HHS Public Access

Author manuscript

Res Autism Spectr Disord. Author manuscript; available in PMC 2021 January 01.

Published in final edited form as:

Res Autism Spectr Disord. 2020 January ; 69: . doi:10.1016/j.rasd.2019.101453.

Assessment of Personal Narrative Writing in Children with and without Autism Spectrum Disorder

Elizabeth Hilvert[1], **Denise Davidson**[1], **Perla B. Gámez**[1]

[1]Department of Psychology, Loyola University Chicago 1032 W. Sheridan Rd. Chicago, IL, 60660, USA

Abstract

Background: Research has demonstrated that writing may be challenging for many children with Autism Spectrum Disorder (ASD; Mayes & Calhoun, 2006). In our study, we used linguistic analysis to identify and examine the personal narrative writing skills of children with ASD in comparison to neurotypical (NT) children.

Method: This study included 22 children with ASD and 22 NT children. Groups did not differ in terms of age, IQ, and language. Writing samples were coded and compared for aspects of microstructure (e.g., lexical and syntactic complexity, errors) and macrostructure (e.g., quality, or ratings of coherence, structure, and content). We also examined the link between theory of mind (ToM) and personal narrative writing. Of interest was whether ToM uniquely predicted writing performance after controlling for diagnostic group, chronological age, and language ability.

Results: The texts of children with ASD were less syntactically diverse, contained more grammatical errors, and were reduced in overall quality compared to NT children. However, children with ASD did not differ from NT children in terms of lexical complexity, frequency of writing conventions errors, and use of evaluative devices. Overall, ToM uniquely predicted syntactic complexity and text quality in children.

Conclusions: Study findings showed that children with ASD demonstrate some challenges with personal narrative writing compared to NT children. Additionally, difficulty with narrative writing was linked to poorer ToM performance, particularly in children with ASD. Findings highlight the utility of obtaining a variety of writing outcomes, as well as mechanisms related to writing, when evaluating writing for educational decisions.

Keywords

Writing; Personal Narrative; Autism Spectrum Disorder; Theory of Mind

*Corresponding author information: Elizabeth Hilvert, Ph.D., Postdoctoral Trainee, Waisman Center, University of Wisconsin-Madison, 1500 Highland Ave Madison, WI, 53705, USA, elizabeth.hilvert@wisc.edu.

*Present Address: Elizabeth Hilvert is now at the Waisman Center at the University of Wisconsin-Madison.

Conflict of interest: The authors have no conflicts of interest to declare.

Writing is a complex skill that requires the simultaneous recruitment of various motor, linguistic, cognitive, and social skills (Berninger, 2015; Berninger & Abbott, 2010). Children who experience challenges in one or more of these domains are more likely to struggle with written expression. Consequently, this may lead to negative academic, occupational, and life outcomes (e.g., Molitor et al., 2016; College Examination Board, 2004). In addition to difficulties with social communication and an increased frequency of restrictive and repetitive behaviors (American Psychiatric Association [APA], 2013), a number of children with Autism Spectrum Disorder (ASD) demonstrate difficulties in domains such as handwriting (Kushi et al., 2011), structural language (e.g., grammar; Boucher, 2012), and social cognition (e.g., perspective-taking; Baron-Cohen, 2000). Thus, children with ASD are at an increased risk for writing challenges, although the extent and nature of these difficulties have been relatively unexplored.

To date, research studies relying on standardized writing assessments indicate that a majority of children with ASD, and average intelligence, have written language scores that are below expectations based on their standardized full-scale IQ scores (e.g., Mayes & Calhoun, 2003, 2006, 2008). Other studies have used linguistic analysis to evaluate the word, sentence, and textual dimensions of writing in order to more precisely depict how the texts constructed by individuals with ASD either aligned or deviated from those of their neurotypical (NT) peers (see Finnegan & Accardo, 2018). Using this language-based approach, several specific challenges have been identified in children with ASD. Although there are exceptions (e.g., Hilvert, Davidson, & Scott, 2019), studies have shown that difficulties in writing often center on macrostructural processes, that is construction of texts that are coherent, well-structured, and elaborative (Brown, Johnson, Smyth, & Oram Cardy, 2014; Brown & Klein, 2011; Reilly, Polse, & Lai, 2017). Results have been more mixed for text length, lexical diversity, and syntactic complexity, with some, but not all studies demonstrating significant differences between children and adults with and without ASD (Brown et al., 2014; Brown & Klein, 2011; Hilvert et al., 2019; Myles et al., 2003; Reilly et al., 2017; Troyb et al., 2014; Zajic et al., 2018).

These mixed findings could be explained by a number of methodological differences, including differences in sample-matching methods, participant characteristics, the writing variables assessed, and writing genre (Finnegan & Accardo, 2018). In fact, a variety of writing genres have been examined across studies, including expository (e.g., informational; Hilvert et al., 2019; Zajic et al., 2018), persuasive (Brown et al., 2014), fictional (Brown, 2013; Tyrob et al., 2014, Myles et al., 2003), and personal narrative writing (Reilly et al., 2017; Brown & Klein, 2011). Given the differences in each genre's purpose, structure, and content, children's ability to write in a particular style may follow a different developmental progression within each genre (see Berman, 2008). Thus, each writing style may present unique challenges and strengths for children with ASD. In the present study, we were particularly interested in assessing the personal narrative writing skills of children with ASD.

Personal Narrative Writing and Autism Spectrum Disorder

Narration is typically dichotomized as either fictional (e.g., make believe stories) or personal (e.g., stories of personal, past events). Previous research has found that compared to fictional narratives, personal narratives are more prevalent in the naturally-occurring conversations of NT children and that NT children are often better at telling more complex and complete personal narratives (see McCabe, Bliss, Barra, & Bennett, 2008). This may be due to children's exposure from an early age to oral personal narratives in various contexts, including home, school, and in the media. Moreover, personal narratives may be more meaningful to children than other types of oral narratives (e.g., fictional narratives) because personal narratives are rooted in one's social interaction, cultural setting, and personal experiences (McCabe et al., 2008). In NT children, these early skills in oral narration also appear to impact written expression, as personal narrative writing is one of the earliest forms of writing children will master (Berman, 2008). Such findings have important implications for children with ASD, who because of differences in social communication patterns, may engage in less freely-produced personal narratives with others.

Although children with ASD have been found to produce both fictional and personal oral narratives, children with ASD have difficulties telling coherent, casually connected narratives, especially when it comes to talking about past events (e.g., Bang, Burns, & Nadig, 2013; King, Dockrell, & Stuart, 2013). Specifically, children with ASD often tell less syntactically diverse, thematically integrated, and elaborative personal narratives compared to their fictional narratives (Losh & Capps, 2003). Moreover, Losh and Capps (2003) found that children with ASD utilized fewer types of evaluative devices than NT children when telling personal narratives, but used a comparable range of devices when telling fictional narratives. Finally, research has shown that children with ASD are less likely to tell personalized stories that are focused on one specific, casually connected event (Losh & Capps, 2006).

