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An In-Depth Analysis of Expository Writing in Children with and without Autism Spectrum Disorder

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Abstract

Using detailed linguistic analysis, this study examined the expository writing abilities of school age children with Autism Spectrum Disorder (ASD) in comparison to neurotypical (NT) children. Associations between executive functioning (EF) and writing ability in children with and without ASD were also explored. Compared to NT peers, children with ASD wrote shorter expository texts that contained more grammatical errors, and needed more assistance from the experimenter to complete the writing assessment. However, the texts of children with and without ASD did not differ in their lexical diversity, use of writing conventions, and overall quality. Analyses also revealed that greater EF was associated with better writing outcomes in both groups. Educational implications of these findings are discussed.

Keywords

Autism Spectrum Disorder; Writing; Expository; Executive Functioning

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Writing is a skill that is needed throughout the lifespan. Beginning in the grade school years, effective writing skills are necessary at all levels of schooling in order for students to

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demonstrate their acquired knowledge in the classroom (Graham & Harris, 2004). Later, writing skills will be important outside of the classroom, especially for high-skill, high-wage jobs (College Entrance Examination Board, 2004). Additionally, with the prevalence of online communication and social media platforms, writing skills are needed for engaging in effective social interactions with others (Magnifico, 2010). Because writing is a complex skill that relies on the simultaneous coordination of a number of processes many children, including those with developmental disorders such as Autism Spectrum Disorder (ASD), may struggle with writing (Boucher & Oehler, 2013). Specifically, children with ASD will often demonstrate impairments in structural language (Eigsti, de Marchena, Schuh, & Kelley, 2011), fine-motor abilities (e.g., handwriting; Kushki, Chau, & Anagnostou, 2011), and attention/executive functioning (Demetriou et al., 2018), all domains that are essential for writing. The social-communicative and perspective-taking challenges (Baron-Cohen, 2000) that children with ASD face can also pose problems given that good writing requires the consideration of a "distant" audience.

However, despite the importance of writing for academic, occupational, and social success, relatively little is known about the extent and nature of writing difficulties in children with ASD, especially compared to other domains of language. To date, most research on writing ability in children with ASD has used standardized assessments. When using these tests, several researchers have reported a discrepancy in ability profiles with children's writing scores being significantly lower than their full-scale IQ (FSIQ; e.g., Mayes & Calhoun, 2006, 2008; Zajic et al., 2018). In fact, as many as 60% of children with ASD and normal intelligence may demonstrate such a discrepancy (Mayes & Calhoun, 2006). Although these assessments provide a quick and valuable evaluation of a child's general writing ability, one drawback is that they often aggregate performance across various skills, reducing their ability to detect more nuanced, and perhaps educationally meaningful, differences in writing performance.

To avoid this limitation, several recent studies have used more detailed linguistic approaches to characterize how real texts constructed by individuals with ASD specifically align or deviate from neurotypical children (NT). These studies have found that individuals with ASD have greater difficulty writing high quality texts, which includes topic maintenance and developing ideas in a coherent and hierarchically organized manner (Brown, 2013; Brown & Klein, 2011; Brown, Johnson, Smyth, & Oram Cardy, 2014). At a more micro level, there is evidence that children with ASD write texts that are less lexically and syntactically complex compared to NT children (Brown et al., 2014; Reilly, Polse, & Lai, 2017). Moreover, a minority of children with ASD may be unable or refuse to produce written texts altogether (Dockrell, Ricketts, Charman, & Lindsay, 2014). While these studies are helpful in expanding our understanding of writing beyond standardized test performance, most of the text-based analyses of writing in indviduals with ASD have focused on narrative writing, with other genres (e.g., expository) less likely to be studied (Brown, 2013; Dockrell et al., 2014; Reilly et al., 2017).

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Expository Writing in Individuals with ASD

Genre is an important factor to consider when examining the written expression skills of school-age children because different genres serve different communicative purposes and require different types of organizational structure and content. In elementary and secondary education settings, the most commonly used style of writing is expository, which refers to the academic, informational language used to explain, describe, or inform others about a topic. In fact, expository text makes up the majority of informational content children consume during the school day, and is the primary way in which children then demonstrate their acquired knowledge of that content (Nippold, 2016; Scott, 2010). As a result, the ability to comprehend and create elaborate expository texts is critical to the academic success of school age students.

