story grammar ($z = .484$, $p = .05$) and added/invented details ($z = .525$, $p = .045$), while, for the TD group, receptive vocabulary was positively correlated with internal responses ($z = .568$, $p = .04$). Syntactic comprehension for the TD group was significantly positively correlated with both information units denoting setting ($z = .725$, $p = .01$) and the Story Composite Score ($z = .592$, $p = .038$), while no significant correlations were found for the autistic group.

Discussion

The current study has assessed the narrative performance of young, school-aged autistic children as compared to a group of age- and IQ-matched TD children on the Monkey Cartoon storytelling task of ADOS-2, using a different scoring method from the one specified in ADOS-2 (Canfield et al., 2016; Lê et al., 2011). Children's narrative output was analyzed in terms of macrostructural properties, including story completeness and story grammar, as well as information units referring to the story's setting and characters' internal states, and finally off-topic information. The study has found that autistic children's narratives included significantly fewer core story events than TD peers, less information on the time or/and place of the story, and more off-topic or noncontingent utterances. The autistic children were also found to score lower than controls in the Story Composite Score, which is a general proxy for story quality comprising story completeness, story grammar, setting and internal responses. Also, autistic children with higher vocabulary skills tended to score higher in story grammar as compared to their peers with lower vocabulary scores, yet, those children with higher vocabulary scores tended to also include more irrelevant information units in their narratives. Narrative production in the TD group, on the other hand, appeared to be related to the children's both lexical and syntactic skills, especially when instantiating references to the story characters' mental states and the setting of the story, respectively. The overall results evince that the Monkey Cartoon story in ADOS-2 is a viable task to highlight narrative macrostructural weaknesses in autistic children, further implying that its use may extend to narrative assessment besides its conventional function to assess symptoms in ASD through children's nonverbal and verbal communication.

The narrative performance of the 9-to-12-year-old autistic children that participated in the current study suggests deficits mainly at the level of thematic content rather than that of story organization, or else story grammar. Specifically, though the autistic children tended to omit core events of the story, the units denoting initiating events/problems, attempts to solve them and direct consequences were very close in rates to TD children (52.2% ≈ 56.2% for the autistic and TD children, respectively; see Table 2 in the Results).

Table 2. Groups' Mean Receptive Vocabulary and Syntactic Comprehension Scores (Standard Deviations Within the Parentheses), Mean Narrative Length (Mean Number of Verb Clauses), and Mean Scores in the Narrative Macrostructural Categories of the Monkey Cartoon Narrative Production Task.

				Narrative Macrostructural Measurements					
Group	Receptive Vocabulary (Percentiles)	Syntactic Comprehension (%)	Narrative Length	Story Completeness (Max. Score 6)	Story Grammar (%)	Setting	Internal Response	Added/Invented Detail	Story Composite Score
Autistic children	66.4 * (7.8)	93.8** (5.4)	10.3 (2.2)	2.8*** (2.0)	52.2 (13.9)	0.9*** (1.0)	1.5 (1.4)	1.3* (1.5)	8.2*** (2.2)
TD children	72.0 (6.1)	97.8 (1.8)	11.4 (1.5)	5.0 (1.2)	56.2 (11.8)	3.1 (1.2)	2.3 (1.3)	0.4 (0.8)	11.7 (2.1)

Note. TD: typically-developing; max: maximum.
*$p < .05$; **$p < .01$; ***$p < .001$.