Yet, is not clear whether difficulties with oral personal narration are present in written expressions. To our knowledge, only two studies have specifically compared the personal narrative writing of individuals with ASD to NT individuals. Brown and Klein (2011) found that adults with ASD wrote personal narrative texts that were lower in quality (e.g., coherence, structure, and elaboration) than NT adults. Additionally, the personal narratives written by adults with ASD were shorter, or less productive, than those of their NT counterparts. However, the majority of word and sentence-level features of writing—lexical complexity, grammatical complexity, and frequency of spelling and grammar errors—were relative strengths for adults with ASD as no significant differences between individuals with and without ASD were found (Brown & Klein, 2011). In another study, Reilly et al. (2017) asked children with and without ASD to write about a time when someone made them mad or sad. Reilly et al. (2017) found that children with ASD wrote shorter texts, made more grammatical errors, and wrote fewer and less diverse complex sentences compared to NT children. Moreover, children with ASD had greater difficulty including the story elements of interest (e.g., setting, problem, attempt at resolution, conclusion) in their writing, with the greatest difficulty providing sufficient information about the story setting. However, children with ASD did not differ from their NT peers in their use of evaluative devices (e.g., emotion

terms, character speech). Thus, children and adults with ASD appear to have difficulty with the global or text-level aspects of writing personal narratives, whereas children with ASD may also have difficulties with microstructural properties, e.g., using complex and correct grammar (Reilly et al., 2017). However, given the limited literature base on personal narrative writing, more research is needed to better understand the challenges children with ASD may have with both the macro- and microstructural aspects of this writing style.

Theory of Mind and Narrative Writing

Given that personal narratives are often grounded in social experiences, a number of social cognitive skills may underlie the development of written personal narratives. One social cognitive skill that may be important is theory of mind (ToM). ToM refers to the ability to comprehend the mental states (e.g., beliefs, desires, intentions) of oneself and others, and to understand that others' mental states can differ from one's own (see Miller, 2006; Byom & Mutlu, 2013; Slaughter, 2015, for reviews). Study findings have shown that the development of ToM is also dynamically and strongly related to oral language development (Miller, 2006). In fact, difficulties with ToM is one of the most prevalent theories used to explain communicative and linguistic difficulties in individuals with ASD (e.g., Baron-Cohen, Leslie, & Frith, 1985; Frith, 2001; Tager-Flusberg, 2007), as many children with ASD demonstrate delays in this domain (Baron-Cohen, 2000).

We hypothesized that ToM ability would influence personal narrative writing in a number of ways. First, strong ToM skills may help children to write about their own thoughts and feelings, and those of their characters (Tager-Flusberg & Sullivan, 1995). Second, being able to "read" the minds of others may make it easier to take the perspective of the reader and understand what the reader needs to know for the text to make sense. Yet, past studies provide conflicting evidence for the role of ToM in the writing process. Whereas several studies have linked ToM impairments to poorer personal and fictional narrative writing in adults with ASD (Barnes, Lombardo, Wheelwright, & Baron-Cohen, 2009; Brown & Klein, 2011), Brown (2013) did not find an association between ToM and fictional narrative writing quality in children and adolescents with ASD. Given these conflicting findings, it is unclear how perspective taking skills may relate to personal narrative writing, especially when examining children's writing at both the macro-and microstructural levels.

Present Study

Given the limited literature-base on personal narrative writing in children with ASD, the first objective of the present study was to characterize the personal narrative writing skills of 8- to- 14-year old children with ASD in comparison to their NT peers. Children's texts were coded for a number of microstructural aspects including lexical and syntactic complexity, as well as the frequency of grammar errors, writing convention errors (e.g., spelling), and evaluation (e.g., mental state and causal references, sound effects). In terms of macrostructural features, we examined children's writing productivity (i.e., text length), overall quality (i.e., ratings of coherence, structure, and content), and degree of personalization (i.e., is the narrative focused on a specific, temporally sequenced event). The second objective of this study was to examine the link between ToM ability and personal

narrative writing in children with and without ASD. We also examined whether ToM ability uniquely predicted writing skills after controlling for other factors known to influence writing performance, including diagnostic group, chronological age, and language ability.

Predictions were as follows:

Aim 1: In line with previous findings, it was hypothesized that children with ASD would write personal narratives that were shorter, less personalized, and rated lower in quality than NT children (Brown & Klein, 2011; Reilly et al. 2017). Given the conflicting results of Brown and Klein (2011) and Reilly et al. (2017), it was an open question as to whether children with ASD would construct less lexically and syntactically complex sentences, use fewer evaluative devices, and produce more grammatical errors than NT children.

Aim 2: Based on prior research examining personal narratives (Brown & Klein, 2011), it was predicted that ToM ability would be positively associated with, and uniquely predictive of, personal narrative writing in all children at the micro and macrostructural levels.

Methods

Participants

Forty-four children between 8 and 14 years of age, served as participants in this study; 22 children with ASD (M_{age} = 11;03) and 22 NT children (M_{age} = 11;01). Participating children were native English speakers, and had an overall IQ greater ≥ 75 as established by the Weschler Abbreviated Scale of Intelligence (WASI-II; Weschler, 2011). Children were recruited from schools in the Midwestern region of the United States. See Table 1 for additional participant information.

The children with ASD had a clinical diagnosis previously established by medical evaluation with a pediatrician and/or a licensed clinical psychologist in accordance with the *Diagnostic and Statistical Manual of Mental Disorders* (APA, 2000, 2013). Children's diagnosis was confirmed with two widely used diagnostic screeners: the Childhood Autism Rating Scale, Second Edition (CARS-2; Schopler, Van Bourgondien, Wellman, & Love, 2010), and the Social Responsiveness Scale, Second Edition (SRS-2; Constantino & Gruber, 2012). See Table 1 for more information about children's symptom severity.

General Procedure

Following Institutional Review Board approval, informed consent was provided by children's parents, and verbal assent was obtained from each child. Children were tested in a quiet room at their school, at their home, or in our research lab depending on the wishes of the parent. Testing took place over two – four sessions depending on the child's needs and schedule.

Materials

Diagnostic Measures.—The CARS-2 (Schopler et al., 2010) is a behavior rating-scale used to aid in the identification of children with ASD and determine symptom severity based on experimenter observation and parent report. The CARS-2 has good internal consistency (Cronbach's $\alpha = 0.96$) and interrater reliability ($r = 0.95$; Schopler et al., 2010). The CARS-2 also has a strong association ($r = 0.77$) with the "gold standard" Autism Diagnostic Observation Schedule (ADOS; Schopler et al., 2010). Only children with ASD were assessed using the CARS-2.

The SRS-2 is a 65-item parent-report questionnaire (Constantino & Gruber, 2012) that assesses social awareness, motivation, anxiety/avoidance, social communication, and stereotypical behaviors or highly restricted interests, characteristic of ASD. The SRS-2 is correlated to gold standard diagnostic tools such as the ADOS and the Autism Diagnostic Interview-Revised, and has good internal consistency (.95; Bruni, 2014).

Standardized Assessments.—Children's intellectual functioning was assessed using the twosubtest version (FSIQ-2) of the WASI-II (Wechsler, 2011), which includes the Matrix Reasoning subtest (measure of non-verbal intelligence) and the Vocabulary subtest (measure of verbal intelligence). The FSIQ-2 version of the WASI-II has good test-retest (.93) and interrater reliability (.98-.99).

In order to assess children's oral language ability more comprehensively, children completed the four subtests that comprise the Core Language Score of the CELF-5 (Wiig et al., 2013). The Core Language Score is a standardized score that taps into expressive and receptive language, as well as children's knowledge of vocabulary and grammar. The Core Language Score has good reliability ($r = .96$).

Theory of Mind Measures.—In order to assess second-order false belief, the Birthday Puppy Story (Sullivan, Zaitchik, & Tager-Flusberg, 1994) was administered, which is a story about a mother who intentionally lies to her son about what she got him for his birthday in order to surprise him. The story was read aloud by the experimenter and accompanied by an illustration of the scenes being depicted. Two-dimensional cardboard figures were used to act out the story. Children were presented with three probe questions, two control questions, two test questions assessing ignorance and false-belief, and a justification question where children had to explain their response to the second-order false belief question. Children received a total score out of six on this assessment that included their answers to all questions, except the control questions.