Across the various subgenres (e.g., descriptive/informational, comparison, cause and effect), expository texts are generally hierarchically and locally organized by a central proposition or thesis, which is followed up with qualifications, elaborations, and examples (Scott, 2010). Research has shown that typically developing children's ability to explain these ideas coherently using appropriate thematic structure begins to develop around 9 years of age and continues throughout secondary schooling (Berman, 2008). In order to draw such logical connections between ideas, make comparisons and so forth, children need to combine clauses together to create longer and more complex sentences (Scott, 2010). As such, children tend to use more advanced and formal language devices when writing expository essays compared to other styles of writing, such as narratives (Lundine & McCauley, 2016). Because of these conceptual and linguistic requirements, expository writing may be particularly challenging for children with ASD.

To our knowledge, only one study has taken a detailed approach to examining expository texts written by individuals with ASD. Brown and Klein (2011) examined the expository writing skills of adults with ASD and NT adults by asking them to write an essay about "problems between people". Three overall writing measures were obtained: a productivity composite (e.g., total words, sentences, clauses), a mechanics composite (e.g., syntactic and lexical complexity, spelling and grammatical errors), and a quality composite (e.g., ratings of text structure, content, coherence). Brown and Klein (2011) found that adults with ASD wrote expository texts that were lower in overall quality than NT adults, especially in terms of how coherent the texts were. In contrast, no group differences were found for the productivity or mechanics composites.

These difficulties with text quality may reflect impairments that individuals with ASD have with pragmatics (Eigsti et al., 2011), as writing requires considerable pragmatic sophistication. Pragmatic deficits may impact the ability to consider or presuppose a reader's prior knowledge or what type of information the reader would need to know for a text to make sense. This may in turn directly affect the relevance, appropriateness, and coherence of the information provided by individuals with ASD, leading to texts that are lower in quality, as shown by Brown and Klein (2011). Given the potential associations between pragmatics and writing quality, as well as documented pragmatic deficits in both adults and children with ASD, we would expect to see quality differences in the expository writing of children

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with ASD. Whether the lack of microstructural differences (word and sentence level features) between adults with ASD and NT adults (Brown & Klein, 2011) would hold for the same comparison in children is unclear.

Impairments in structural language are common in children with ASD (see Eigsti et al., 2011; Tager-Flusberg, Edelson, & Luyster, 2011, for reviews). Thus, in the present study, we were interested in examining whether deficits with word and sentence level aspects of expository writing would be present, or whether a similar pattern of findings as Brown & Klein (2011) would hold true for children with ASD. Given that impairments in structural language are often more pronounced in childhood than adulthood for those with ASD (Levy & Perry, 2011), many school-age children with ASD may still lack fluency with the basic syntactic and lexical structures needed for writing, let alone the more uniquely "written" structural features that begin to characterize the expository writing of NT children by mid-elementary grades and beyond (Scott, 2010).

Although research has yet to examine whether microstructural features of expository writing would be difficult for children with ASD, a study on persuasive writing in adolescents with ASD points to this possibility (Brown et al., 2014). Persuasive text structure is similar to expository text structure to the extent that children are expected to provide a thesis statement followed by details organized into subordinate categories. However, instead of providing descriptive information about a specific topic, the writer must also try and convince others to agree with their viewpoint on the topic (Nippold & Ward-Lonergan, 2010). Brown et al. (2014) found that children with ASD wrote persuasive essays that not only differed in overall quality, but were slightly shorter and reduced in syntactic complexity compared to NT children. Given these results, it may be that children with ASD also demonstrate both quality and structural (i.e. word and sentence level) difficulties with expository writing.