This seems to agree with Canfield et al.'s (2016) study, which also found that adolescents with and without ASD exhibited nearly the same story grammar scores on the same task (specifically, 60% ≈ 62% for the autistic and TD adolescents, respectively). This pattern implies that autistic individuals across both studies were able to identify characters as causal agents, and verbally express their goals and the outcomes of their attempts to resolve conflicting situations in the story. However, the autistic children of the current study tended to produce a considerably larger amount of irrelevant information (coded as "Added/invented detail") in their narrations, suggesting a deficit in their ability to differentiate between story-relevant and irrelevant information. The majority of the autistic children's utterances being characterized as added/invented details were linked to the visual stimuli of the pictures, specifically, the *tree* and the *coconuts* (see examples 6–8 in Methodology), which makes us hypothesize that these noncontingent expressions may have stemmed from autistic children's diminished suppression of distracting details in the pictures that were irrelevant to the core events of the story. As suggested by previous research (Andreou et al., 2025; Lian et al., 2023), autistic children can easily be distracted and overwhelmed when perceptually complex stimuli appear, and overattention to irrelevant visual details may be one of the reasons for autistic children's high rates of noncontingent expressions while narrating the Monkey Cartoon story in the current study. Though in Canfield et al.'s (2016) study, the instances of added/invented detail were numerically higher in the autistic adolescents than their non-autistic peers, the difference was not significant. Furthermore, their study provides no information about the nature of these details, that is, whether they were relevant to the visual stimuli of the Monkey Cartoon story, or not. The fact that the two studies dissociated in terms of the significance of the effect of the "Added/invented detail" category on the autistic groups' narrative performance, that is, the effect was significant in the current study but nonsignificant in Canfield et al. (2016), probably suggests developmental differences for pragmatic language skills in ASD. However, further research in different age groups would be necessary to reach safe conclusions.

Overall, the extensive use of noncontingent expressions by autistic children seems to converge with previous research that has yielded similar findings in discourse production in ASD (e.g., Hale & Tager-Flusberg, 2005; Mäkinen et al., 2014; Norbury et al., 2014; Young et al., 2005), and may be indicative of deficits in coding pragmatically relevant information in social contexts, including narratives. Interestingly, in the current study autistic children with higher receptive vocabulary were found to produce more irrelevant information than their peers with lower receptive vocabulary scores, which may be explained by the fact that the added details tended to include low-

Table 3. Correlations between Narrative Macrostructural Measures, Receptive Vocabulary, and Syntactic Comprehension for Each Group.

		Narrative Macrostructural Measurements					
Group		Story Completeness	Story Grammar	Setting	Internal Response	Added/ Invented Detail	Story Composite Score
Autistic children	Receptive vocabulary	−.034	.449*	.301	−.371	.481*	.154
	Syntactic comprehension	.116	.064	−.104	−.150	.176	.057
TD children	Receptive vocabulary	.186	.447	−.221	.514*	−.351	−.397
	Syntactic comprehension	−.338	−.046	.587**	.076	.165	.539*

Note. TD: typically developing.
*$p < .05$; **$p < .01$.

frequency words (e.g., see "piperi" /peper/, "ekraɣice" /erupted/, ðifilo /two-leaved/ in examples 6–8 in Methodology). Expressions denoting the story's setting were also less frequent in the autistic (vs. TD) group, which suggests that the autistic children were less motivated to anchor events in appropriate time or/and place, to bond with other information in the story. Previous research in various language domains has highlighted attenuated urge to take the listener's perspective as the cause of language impairments in ASD. More specifically, Thurber and Tager-Flusberg (1993)'s narrative study found that the autistic children were less motivated than their TD peers to produce lexically rich and fully fledged stories, thus, the lexical diversity of the autistic group's narration was significantly lower. On a similar note, Peristeri et al.'s recent narrative study (2024) has claimed that autistic children's weak inclination to invest on the informational needs of their listener may have been one of the reasons for their enhanced use of silent pauses in their narrative production. An alternative explanation for the extensive use of added details in their stories could be difficulties in monitoring shared information which have also been reported for autistic children (Peristeri et al., 2021; Shic et al., 2011).