Additionally, the Strange Stories Test (Happé, 1994) was administered, which consists of eight scenarios that assess children's higher order or advanced understanding of mental states. These stories measure the attribution of complex mental states underlying nonliteral utterances, such as sarcasm, white lies, and contrary emotions. Children's answers were scored for correctness (0 – 2), with a maximum score of 16. For reliability purposes, two experimenters double-coded 25% of these tests. Good interrater reliability (> .75; Cicchetti, 1994) was reached using intra-class correlations (ICC = .85). Finally, a total ToM score was

created by summing z-scores from the Birthday Puppy Test and the Strange Stories Test. This score was used in all subsequent analyses.

Writing Assessment.—Children were asked to write their personal narrative on the computer using a word processing program (Microsoft Word, 2016), with the spelling and grammar check functions turned off. The following personal narrative prompt was read aloud by the experimenter and provided as a reference during the task: "Write a story about a time that you had a problem or fight with another person or other people. It could be with a friend, sibling, parent, teacher, or another relative. Take time to think about and plan your story before you begin, including all elements of a good story. Write as much as you can." This specific prompt was adapted from Berman and Nir-Sagiv (2007) who used it with NT children and Brown and Klein (2011) who used it with adults with ASD. Moreover, we chose the content of this personal narrative prompt because past research has shown that children are better able to recall specific events in more detail if they are less routinized or scripted (e.g., day at school) because non-routinized events have more variation and are experienced less frequently (Hudson & Shapiro, 1991; Peterson & McCabe, 1983).

Children were asked to write for at least 15 minutes. However, many children refused to keep writing once they felt they were done. Mean time spent writing was 10 minutes 24 seconds (*SD* = 4 minutes 16 seconds), with a range of 5 to 22 minutes. "While children were writing, the experimenter noted whether they needed to (1) redirect the child's attention to the task, (2) use neutral prompting to help the child persist on the task (e.g., "Can you tell me/write anything else?"), or (3) neutral prompting to help with topic generation (e.g., "Can you think of a time when you have had a problem or fight with someone?"). Prompting was only used when necessary for children to get started with the writing assessment and stay on task for a set amount of time.

Coding of Text Variables

Children's texts were transcribed using the Systematic Analysis of Language Transcripts (SALT; Miller & Iglesias, 2016), and segmented into T-units (i.e., any independent clause and any clauses dependent on it; Hunt, 1965). To ensure reliability, 25% of all texts were double-transcribed by the first-author and a research assistant blind to diagnostic group. Overall agreement between coders was 88%. Microstructure and macrostructure variables were selected for their comparability to prior studies on writing and oral narration in ASD. Selected variables were also based on recommendations outlined by Scott (2009) in her review of language-based writing assessments. Children's texts were coded for the following aspects of writing (see Table 2 for additional details).

Microstructure:

1. Lexical complexity (frequency of large words)
2. Syntactic complexity (subordination index and syntactic diversity)
3. Frequency of grammatical errors (Scott & Windsor, 2000)
4. Frequency of writing convention errors (punctuation, spelling, capitalization errors)

5. Frequency of evaluative devices (e.g., character speech, sound effects, mental states; Losh & Capps, 2003)

Macrostructure:

6. Productivity (total number of T-units)
7. Quality (holistic ratings of coherence, structure, and content; Brown, 2013)
8. Personalization (whether narratives were focused on a specific, temporally sequenced event in which the child was the protagonist; Losh & Capps, 2006)

Information regarding text productivity was obtained through automated SALT analyses. The remaining variables were coded by the first author and a research assistant blind to diagnostic group, and good inter-rater reliability was established ($ICC_{avg.}$ = .89; ICC range = .75 – 98). To reduce the risk of Type 1 errors, total scores were created for writing conventions and quality. The decision to form these totals was supported by good inter-item reliability between the individual variables (writing conventions: α = .83; quality: α = .94). All other text features were analyzed individually.

Data Analysis

Demographic Comparisons.—Following the guidelines of Kover and Atwood (2013), children with ASD and NT children were matched on chronological age and parent reported year in school (p > .50 and small effect sizes). Children with ASD and NT children were similar in terms of race/ethnic identity and gender, as well as FSIQ, nonverbal intelligence (WASI-II Matrix Reasoning subtest), and verbal intelligence (WASI-II Vocabulary subtest). Groups were also similar on the CELF-5 Core Language Score and the two subtests from the Core Language Score that all children completed: Formulated Sentences and Recalling Sentences. Similarity was defined as ps > .08 and small to medium effect sizes. As expected, children with ASD did have significantly higher T-scores on the SRS-2. Means, standard deviations, and results of significance testing can be found in Tables 1 and 3.

Aim 1.—Data were first checked for homogeneity of variance and normality of distribution. Levene's test revealed that unequal variance was present for several writing variables (e.g., subordination index), and Shapiro-Wilks tests revealed that some variables were non-normally distributed (e.g., frequency of large words), although histograms revealed similar shaped distributions for both groups on these variables. For these reasons, we used Mann-Whitney U tests to compare the personal narrative writing of children with ASD and NT children for all continuous variables: lexical complexity, subordination index, syntactic diversity, frequency of writing convention errors, frequency of evaluation, productivity, and quality (Tabachnick & Fidell, 2007). Chi-square analyses were used to examine whether the narratives produced by children with and without ASD differed in terms of personalization, and in their need for experimenter assistance (i.e., prompting, topic generation, and attention redirection). Effects sizes were interpreted as small (d = .2; phi = .1), medium (d = .5, phi = .3), and large (d = .8, phi = .5). Post-hoc power analyses were conducted using G*power (Faul, Erdfelder, Lang, & Buchner, 2007). For analyses using Mann-Whitney U tests, there was a 73% chance of detecting a large effect with a normal distribution, and an 89% chance

of detecting a large effect when using a Laplace distribution (for data with kurtosis). There was a 91% chance of detecting a large effect when using Chi-square analyses.

Aim 2.—First, we examined performance on the ToM tasks to see whether children passed the control questions on the Birthday Puppy Test. Although, four out of the 22 children with ASD failed either the nonlinguistic or the linguistic control question on the Birthday Puppy Test, these children demonstrated some understanding of ToM based on their correct answers on other questions of this task, or demonstrated awareness of higher-order ToM concepts elicited via the Strange Stories Test. Therefore, we elected to keep these children in subsequent analyses. Second, we conducted Spearman correlations to examine whether chronological age, FSIQ, language, and ToM were associated with personal narrative writing.

However, because it is well-established that ToM is dynamically related to oral language ability during childhood (Miller, 2006) and this ability improves with age, multiple regression analyses were then conducted in order to determine which factors (i.e., diagnostic group, age, oral language ability, ToM) uniquely predicted children's writing skills. This allowed us to explore whether significant associations between ToM and writing were perhaps the result of shared language demands or improvement with age. Although FSIQ may also influence ToM, FSIQ was not included in the model due to limited power and its strong association with language ability in children with ASD ($r(20) = .80$, $p = .0001$). Prior to analyses, we confirmed that our data fit all necessary assumptions (i.e., linear relationships, multivariate normality, no multicollinearity, and homoscedasticity). Given the number of text variables which increases the likelihood of false discovery, regression analyses were only conducted on the continuous writing variables that differed significantly between children with and without children with ASD, as demonstrated by the analyses for Aim 1. Post-hoc power analyses using G*power revealed that with a four-predictor model there was an 86% chance of detecting a large effect ($f^2 = .35$).

Results

Aim 1: Comparing Personal Narrative Writing Skills in Children with and without ASD

Means, standard deviations, and the results of statistical testing for each writing variable are shown in Table 4. Mann-Whitney U tests revealed that at the microstructural level, children with ASD wrote personal narratives that were less syntactically diverse and contained more grammatical errors than NT children. At the macrostructural or text level, children with ASD wrote personal narratives that were rated lower in quality and were less likely to be personalized than those composed by NT children. In terms of personalization, 73% of children with ASD wrote personalized narratives compared to 100% of NT children. In contrast, the analyses demonstrated that children with ASD did not differ from NT children in terms of lexical complexity, subordination, frequency of writing convention errors, frequency of evaluation, and productivity. See Table 5 for examples of children's narratives.