Executive Functioning and Writing

According to Berninger's multidimensional model of writing development, not only does the writing system interact with our other language systems throughout development (Berninger, 2015; Berninger & Abbott, 2010), but it is also largely dependent on the executive functioning (EF) system (Berninger, Abbott, Cook, & Nagy, 2017). EF refers to the mental processes that enable us to plan, focus our attention, remember information, as well as monitor and adapt to changing situations (Diamond, 2013). EF ability includes but is not limited to, working memory, cognitive flexibility, inhibition, and problem-solving (Diamond, 2013; Kenworthy, Yerys, Anthony, & Wallace, 2008). Research on writing development in NT children has demonstrated that in order to write well, children need to recruit lower-level EFs (e.g., inhibition, cognitive flexibility), as well as higher-level EFs for planning, translating cognitions into language, reviewing, and revising during text construction (e.g., Berninger et al., 2017). In fact, of the various ways in which language is accessed or expressed (e.g., speaking, listening, reading), writing may require the greatest involvement of our EF system (Berninger et al., 2017). Moreover, EF becomes especially critical to writing success as children move through school and the tasks become more demanding and complex (Graham, Harris, Olinghouse, 2007).

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Such findings are important because recent meta-analytic research shows that individuals with ASD generally perform at lower levels on instruments designed to measure various EF parameters than their NT counterparts (Demetriou et al., 2018). Therefore, for children with ASD, reduced EF ability may contribute to the difficulties they experience in writing. Support for this hypothesis can be found in Zajic et al. (2018), who examined the specific role of attention disturbance on the writing of children with ASD. In their research, children with ASD who exhibited high levels of ADHD symptoms had lower, overall standardized writing scores than NT children. In contrast, scores of children with ASD with low levels of ADHD symptoms did not differ from NT children. Moreover, Dockrell et al. (2014) found that children with ASD with higher verbal working memory had a better grasp on foundational writing skills (i.e., handwriting fluency, spelling). Although limited, these studies provide evidence that EF ability, or the lack thereof, may be highly associated with writing impairments in children with ASD.

Overview of the Current Study

Despite research indicating children with ASD tend to have a high frequency of learning disabilities in writing (e.g., Mayes & Calhoun, 2006), studies that have characterized the writing ability of children with ASD, especially in the expository context, are limited. Therefore, the first objective of the present study was to examine the expository writing skills of children with and without ASD at both macro- and microstructural levels using fine-grained linguistic analysis. Using a prompt tied to a self- chosen interest, the resulting expository texts of 8- to 14-year-old children with ASD were compared to those of their NT peers on a number of text variables, including productivity, syntactic complexity, lexical complexity, frequency of grammatical errors, use of writing conventions (e.g., punctuation, spelling, capitalization), and overall quality. In line with Brown and Klein (2011), it was hypothesized that children with ASD would write expository texts that were rated lower in quality. However, it was unclear whether writing difficulties would also extend to word and sentence level features of writing, such as syntactic and lexical complexity, and the frequency of errors.

The second goal of this study was to explore whether EF is an underlying cognitive mechanism that may be contributing to differences in expository writing profiles between children with and without ASD. To address this aim, we examined relations between writing performance and EF, and whether EF uniquely predicted writing ability when accounting for diagnostic group, chronological age, and oral language ability. When measuring EF, Kenworthy et al. (2008) suggest using a multi-method (i.e., parent/teacher report and experimental tasks), multi-trait approach (i.e., assessing more than one domain) in order to fully capture children’s EF abilities. Based on this recommendation, children were evaluated using a parent report measure and a performance-based measure that assess multiple EF constructs. It was expected that children with ASD would have greater EF impairments compared to NT children, and that children with ASD with stronger EF skills would demonstrate better writing at the word, sentence, and text level than those with weaker EF skills (e.g., Zajic et al., 2018).

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Methods

Participants

Fifty-seven children were recruited to participate in the present study. However, our initial evaluation of the data revealed that a small number of students with ASD (*n* = 5) either refused to write or would only dictate to the experimenter what they would like to say. These children were excluded from all subsequent analyses. As such, the final sample of participants included a total of 52 children between 8 and 14 years of age; 24 children with ASD (M_{age} = 10;09) and 28 NT children (M_{age} = 10;08). All children had an overall FSIQ greater > 70, as established by the Wechsler Abbreviated Scale of Intelligence (WASI-II; Wechsler, 2011), were native English speakers as determined through parent report, and were part of a larger study examining writing development. Children were recruited from local school districts in two Midwestern cities in the United States. See Table 1 for additional participant information.