Finally, the correlation analyses revealed differences in the relation between language ability and narrative macrostructure across the two groups of the current study. Specifically, TD children used both lexical and syntactic skills to verbally encode the story characters' mental states and the setting, respectively, while autistic children's inclusion of the episodic components of the story (i.e., the story grammar) tended to increase with higher vocabulary skills. Also, the relations between narrative macrostructure and language (especially syntax) appeared to be stronger in magnitude in the TD as compared to the autistic group (as revealed by Fisher r to z transformation; see Table 3), which further implies that language ability strengthened narrative macrostructure in the TD group to a greater extent than in the autistic group. This dissociation may have stemmed from the fact that the autistic children scored lower than their TD peers in both language ability measures, that is, receptive vocabulary and syntactic comprehension, thus, the former group was less efficient to use language resources while telling the story. Previous research (Allen et al., 1994) has shown that higher syntactic complexity in 6- and 8-year-old TD children leads to more globally organized narratives, while relations between syntax and narrative macrostructure have been also observed for autistic children without language impairment (Baixauli et al., 2016; Peristeri et al., 2017). It seems that drawing on syntax contributed considerably to the coherent organization of the story at least for the TD children of the current study.

Though the present study shows that the Monkey Cartoon storytelling task of ADOS-2 is a viable tool to reveal pragmatic difficulties in young, school-aged autistic children, our conclusions would have been strengthened by a larger sample size, especially after considering the substantial heterogeneity that is encountered across autistic cognitive profiles. On a similar note, the findings cannot be generalized to the wider population of autistic children who may be less verbally able, have lower than normal IQ scores or/and are unable to attend mainstream schools. As a result, information related to narrative macrostructure in children having higher autism severity levels is missing in this study. Furthermore, future research needs to explore additional skills (beyond language), such as theory of mind and executive functions, that have been shown to be inextricably linked to narrative performance in ASD (e.g., Greco et al., 2023; Peristeri et al., 2020; Siller et al., 2014). Finally, though the current study has revealed relations between TD and autistic children's language (lexical and syntactic) skills and narrative macrostructural performance on the Monkey Cartoon storytelling task of ADOS-2, due to the small sample size it was not feasible to match participants on language. According to the results, the autistic group scored significantly lower than the TD group on both measures of structural language, that is, receptive vocabulary and syntactic

comprehension. Matching the two groups on structural language would have allowed us to establish further meaningful connections between autistic children's narrative performance and their language abilities.

Conclusions

Overall, the current study has shown that the Monkey Cartoon storytelling task of ADOS-2 was efficient at revealing pragmatic weaknesses mainly at the thematic content level in autistic children. Moreover, the frequent use of semantically- and pragmatically irrelevant information in storytelling differentiated autistic from TD children, thus, it may be treated as a distinguishing feature of ASD in storytelling, and it mainly characterized children with high vocabulary skills. Notably, the autistic group exhibited preserved story grammar skills, which further suggests that macrostructural deficits in ASD are not all or nothing, but comprise distinct components which may be differentially affected in children on the spectrum. The overall findings of the study indicate that the Monkey Cartoon storytelling task may have utility as a reliable method for assessing pragmatic skills in children with ASD, with clinical implications for enhancing language assessment and clinical practice services in countries like Greece facing a shortage of reliable narrative assessment tools for autistic children.

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Statements and Declarations

Ethical Considerations

Parents or/and legal guardians of all children released their written informed consent for their participation in the study and the treatment of the data in accordance with the Declaration of Helsinki. The study was approved by the Institutional Review Board (or Ethics Committee) of the National and Kapodistrian University of Athens (protocol code: 63164/27.6.2022, 34/2022; date of approval: 14 July 2022).

Consent for Publication

The authors of the study confirm that written informed consent for publication was provided by the legally authorized representatives of the study's participants.

Author Contributions/CRediT

Conceptualization: EP, SV, and MN; methodology: EP, SV, and MN; software: EP; formal analysis: EP; data curation: KD and AB; writing—original draft preparation: EP; writing—review and editing: SV and MN; supervision: SV; project administration: SV. All authors have read and agreed to the published version of the manuscript.

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Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Data Availability

The database can be accessed via https://osf.io/f3vbk/

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