There were also behavioral differences in writing performance between children with and without ASD that we did not anticipate. Specifically, children with ASD were more likely to

need attention redirection, additional prompting, and initial assistance with topic generation (Table 4).

Aim 2: Examining Associations Between Writing, Age, FSIQ, Language, and ToM

Chronological Age.—Spearman correlations in Table 6 show that chronological age was positively related to syntactic diversity, productivity, and quality ratings in children with ASD. Furthermore, for NT children, chronological age was positively related to syntactic diversity and productivity, and negatively related to writing convention errors.

FSIQ.—As shown in Table 6, FSIQ was negatively related to the frequency of large words used by children with ASD. No other significant correlations were found for the ASD group. For NT children, FSIQ was positively related to syntactic diversity, productivity, and quality, and was negatively related to writing convention errors.

Language.—Table 6 also shows that correlational analyses revealed that language ability, as measured by the Core Language Score, was negatively related to the frequency of large words and use of grammar errors, and positively related to the use of subordination in children with ASD. In addition, for NT children, oral language ability was positively related to the use of complex syntax (subordination index and syntactic diversity) and writing quality.

ToM.—As shown in Table 1, an independent samples t-test revealed that children with ASD scored lower than NT children on the ToM total z-score. Correlations revealed that ToM was positively related to syntactic diversity and subordination, as well as quality ratings for children with ASD. Moreover, ToM ability was negatively related to the frequency of large words in children with ASD. For NT children, ToM was only related to quality ratings. See Table 6 for correlation values.

Assessing Predictors of Personal Narrative Writing.—Multiple linear regression analyses were conducted to determine how diagnostic group (ASD, NT), chronological age, oral language ability (i.e., Core Language Score), and ToM ability uniquely predicted children's personal narrative writing. Separate analyses were conducted for each *continuous* writing outcome that differed between the two groups: syntactic diversity, grammatical complexity, and quality. See Table 7 for statistical information.

For both syntactic diversity and writing quality, the overall model accounted for a significant amount of variance (56% and 55%, respectively), $ps = .0001$, and both chronological age and ToM were significant, unique predictors of these writing outcomes, $ps < .007$. Specifically, children who were older and children who had better ToM skills wrote more syntactically diverse texts that were rated higher in quality. No significant results were found for the frequency of grammatical errors.

Discussion

Despite known difficulties in oral narration (e.g., Bangs et al., 2013; Losh & Capps, 2003), few studies have examined the personal narrative writing skills of children with ASD. Thus,

the present research used linguistic analysis to characterize and compare the personal narrative writing of children with ASD to NT children. Our findings revealed that children with ASD differed from NT children in several ways, and that ToM was an important mechanism for effective personal narrative writing in both children with and without ASD.

Comparing the Personal Narrative Writing of Children with and without ASD

When examining word level aspects of writing microstructure, findings revealed that the personal narratives of children with ASD were as lexically complex as those of the NT children. Moreover, children with ASD employed a similar frequency of evaluative devices as NT children. Although these results were unexpected based on our knowledge of oral narration in ASD (Losh & Capps, 2003; Tager-Flusberg & Sullivan, 1995), Reilly et al. (2017) also found that children with and without ASD did not differ in their use of evaluative devices when writing personal narratives. It may be that compared to telling stories orally, writing provided children with greater control over their linguistic output and more "off-line time to look for the appropriate words or for syntactic structures that provide a different perspective" (Drijbooms et al., 2017; p. 770).

At the sentence level, children with ASD wrote texts that were less syntactically diverse (i.e., used fewer different types of complex clauses) and had more grammatical errors than their NT peers. These results align with those of Reilly et al. (2017), who showed that children with ASD had greater difficulty using complex, diverse, and correct grammar compared to NT children. However, our findings are inconsistent with Brown and Klein (2011), who found no differences between adults with and without ASD for these aspects of writing. Together, these results suggest that some school-age children with ASD may still lack fluency with the basic grammatical structures and rules needed for writing, but that they may acquire these skills by adulthood. Nevertheless, children with ASD did not differ from their NT peers in their use of correct spelling, punctuation and capitalization.

At the macrostructural level, the personal narratives of children with ASD were rated lower in overall quality, indicating they had a more difficult time than NT children writing coherent stories that were well-structured and included enough information about the story setting, characters, and actions. This falls in line with our predictions and the findings from previous studies on narrative and non-narrative writing in children and adults with ASD (Brown & Klein, 2011; Brown, 2013; Reilly et al., 2017). Similar to oral narrative research (Losh & Capps, 2006), we found that a significant proportion of children with ASD (27%) wrote stories that were not personalized, or were not centered around one specific, temporally sequenced event. Challenges with writing also extended to the writing process more generally, as a greater proportion of children with ASD needed reminders to stay on task, additional neutral prompting to continue writing, and some assistance with generating an initial idea or topic from the experimenter. Similar difficulties have been noted in other studies. For instance, despite receiving average standardized writing scores, Siverston (2010) reported that the children with ASD had significant difficulty initiating and completing writing tasks.

Examining Predictors of Narrative Writing

Given the previously reported heterogeneity in written expression among children with ASD (e.g., Dockrell, Ricketts, Charman, & Lindsay, 2014), we also explored how age, FSIQ, language ability, and ToM knowledge were related to writing performance, and whether ToM uniquely predicted writing ability. Our findings indicated that age, FSIQ, language ability, and ToM were related to various dimensions of writing in both children with and without ASD.

Despite children with ASD having lower ToM scores, analyses revealed that all children with better ToM skills composed stories that were more coherent, structured, and elaborative. These results support the assertion that better ToM understanding can affect the writer's ability to take the perspective of the reader, and in turn lead to the inclusion of appropriate background information as well as explicit connections that lead the reader through the text (Colle et al., 2008; Loveland et al., 1990). Additionally, ToM uniquely predicted both writing quality and syntactic complexity *after* controlling for diagnostic group, language ability, and chronological age.

Nevertheless, our correlation results showed that writing performance may be more closely associated with ToM abilities in children with ASD. More specifically, children with ASD who had better perspective taking skills wrote more complex sentences that incorporated a wider range of subordinate clauses. This finding extends previous research which has linked the development of complex syntactic structures in expressive language to the mastery of ToM (de Villiers & de Villiers, 2014; Whyte, Nelson, & Scherf, 2014). Unexpectedly, children with ASD with lower ToM, FSIQ, and oral language abilities used more lexically complex words when writing their personal narratives; though no such associations were found for NT children. Given that large words tend to occur at a lower frequency, it may be that children with ASD with lower cognitive, language, and perspective taking skills are more likely to use idiosyncratic or overly formal language that is often characteristic of ASD (Rapin & Dunn, 2003; Volden & Lord, 1991).

As expected, children with and without ASD with better oral language abilities wrote personal narratives that were more syntactically complex. Additionally, NT children with better language skills wrote narratives rated higher in quality, and children with ASD with better language skills made fewer grammar errors. However, oral language ability was not associated with writing performance in children once diagnostic group, chronological age, and ToM ability were considered. With regards to chronological age, analyses revealed that age was a unique predictor of children's ability to write syntactically diverse, as well as coherent, well-structured and elaborative personal narratives. Older children with and without ASD also wrote longer personal narratives than their younger counterparts. Such results indicate that while children with ASD did have more difficulty with these aspects of writing than their peers, these skills are not immutable, but are able to improve with development. Finally, FSIQ was closely linked with writing performance in NT children (i.e., syntactic diversity, writing conventions, productivity, and quality), but only one association was found for children with ASD (i.e., lexical complexity).