All children with ASD had a clinical diagnosis previously established by a pediatrician and/or a licensed clinical psychologist in accordance with the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (American Psychiatric Association, 2013), and met the criteria for ASD as outlined by the Individuals with Disabilities Education Improvement Act (Individuals with Disabilities Education Act; 2004). Based on school report, all children with ASD were receiving services for their diagnosis through an Individualized Education Program. An ASD diagnosis was further corroborated for purposes of the present study with two widely used diagnostic tools: 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). The CARS-2 is a behavior rating-scale used to help identify children with autism and determine symptom severity based on experimenter observation and parent report. The CARS-2 has a high degree of internal consistency (Cronbach's α = 0.96) and good interrater reliability (r = 0.95), as well as a strong association (r = 0.77) with the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 1999), a common, gold standard diagnostic assessment. Only children with ASD were assessed using the CARS-2. Fifteen children with ASD had mild-to-moderate symptoms, and nine had severe symptoms.

The SRS-2 is a 65-item parent-report questionnaire (Constantino & Gruber, 2012) that assesses social awareness, motivation, anxiety/avoidance, the capacity for reciprocal social communication, and stereotypical behaviors or highly restricted interests characteristic of ASD. The SRS-2 is able to differentiate individuals along a continuum of severity of social impairments, and is also related with gold standard diagnostic tools such as the ADOS and the Autism Diagnostic Interview, Revised (Bruni, 2014). All parents were asked to complete the SRS-2. Five children with ASD had a mild social impairment (60 – 65 T-score), four had a moderate social impairment (66 – 75 T-score), and nine had a severe social impairment (T-score ≥ 76). Despite continued efforts, six parents of children with ASD did not fill out the SRS-2 questionnaire. However, no differences in chronological age, $t(22) = 1.80$, $p = .09$, CARS-2 scores, $t(22) = 1.35$, $p = .19$, or FSIQ, $t(22) = -.43$, $p = .67$, were found between

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children with and without SRS-2 scores. All NT children fell below the threshold for ASD symptoms (T-score ≤ 59).

Comparisons between Participant Groups

As shown in Table 1, children with ASD did not differ from NT children in terms of chronological age, sex, race/ethnic identity, or nonverbal IQ as measured by the WASI-II Matrix Reasoning. However, children with ASD scored lower on FSIQ and verbal IQ (WASI-II Vocabulary Subtest). Moreover, children with ASD had lower Core Language Scores from the Clinical Evaluation of Language Fundamentals, Fifth Edition (CELF-5; Wiig, Semel, & Secord, 2013), and higher SRS-2 T-scores compared to NT children (see Table 1).

Measures

Intellectual Functioning—Intellectual functioning was measured using the WASI-II (Wechsler, 2011). The two-subtest version (FSIQ-2) was administered, which is comprised of the Matrix Reasoning (measure of non-verbal intelligence) and Vocabulary subtests (measure of verbal intelligence). The FSIQ-2 has good test-retest reliability (.93), and interrater agreement for these subtests is high (.98-.99; Wechsler, 2011).

Language Ability—Children's structural language ability was assessed using the CELF-5 (Wiig et al., 2013). The CELF-5 is a standardized measure of language ability that assesses oral language across a variety of domains. The four subtests that comprise the Core Language Score were administered. 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 has good sensitivity and specificity (.97) at identifying children with a language disorder (standard score of 85 or less).

Executive Functioning—Based on Kenworthy et al.'s (2008) recommendation to use a multi-method, multi-trait approach, two EF assessments were administered: a parent report measure and a performance-based measure. Specifically, parents of all children were asked to complete the parent-report form of the Behavior Rating Inventory of Executive Function, Second Edition (BRIEF-2; Gioia, Isquith, Guy, & Kenworthy, 2015). The BRIEF-2 is an 86-item standardized parent questionnaire that taps into everyday behaviors and activities associated with EF. The overall Global Executive Composite (GEC) score was used in the present study, and captures information about behavior, emotion, and cognitive regulation. Higher scores on the GEC indicate greater executive dysfunction. The BRIEF-2 has good internal consistency (.80–.98) and test-retest reliability (.82; Gioia et al., 2015).