Limitations and Future Directions

Despite providing insight into the writing difficulties of children with ASD, several limitations must be noted. Although we controlled for factors that may contribute to writing heterogeneity and used non-parametric tests when appropriate, substantial writing variability was still present among our relatively small sample that may have reduced our power to detect group differences and the generalizability of our results to a larger group of children. Therefore, significance level should be considered along with effect sizes. Moreover, it is important to note that while this study explored the role of age, ToM, and oral language, we did not address the influence that other factors (e.g., reading ability, socio-emotional development) may have on the writing skills of children given that it was beyond the scope of the study.

Additionally, writing performance can be influenced by a number of methodological factors, especially considering that there are few standardized guidelines for measuring writing in specific genres (Finnegan & Accardo, 2018). Performance may be affected by the specific topic selected for the writing prompt, as certain topics may be more or less difficult for children based on their skills, knowledge, or interests (Hidi & McLaren, 1991; Olinghouse et al., 2015). Although prompting was minimized and used primarily for procedural purposes, a greater amount of prompting was used with children with ASD. Additionally, children's writing profiles may also differ based on the specific variables and coding schemas that are selected. For example, there are a number of ways to assess personal narrative macrostructure (e.g., Narrative Assessment Profile, story grammar, high-point analysis; McCabe & Bliss, 2003) that may provide additional information about children's writing. Along the same lines, the majority of measures assessing narrative macrostructure, including the one used in the present study, do so using an Aristotelian or European American framework, where stories should have a beginning, middle, and end, and events are expected to be sequentially ordered and told with an individualistic orientation (Gorman, Fiestas, Pẽna, & Clark, 2011). Although this is the structure that is typically taught in U.S. classrooms, it will be important for studies to explore children's use of culturally infused creative and stylistic devices, as well as the implications of clinician and educator bias towards a specific narrative structure (Gorman et al., 2011). Finally, given that children were asked to "write on demand", it will be important for future research to examine whether these results would hold in more naturalistic settings where children are given the opportunity to engage in the writing process over time.

Conclusions

The current study provides evidence that children with ASD may experience challenges in their personal narrative writing in comparison to their NT peers. Specifically, children with ASD demonstrated some difficulties at the sentence and text level. At a more qualitative level, children with ASD were more likely to struggle getting started and staying on task compared to their NT peers. Age, FSIQ, language ability, and ToM knowledge were related to writing at the word, sentence, and text level for children with and without ASD, though the specific pattern of associations varied by group. Overall, our findings highlight the utility of taking a multidimensional assessment approach, capturing a variety of qualitative and quantitative writing outcomes and mechanisms related to writing. By doing so, clinicians

and educators may be able to use this information to develop more individualized, effective curricula and interventions to support the written expression goals of children with ASD.

Acknowledgements:

We would like to thank all the children, families, and staff at the schools who participated in this research study. We would also like to thank Drs. Cheryl M. Scott and Molly Losh for their input on the study design. Special thanks to Peyton Holleran for her help with transcription and coding. This study was supported in part by the Arthur J. Schmitt Foundation (Dissertation Fellowship in Leadership and Service, E. Hilvert, PI). Additional funding was provided by the NICHD (T32 HD07489, S. Hartley, PI). Portions of this research were presented at the annual meeting for the International Society for Autism Research, Rotterdam, Netherlands. The data were collected as part of the first author's doctoral dissertation.

References

American Psychiatric Association (2000). Diagnostic and statistical manual of mental disorders (4th ed.). Washington, DC: Author.

American Psychiatric Association (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Washington, DC: Author.

Bang J, Burns J, & Nadig A (2013). Brief report: Conveying subjective experience in conversation: production of mental state terms and personal narratives in individuals with high functioning autism. Journal of Autism and Developmental Disorders, 43, 1732–1740. doi:10.1007/s10803-012-1716-4 [PubMed: 23179342]

Barnes JL, Lombardo MV, Wheelwright S, & Baron-Cohen S (2009). Moral dilemmas film task: A study of spontaneous narratives by individuals with autism spectrum conditions. Autism Research, 2, 148–156. doi:10.1002/aur.79. [PubMed: 19575384]

Baron-Cohen S (2000). Theory of mind and autism: A review. International Review of Research in Mental Retardation, 23, 169–184. doi:10.1016/S0074-7750(00)80010-5

Baron-Cohen S, Leslie AM, & Frith U (1985). Does the autistic child have a "theory of mind"? Cognition, 21, 37–46. [PubMed: 2934210]

Berman RA (2008). The psycholinguistics of developing text construction. Journal of Child Language, 35, 735–771. doi:10.1017/S0305000908008787 [PubMed: 18838011]

Berman RA, & Nir-Sagiv B (2007). Comparing narrative and expository text construction across adolescence: A developmental paradox. Discourse Processes, 43, 79–120.

Berninger VW (2015). Interdisciplinary frameworks for schools: Best professional practices for serving the needs of all students. Washington, DC: American Psychological Association.

Berninger VW, & Abbott RD (2010). Listening comprehension, oral expression, reading comprehension, and written expression: Related yet unique language systems in grades 1, 3, 5, and 7. Journal of Educational Psychology, 102, 635–651. doi:10.1037/a0019319 [PubMed: 21461140]

Boucher J (2012). Research review: Structural language in autistic spectrum disorder- characteristics and causes. Journal of Child Psychology and Psychiatry, 53, 219–233. doi:10.1111/j.1469-7610.2011.02508.x [PubMed: 22188468]

Brown HM (2013). Academic achievement of children and adolescents with high-functioning Autism Spectrum Disorder with in-depth focus on written expression. University of Western Ontario: Electronic Thesis and Dissertation Repository.

Brown HM, Johnson AM, Smyth R, & Oram Cardy J (2014). Exploring the persuasive writing skills of students with high-functioning autism spectrum disorder. Research in Autism Spectrum Disorders, 8, 1482–1499. doi:10.1016/j.rasd.2014.07.017

Brown HM, & Klein PD (2011). Writing, Asperger syndrome, and theory of mind. Journal of Autism and Developmental Disorders, 41, 1464–1474. doi:10.1007/s10803-010-1168-7 [PubMed: 21207128]

Bruni TP (2014). Test review: Social Responsiveness Scale, Second Edition. Journal of Psychoeducational Assessment, 32, 365–369.

Byom LJ, & Mutlu B (2013). Theory of mind: Mechanisms, methods, and new directions. Frontiers in Human Neuroscience, 7, 1–12. doi:10.3389/fnhum.2013.00413 [PubMed: 23355817]

Cicchetti DV (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. Psychological Assessment, 6, 284–290. doi:10.1037/1040-3590.6.4.284

Colle L, Baron-Cohen S, Wheelwright S, & van der Lely HK (2008). Narrative discourse in adults with high-functioning autism or Asperger syndrome. Journal of Autism and Developmental Disorders, 38, 28–40. doi:10.1007/s10803-007-0357-5 [PubMed: 17345168]

College Entrance Examination Board. (2004). Writing: A ticket to work… or a ticket out. National commission on writing for America's families, schools, and colleges, 1–40.

Constantino JN, & Gruber CP (2012). Social Responsiveness Scale, Second Edition Los Angeles, CA: Western Psychological Services.

de Villiers JG, & de Villiers PA (2014). The role of language in theory of mind development. Topics in Language Disorders, 34, 313–328.

Dockrell JE, Ricketts J, Charman T, & Lindsay G (2014). Exploring writing products in students with language impairments and autism spectrum disorders. Learning and Instruction, 32, 81–90. doi:10.1016/j.learninstruc.2014.01.008

Drijbooms E, Groen MA, & Verhoeven L (2017). Children's use of evaluative devices in spoken and written narratives. Journal of Child Language, 44, 767–794. doi:10.1017/S0305000916000234 [PubMed: 27251485]

Faul F, Erdfelder E, Lang AG, & Buchner A (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods, 39, 175–191. [PubMed: 17695343]

Finnegan EG, & Accardo AL (2018). Written expression in individuals with autism spectrum disorder: A meta-analysis. Journal of Autism and Developmental Disorders, 48, 868–882. doi:10.1007/s10803-017-3385-9 [PubMed: 29164435]

Frith U (2001). Mind blindness and the brain in autism. Neuron, 32, 969–979. [PubMed: 11754830]

Gorman BK, Fiestas CE, Pẽna ED, & Clark MR (2011). Creative and stylistic devices employed by children during a storybook narrative task: A cross-cultural study. Language, Speech, and Hearing Services, 42, 167–181. doi:10.1044/0161-1461(2010/10-0052)

Happé FG (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. Journal of Autism and Developmental Disorders, 24, 129–154. [PubMed: 8040158]

Hidi SE, & McLaren JA (1991). Motivational factors and writing: The role of topic interestingness. European Journal of Psychology of Education, 6, 187–197.

Hilvert E, Davidson D, & Scott CM (2019). An in-depth analysis of expository writing in children with and without autism spectrum disorder. Journal of Autism and Developmental Disorders, 49, 3412–3425. doi:10.1007/s10803-019-04057-2 [PubMed: 31104260]

Houck CK, & Billingsly BS (1989). Written expression of students with and without learning disabilities: Differences across the grades. Journal of Learning Disabilities, 22, 561–568. [PubMed: 2809408]

Hudson JA, & Shapiro LR (1991). From knowing to telling: The development of scripts, stories, and personal narrative In McCabe A & Peterson C (Eds.), Developing narrative structure (pp. 89–136). Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.

Hunt KW (1965). Grammatical structures written at three grade levels (Research Report No. 3). Champaign, IL: National Council of Teachers of English.

King D, Dockrell JE, & Stuart M (2013). Event narratives in 11–14 year olds with autistic spectrum disorder. International Journal of Language and Communication Disorders, 48, 522–533. doi:10.1111/1460-6984.12025 [PubMed: 24033651]

Kover ST, & Atwood AK (2013). Establishing equivalence: Methodological progress in group-matching design and analysis. American Journal on Intellectual and Developmental Disabilities, 118, 3–15. doi:10.1352/1944-7558-118.1.3 [PubMed: 23301899]

Kushki A, Chau T, & Anagnostou E (2011). Handwriting difficulties in children with autism spectrum disorders: A scoping review. Journal of Autism and Developmental Disorders, 41, 1706–1716. doi:10.1007/s10803-011-1206-0. [PubMed: 21350917]

Losh M, & Capps L (2003). Narrative ability in high-functioning children with autism or Asperger's syndrome. Journal of Autism and Developmental Disorders, 33, 239–251. [PubMed: 12908827]

Losh M, & Capps L (2006). Understanding of emotional experience in autism: Insights from the personal accounts of high-functioning children with autism. Developmental Psychology, 42, 809–818. doi:10.1037/0012-1649.42.5.809 [PubMed: 16953688]

Loveland KA, Mc Evoy RE, Tunali B, & Kelley ML (1990). Narrative story telling in autism and Down's syndrome. British Journal of Developmental Psychology, 8, 9–23. doi:10.1111/j.2044-835X.1990.tb00818.x

Mayes SD, & Calhoun SL (2003). Ability profiles in children with autism. Autism, 6, 65–80. doi:10.1177/1362361303007001006

Mayes SD, & Calhoun SL (2006). Frequency of reading, math, and writing disabilities in children with clinical disorders. Learning and Individual Differences, 16, 145–157. doi:10.1016/j.lindif.2005.07.004

Mayes SD, & Calhoun SL (2008). WISC-IV and WIAT-II profiles in children with high-functioning autism. Journal of Autism and Developmental Disorders, 38, 428–439. doi:10.1007/s10803-007-0410-4 [PubMed: 17610151]

McCabe A, & Bliss L (2003). Eliciting and analyzing personal narrative In McCabe A & Bliss L (Eds.), Patterns of narrative discourse: A multicultural lifespan approach (pp: 3 – 20). Boston, MA: Allyn & Bacon.

McCabe A, Bliss L, Barra G, & Bennett M (2008). Comparison of personal versus fictional narratives of children with language impairment. American Journal of Speech Language Pathology, 17, 194–206. doi:10.1044/1058-0360(2008/019) [PubMed: 18448606]

Miller CA (2006). Developmental relationships between language and theory of mind. American Journal of Speech Language Pathology, 15, 142–154. doi:10.1044/1058-0360(2006/014) [PubMed: 16782686]

Miller J, & Iglesias A (2016). Systematic Analysis of Language Transcripts (SALT), Research Version. Middleton, WI: SALT Software, LLC.

Molitor SJ, Langberg JM, Bourchtein E, Eddy LD, Dvorsky MR, & Evans SW (2016). Writing abilities longitudinally predict academic outcomes of adolescents with ADHD. School Psychology Quarterly, 31, 393–404. doi:10.1037/spq0000143 [PubMed: 26783650]

Myles BS, Huggins A, Rome-Lake M, Hagiwara T, Barnhill GP, & Griswold DE (2003). Written language profile of children and youth with Asperger syndrome: From research to practice. Education and Training in Developmental Disabilities, 38, 362–369.

Olinghouse NG, Graham S, & Gillespie A (2015). The relationship of discourse and topic knowledge to fifth graders' writing performance. Journal of Educational Psychology, 107, 391–406. doi:10.1037/a0037549

Peterson C, & McCabe A (1983). Developmental psycholinguistics: Three ways of looking at a child's narrative. New York: Plenum.

Rapin I, & Dunn M (2003). Update on the language disorders of individuals on the autism spectrum. Brain Development, 25, 166–172. [PubMed: 12689694]

Reilly JS, Polse L, & Lai J (2017). Written narratives in children with autism In Segers E & van den Broek P (Eds.), Developmental perspectives in written language and literacy (pp. 379 – 398). Amsterdam: John Benjamins Publishing Company.

Schopler E, Van Bourgondien ME, Wellman GJ, & Love SR (2010). Childhood Autism Rating Scale, Second Edition Los Angeles, CA: Western Psychological Services.

Scott CM (2009). Language-based assessment of written expression In Troia GA (Ed), Instruction and assessment for struggling writers: Evidence-based practices (pp. 358–385). New York, NY: Guilford Press.

Scott CM, & Windsor J (2000). General language performance measures in spoken and written narrative and expository discourse of school-age children with language learning disabilities. Journal of Speech, Language, and Hearing Research, 43, 324–339.

Siverston K (2010). Stories from the spectrum: How special interest areas affect writing quality for students with autism spectrum disorders (Unpublished doctoral dissertation). University of Minnesota-Duluth, Minnesota, Duluth.

Slaughter V (2015). Theory of mind in infants and young children: A review. Australian Psychologist, 50, 169–172.

Sullivan K, Zaitchik D, & Tager-Flusberg H (1994). Preschoolers can attribute second-order beliefs. Developmental Psychology, 30, 395–402. doi:10.1037/0012-1649.30.3.395

Tabachnick BG, & Fidell LS (2007). Using multivariate statistics (5th ed.). Boston, MA: Allyn & Bacon/Pearson Education.