EF skills were also assessed through direct experimental evaluation using the Wisconsin Card Sorting Task-64 Card Version (WCST-64; Kongs, Thompson, Iverson, & Heaton, 2000). The WCST-64 is a widely-used measure of EF that taps into a broad number of skills (e.g., working memory, problem- solving), but is primarily used to measure cognitive

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flexibility (Kenworthy et al., 2008). During this task, stimulus or target cards are placed in front of the child, and the child is asked to match a response card to a stimulus card according to the current matching principle (e.g., color). Children must determine the matching principle solely based on feedback from the experimenter (i.e., match was correct or incorrect). Once a child achieves 10 consecutive correct matches, the experimenter changes the matching principle. The Perseverative Errors standard score was used to assess cognitive flexibility, with a higher score indicating better cognitive flexibility. Errors are classified as perseverative when the child continues with the previously correct matching principle despite negative feedback.

Writing Assessment—Each child was asked to compose one expository essay on a computer using a word processor with spelling and grammar check turned off. Children were asked to complete the writing task on the computer because previous research has demonstrated that many children with ASD have substantial handwriting impairments (Kushki et al., 2011), and that some of these children refuse to produce handwritten texts (Dockrell et al., 2014). Completing writing tasks on the computer can provide a successful alternative to writing by hand for children with ASD (Coffin, Smith Myles, Rogers, & Szakacs, 2016).

The following expository prompt was read aloud by the experimenter and provided on paper to the child to use while writing: "Choose a topic that is interesting to you, and that you know something about. It can be a favorite object, place, or activity. Imagine you have been asked to write a report about that topic. Decide on what is most important about that topic and then write an essay including that information. Please take time to think about and plan your essay before you begin, including all elements of a good essay. Write as much as you can." The wording of this prompt was adapted from Olinghouse, Graham, and Gillespie (2015). However, unlike Olinghouse et al. (2015), children chose a topic that was "interesting to them and they knew something about" instead of writing a descriptive essay about outer space. We chose to leave the topic choice up to the child to minimize differences in declarative knowledge.

Children were asked to write for at least 15 minutes, but they could have more time if needed. If children finished before this time was up, the experimenter asked the child to try to work on their writing a little longer. However, many children refused to keep writing once they felt they were done, and spent an average of 10 minutes writing. While children were writing, the experimenter noted several observations, including: (1) whether the experimenter needed to redirect the child's attention to the task, (2) whether the experimenter needed to use neutral prompting to help the child persist on the task (e.g., "What else can you tell me about the topic you selected?"; "What else do you know about your topic?"), and (3) whether the child needed help generating ideas to get started. For the latter, the experimenter would reframe the prompt into a question, such as "What is your favorite activity/object/place? Do you have a favorite object/place/activity?", in an effort to help the child generate an idea out loud.

Coding of Text Variables—Prior to analysis of study samples, the first author and trained research assistant blinded to diagnostic group established acceptable coding reliability

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(80%) on practice files. Children's writing compositions were then transcribed using the Systematic Analysis of Language Transcripts (SALT; Miller & Iglesias, 2018). Twenty-five percent of all writing samples were double-transcribed and coded by the first-author and the trained research assistant. The unit of segmentation chosen was the T-unit, which refers to any independent clause and any clauses dependent on it (Hunt, 1965). Overall agreement between the two coders on what constituted a T-unit was 87.41%. All texts were then coded on variables that assessed productivity, lexical complexity, syntactic complexity, frequency of grammatical errors, frequency of writing conventions errors, and overall quality. Automated SALT analyses provided information on the total number of words, total T-units, and number of different words. For the remaining variables coded by hand, good inter-rater reliability (> .75; Cicchetti, 1994) between the first author and the research assistant was established using intra-class correlations (ICC; range = .80 – 98; ICC_{avg} = .89). The ICCs were as follows: frequency of long words (.98), frequency of rare words (.94), subordination index (.80), syntactic diversity (.95), frequency of writing convention errors (.94), frequency of grammatical errors (.90), and quality-related variables, i.e., coherence (.87), structure (.80), and content (.87).

Productivity—Children's productivity, or fluency was quantified in two ways: (1) the total number of words in a text and (2) the total number of T-units in a text.