Tager-Flusberg H, & Sullivan K (1995). Attributing mental states to story characters: A comparison of narratives produced by autistic and mentally retarded individuals. Applied Psycholinguistics, 16, 241–256. doi:10.1017/S0142716400007281

Tager-Flusberg H (2007). Evaluating the theory-of-mind hypothesis of autism. Current Directions in Psychological Science, 16, 311–315. doi:10.1111/j.1467-8721.2007.00527.x

Troyb E, Orinstein A, Tyson K, Helt M, Eigsti I, Stevens M, & Fein D (2013). Academic abilities in children and adolescents with a history of autism spectrum disorders who have achieved optimal outcomes. Autism, 18, 233–243. doi:10.1177/1362361312473519 [PubMed: 24096312]

Volden J, & Lord C (1991). Neologisms and idiosyncratic language in autistic speakers. Journal of Autism and Developmental Disorders, 21, 109–130. [PubMed: 1864825]

Wechsler D (2011). Wechsler Abbreviated Scale of Intelligence, Second Edition San Antonio, TX: Pearson Assessments.

Wiig EH, Semel E, & Secord WA (2013). Children's Evaluation of Language Fundamentals, Fifth Edition San Antonio, TX: Pearson Assessments.

Whyte EM, Nelson KE, & Scherf KS (2014). Idiom, syntax, and advanced theory of mind abilities in children with autism spectrum disorders. Journal of Speech, Language, and Hearing Research, 57, 120–130. doi:10.1044/1092-4388(2013/12-0308).

Zajic MC, McIntyre N, Swain-Lerro L, Novotny S, Oswald T, & Mundy P (2018). Attention and written expression in school-age, high-functioning children with autism spectrum disorders. Autism, 22, 1–14. doi:10.1177/13623

Highlights

- Children with ASD showed narrative writing challenges at the sentence and text level.
- Children with ASD had greater difficulty getting started and staying on task.
- Theory of mind was related to syntactic diversity and writing quality.

Table 1

Demographic Information

	Children with ASD (n = 22)	NT Children (n = 22)	*t* / X^2	*p*	*d/phi*
Chronological Age	11;03 (2;00)	11;01 (1;08)	.37	.72	.11
(range)	8;06–14;11	8;01–13;11			
Male:Female	20:2	16:6	2.44	.12	.24
Racial/Ethnic Identity			6.65	.25	.39
African American	4.5%	9.1%			
Asian	4.5%	0.0%			
White	68.2%	68.2%			
Latino/Latina	9.1%	22.7%			
More than one race	13.7%	0.0%			
CARS-2 T-score[a]	50.63 (7.13)	-------			
Mild-to-moderate	63.6%	-------			
Severe	36.4%	-------			
SRS-2 T-score	72.44 (10.53)	47.76 (11.27)	7.03	.0001	2.26
Normal (59 or lower T-score)	0%	100%			
Mild (60 – 65 T-score)	25.0%	0%			
Moderate (66 – 75 T-score)	18.8%	0%			
Severe (76 or higher T-score)	56.2%	0%			
Year in School			1.59	.90	.19
Grade 3	27.4%	22.7%			
Grade 4	13.6%	9.1%			
Grade 5	13.6%	22.7%			
Grade 6	18.2%	27.3%			
Grade 7	13.6%	9.1%			
Grade 8	13.6%	9.1%			
Type of School			12.94	.0001	.54
Private alternative school[b]	45.5%	---			
Public or private school	54.5%	100%			

Res Autism Spectr Disord. Author manuscript; available in PMC 2021 January 01.

Note.

[a] A CARS-2 T-score of 50 indicates that symptomatology falls in at least the 50^{th} percentile compared to other individuals with ASD.

[b] Private schools that offer specialized, individualized education to children with developmental disorders.

Table 2

Description of Writing Variables

Writing Variable	Measurement	Definition
Lexical complexity	Frequency of large words	The number of words with seven or more letters divided by the total number of words (Brown et al., 2014; Houck & Bilingsly, 1989).
Syntactic complexity	Subordination index	The frequency of clauses/T-unit. Subordinate clauses referred to verb complements, adverbial clauses and relative clauses. Coordinated clauses with a deleted second co-referential subject were also counted for purposes of calculating the subordination index.
	Syntactic diversity	The number of different types of complex syntactic devices employed within the text (adverbial, relative, coordinated clauses and verb complements; max score = 4).
Writing conventions[a]	Frequency of punctuation errors	The total number of punctuation errors/number of T-units.
	Frequency of spelling errors	The total number of spelling errors/number of T-units.
	Frequency of capitalization errors	The total number of capitalization errors/number of T-units.
Grammatical errors	Frequency of grammar errors	The total number grammar errors/number of T-units. Errors included omitted obligatory tense markers or arguments, missing grammatical morphemes, wrong forms of verbs, pronoun number or case errors, difficulties with main and subordinate clause relationships, and utterance level-errors (Scott & Windsor, 2000).
Evaluation	Frequency of evaluation	Total number of evaluative devices/number of T-units. Evaluative devices included: (1) emotive/cognitive states and behaviors, (2) causality, (3) negatives, (4) hedges, (5) character speech/onomatopoeia/sound effects, (6) intensifiers, and (7) subjective remarks. See Losh & Capps (2003) for more information.
Productivity	Total T-units	Total number of T-units.
Quality[a] (score 0–12)	Coherence (0–4)	The degree to which ideas were connected, topic changes were smooth, and the writing was understandable.
	Structure (0–4)	The degree to which essential narrative structural elements existed in the text (i.e., initiating event, problem/conflict, plans, resolution, ending).
	Content (0–4)	The degree to which essential narrative background information was provided (e.g., setting, characters, story actions). These three coding schemas were adapted from Brown (2013).
Personalization	Frequency of personalized narratives	Personalized narratives, or stories, needed to have two or more temporally ordered clauses that were related from an evaluative perspective, and that focused on a specific event in which the child was the protagonist (Losh & Capps, 2006). Children received a score of 1 if their narrative was personalized, and a score of 0 if their narrative was not personalized.

Note.

[a]Children received total scores for the frequency of writing convention errors and quality.

Res Autism Spectr Disord. Author manuscript; available in PMC 2021 January 01.

Table 3

Means and Standard Deviations on Cognitive, Linguistic, and Theory of Mind Assessments

	Children with ASD (*n* = 22)	NT Children (*n* = 22)	*t*	*p*	*d*
WASI-II					
FSIQ-2[a]	92.86 (12.59)	98.55 (8.51)	−1.75	.09	.52
	75 – 118	84 – 113			
Vocabulary subtest[a]	45.32 (10.09)	49.82 (5.53)	−1.84	.08	.38
	29 – 63	39 – 60			
Matrix Reasoning subtest	45.91 (8.66)	48.73 (7.60)	−1.15	.26	.35
	30 – 58	34 – 64			
CELF-5[b]					
Core Language Score Standardized Score (*n* = 22; 22)[a]	93.46 (19.40)	99.81 (10.40)	−1.36	.18	.41
	62 – 133	79 – 118			
Formulated Sentences Scaled Score (*n* = 22; 22)	9.00 (4.24)	10.05 (3.50)	−.89	.38	.27
	2 – 15	1– 16			
Recalling Sentences Scaled Score (*n* = 22; 22)	8.00 (3.75)	9.22 (2.29)	−1.31	.20	.40
	2 – 15	5 – 13			
Semantic Relationships Scaled Score (*n* = 18; 20)	8.72 (2.82)	10.85 (1.98)	−2.71	.01	.87
	2 – 12	8 – 15			
Word Classes Scaled Score (*n* = 13; 16)	10.46 (4.24)	10.81 (2.64)	−.27	.79	.10
	3 – 17	7 – 16			
Understanding Spoken Paragraphs Scaled Score (*n* = 5; 4)	6.60 (2.07)	11.5 (1.29)	−4.10	.01	2.84
	5 – 10	10 – 13			
Word Structure Scaled Score (*n* = 4; 2)	7.75 (3.95)	5.50 (3.53)	.68	.54	.60
	3 – 11	3 – 8			
Sentence Comprehension Scaled Score (*n* = 4; 2)	9.50 (3.42)	7.50 (2.12)	.74	.50	.70
	5 – 13	6 – 9			
Theory of Mind					
Birthday Puppy Story (out of 6)	3.91 (1.87)	5.05 (.73)	−2.65	.0001	.80
Strange Stories Test (out of 16)	6.00 (3.90)	11.18 (2.11)	−5.31	.0001	1.65

	Children with ASD (*n* = 22)	NT Children (*n* = 22)	*t*	*p*	*d*
ToM z-score	−1.04 (2.09)	.96 (.83)	−4.19	.0001	1.26

Note.