Lexical Complexity—Three measures of lexical complexity were obtained: (1) lexical diversity, (2) frequency of long words, and (3) frequency of rare words. Lexical diversity was measured with the number of different words (NDW) per 50 words. NDW was determined for the first 50 words to reduce issues that could arise when sampling from texts of varying lengths. However, only 16 children with ASD and 20 NT children produced texts with 50 or more words, and therefore only those children were included in the NDW analysis. Frequency of long words reflects the number of words with seven or more letters divided by the total number of words. Frequency of rare words was determined by counting the number of words that are considered very rare according to the Corpus of Contemporary American English (i.e., words that had a frequency rating of greater than 3000; Davies, 2010) divided by the total number of words.

Syntactic Complexity—Syntactic complexity was measured using two variables: (1) the subordination index and (2) the diversity of complex syntax. The subordination index, or the number of clauses per T-unit, specifically reflects the degree of clausal subordination in a text. In this study, 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 was determined by counting the number of different types of complex syntactic devices employed within the text (i.e., verb complements, adverbial clauses, relative clauses, and coordinated clauses; maximum score = 4).

Grammatical Errors—Using Scott and Windsor's (2000) coding scheme, grammatical errors were defined as any error that rendered a T-unit ungrammatical. This included omitted obligatory tense markers, missing grammatical morphemes (e.g., articles), wrong forms of

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verbs, pronoun number or case errors, omission of obligatory arguments, difficulties with main and subordinate clause relationships, and utterance level-errors (e.g., word order errors). The number of errors was divided by the total number of T-units to determine the error ratio.

Writing Conventions—The frequency of writing conventions errors included the frequency of punctuation, spelling, and capitalization errors that were present in children's writing. The frequency of each respective error was determined by dividing the number of each error by the number of T-units.

Quality—Similar to past writing research (e.g., Brown et al., 2014; Brown & Klein, 2011), coding rubrics were used to evaluate children's texts for three aspects of writing quality: (1) coherence, (2) structure, and (3) content. These coding schemas were the same or modified versions of those designed and used by Brown et al. (2014). All three quality-related variables were coded on a 5-point scale from 0 to 4, 0 being the least proficient and 4 being the most proficient.

1. Coherence: This rating scale provided a measure of the degree to which children's ideas were connected, topic changes were smooth, and the writing was understandable to the reader (see Brown et al., 2014, for a complete description).

2. Structure: Using a modified version of Brown et al.'s (2014) rating system, the degree to which essential expository macrostructural or organizational elements existed (i.e., an introduction to the topic, supporting details about a topic, and a conclusion) was assessed. At the least proficient level (score = 0), children's texts included a few simple sentences that may have been unrelated or related to the topic, but there was no thesis statement or conclusion. At the most proficient level (score = 4), children's texts started to resemble a multi-paragraph essay, with a thesis statement, sections containing distinct subordinate categories with supporting details/explanations, and a conclusion.

3. Content: Also using a modified version of Brown et al.'s (2014) rating system, the coding rubric for *content* assessed the degree to which an appropriate amount of background information was provided, which included children's description or expansion of ideas about the main topic of their expository essay. Specifically, the coding rubric provided information about the extent to which children's discussion of the subordinate categories or supporting details in their essays were developed. At the least proficient level (score = 0), children provided a list of details, all or most of which were not directly related to the topic or one another. At the most proficient level (score = 4), children included three or more subordinate categories, two of which showed good development through supporting details/explanations.

General Procedure

Prior to the start of the study, approval was obtained from the Institutional Review Board at the host university. Informed consent was also obtained from children's parents, and all children provided verbal assent before testing began. Children were tested in a quiet area at

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either their school, home, or in our research lab, depending on parents' wishes. Based on the child's needs and school or parent requests, testing took place over two to four sessions.

Data Analytic Plan

Research Aim 1—To address our first aim, one-way analysis of co-variance (ANCOVA) was conducted with Diagnostic Group (ASD, NT) as the between-subjects variable, and chronological age and FSIQ as covariates. Age was included as a covariate given the broad age range (8–14 years) of the children in the study. FSIQ was chosen as the other covariate as it included the Vocabulary Subtest score and was correlated with the CELF-5 Core Language Score, $r(50) = .74$, $p = .0001$.