[a]Unequal variance was present between the groups for FSIQ, WASI Vocabulary subtest, the Core Language Score, and ToM performance. Thus, results are adjusted for equal variances not assumed.

[b]In accordance with CELF-5 instructions, all children completed Recalling Sentences and Formulated Sentences. For the third and fourth Core subtests, 8-year-olds completed Word Structure and Sentence Comprehension, 9- to 12-year-olds completed Word Classes and Semantic Relationships, and 13-to 14-year-olds completed Semantic Relationships and Understanding Spoken Paragraphs. The Core Language Score is a standardized score ($M = 100$; $SD = 15$). All CELF-5 subtest scores are reported as scaled scores ($M = 10$; $SD = 3$).

Res Autism Spectr Disord. Author manuscript; available in PMC 2021 January 01.

Table 4

Means and Standard Deviations for Personal Narrative Writing Performance

Writing Variable	Measurement	Children with ASD (*n* = 22)	NT Children (*n* = 22)			
		M (SD)/*n*	M (SD)/*n*	*U*/X^2	*p*	*d*/phi
Microstructure						
Lexical complexity	Large words/total words	.09 (.01)	.11 (.01)	229.50	.77	.11
Syntactic complexity	Subordination index	1.60 (.65)	1.86 (.30)	177.00	.13	.49
	Syntactic diversity	2.05 (1.29)	2.86 (1.04)	154.00	.03*	.70
Grammatical errors	Grammar errors/T-units	.34 (.54)	.10 (.15)	134.50	.009*	.61
Writing conventions	Writing convention errors/T-units	2.33 (2.60)	1.18 (1.10)	194.50	.26	.58
Evaluation	Evaluative devices/T-units	.51 (.40)	.50 (.29)	230.50	.78	.03
Macrostructure						
Productivity	Total T-units	8.81 (6.54)	11.09 (7.81)	199.50	.32	.49
Quality (ratings 0 – 12)	Total quality rating	6.36 (4.28)	9.00 (2.51)	158.00	.05*	.75
Personalization	Proportion of personalized narratives	16 (73%)	28 (100%)	6.95	.008*	.40
Behavioral Differences						
Experimenter assistance	Needed attention redirection	5 (23%)	0 (0%)	5.64	.02*	.36
	Needed prompting	10 (46%)	2 (9%)	7.33	.007*	.41
	Needed help with topic generation	9 (41%)	1 (4.5%)	8.28	.004*	.43

Note.

* significant group difference

Table 5

Verbatim Examples of Personal Narratives Written by Children with and without ASD

Text 1: Neurotypical Child (Quality Score: 12)
"Once when I was in 1st grand I had a big fight with my best friend over prety much nothing. It started when I told him that my pokémon cards would cream him in a battle, so we had one. I creamed him and he got realy, realy, mad at me and ran away so fast that he droped his Charzard EX. I took it from the ground and kept it till the next day. When I gave it to him he fliped out that I had taken it, thinking that I had stolen it. When I tryed to tell him that I had tryed to give it to him the day before he refused to belive me and grabed it and took off. That was the last time I ever talked to him. When I moved here I became friends with Fred and whe have been best friends to this day."
Text 2: Child with ASD (Quality Score: 3)
"about trying to be first in line. I do not want to be last in line. because my stuff will be a mess. I'll feel angriest!"
Text 3: Child with ASD (Quality Score: 6)
"One time when I had a problem or a fight with someone is when I have to go the store with mom I don't liken it at all. One of the reasons why I don't like it is I can't access some of the things on my tablet in the car because there is no wifi connection in the car and I was hoping to do some of it. Another reason is it is not fun at all at the store there is nothing to do but shop and I'd rather be home playing my games than being at the store. Those are the reasons why I don't like the going to the store with mom during break."

Note.

Text 1 is an example of a writing sample produced by a NT child. Text 2 provides an example of a child with ASD who demonstrated challenges with writing at both the microstructure and macrostructure level. Text 3 provides an example of a child with ASD who had difficulty creating a personalized narrative that focused on one specific event, but used complex vocabulary and sentence structure. Texts are shown almost exactly as children typed them, including the grammar, spelling, capitalization, and punctuation errors. One exception to this is that all names have been changed for confidentiality purposes. Quality ratings ranged from 0 to 12.

Table 6

Correlations Between Personal Narrative Writing Skills, Age, FSIQ, Language, and Theory of Mind

	Children with ASD (n = 22)			
	Age	***FSIQ***	***Core Language Score***	***ToM***
Lexical Complexity	.34	**−.58** **	**−.56** *	**−.51** *
Subordination Index	.11	.27	**.46** *	**.58** **
Syntactic Diversity	**.49** *	−.02	.24	**.57** **
Grammar Errors	−.16	−.21	**−.44** *	−.37
Writing Convention Errors	−.39	.07	.03	.23
Evaluation	.05	.29	.31	.13
Productivity	**.61** **	−.13	−.13	.15
Quality	**.48** *	.21	.38	**.54** **
Personalization	.27	.14	.27	.37
	NT Children (n = 22)			
	Age	***FSIQ***	***Core Language Score***	***ToM***
Lexical Complexity	.14	−.03	−.21	−.13
Subordination Index	.39	.39	**.52** **	.34
Syntactic Diversity	**.69** ***	**.44** *	**.58** **	.36
Grammar Errors	.11	−.16	−.23	−.10
Writing Convention Errors	**−.42** *	**−.46** *	−.15	−.34
Evaluation	.18	.24	.36	.29
Productivity	**.74** ***	**.62** *	.40	.39
Quality	.40	**.65** **	**.59** *	**.48** *
Personalization[a]	---	---	---	---

Note.

[a]Spearman correlations between ToM and personalization were not examined for NT children as they all told personalized stories.

* $p < .05$;

** $p < .01$;

*** $p < .001$.

Table 7

Assessing Predictors of Personal Narrative Writing

Predictor	β	t	Sig.	Model	Adjusted R^2
Syntactic Diversity					
Diagnostic Group	.05	0.39	0.70	$F(4, 39) = 14.45$, $p = .0001$	.56
Chronological Age *	.45	4.24	0.001		
Core Language Score	.15	1.15	0.26		
Theory of Mind *	.47	2.83	0.007		
Grammar Errors	**β**	**t**	**Sig.**	**Model**	**Adjusted R^2**
Diagnostic Group	−.31	−1.60	0.12	$F(4, 39) = 1.61$, $p = .19$	.06
Chronological Age	−.14	−0.93	0.35		
Core Language Score	.02	0.08	0.94		
Theory of Mind	−.08	−0.32	0.75		
Quality	**β**	**t**	**Sig.**	**Model**	**Adjusted R^2**
Diagnostic Group	.05	0.36	0.72	$F(4, 39) = 12.28$, $p = .0001$	.55
Chronological Age *	.36	3.37	0.002		
Core Language Score	.21	1.56	0.12		
Theory of Mind *	.48	2.91	0.006		

Note.

*Significant predictor within the model.