To minimize the possibility of committing Type 1 errors, several composite scores were obtained by combining the Z-scores of variables that were conceptually similar. By doing so, we obtained a productivity composite (total words and total T-units), a writing conventions composite (frequency of spelling, punctuation, and capitalization errors), and a quality composite (ratings of coherence, structure and content). The decision to form these composites was supported by the high inter-item reliabilities of each composite (Cronbach's $\alpha = .98, .70, .91$, respectively). Although we planned to form a composite for lexical complexity, inter-item reliability was low for the NDW/50, the frequency of long words, and the frequency of rare words (Cronbach's $\alpha = .56$). Therefore, these variables, as well as subordination, syntactic diversity, and the frequency of grammatical errors, were analyzed individually. Separate ANCOVAs were run for each writing composite/variable.

In addition to these ANCOVAs, Chi-square analyses were conducted to examine whether children with and without ASD differed in their choice of writing topic (i.e., object, place, activity), and in their need for experimenter assistance (i.e., prompting, idea generation, and attention redirection).

Research Aim 2—Pearson correlations were first used to examine the relation between writing performance and EF. Multiple regression analyses were then conducted in order to determine which factors (i.e., diagnostic group, age, oral language ability, executive dysfunction, cognitive flexibility) uniquely predicted writing ability. Given the number of text variables assessed, and likelihood of committing Type I errors, regressions between EF and writing ability were only examined for the aspects of writing that differed significantly between children with and without ASD.

Results

Research Aim 1: Examining Similarities and Differences in Writing Ability

Comparison of Expository Writing between Diagnostic Groups—In terms of writing difficulties, one-way ANCOVA analyses revealed that children with ASD wrote expository essays that were less productive (i.e., fewer words and T-units), $F(1, 48) = 4.05$, $p = .05$, $\eta_p^2 = .08$, and contained more grammatical errors than those of their NT peers, $F(1, 48) = 3.88$, $p = .05$, $\eta_p^2 = .08$. Moreover, while not statistically significant, medium effect sizes were present ($\eta_p^2 \geq = .06$) for several other writing variables. In particular, children with ASD tended to use less subordination, $F(1, 48) = 2.91$, $p = .10$, $\eta_p^2 = .06$, and less diverse syntax than NT children, $F(1, 48) = 3.85$, $p = .06$, $\eta_p^2 = .07$.

By way of contrast, analyses revealed that the expository texts written by children with ASD did not differ in their number of different words, $F(1, 32) = 2.43$, $p = .13$, $\eta_p^2 = .08$, frequency of long words, $F(1, 48) = .42$, $p = .52$, $\eta_p^2 = .01$, use of writing convention errors (i.e., spelling, punctuation, and capitalization errors), $F(1, 48) = 2.65$, $p = .11$, $\eta_p^2 = .05$, and overall quality, $F(1, 48) = 1.64$, $p = .21$, $\eta_p^2 = .03$, when compared to the texts composed by NT children. Moreover, children with ASD used a greater frequency of rare words in comparison to NT children, $F(1, 48) = 9.72$, $p = .003$, $\eta_p^2 = .17$. See Table 2 for means and standard deviations.

Assessing Differences in Topic Selection—Children with ASD did not differ from NT children on the topic category they chose to write about, i.e., object, place, activity, $\chi^2(3, N = 52) = 2.37$, $p = .50$, $\Phi = .22$. Twenty-nine percent of children wrote about an object (e.g. Transformers, salamanders, dogs), 9% wrote about a place (e.g., Myrtle Beach, Buffalo Wild Wings), and 51% wrote about an activity (e.g., training huskies, football, video games). The remaining 16% wrote about a topic that didn’t fall into these categories. See Table 3 for examples of expository texts produced by children.

Examining the Need for Experimenter Assistance—Chi-square analyses revealed that the experimenter needed to redirect the attention of children with ASD to the writing task at a greater frequency than NT children, $\chi^2(1, N = 52) = 6.45$, $p = .01$, $\Phi = .35$ (ASD = 21%; NT = 0%). Children with ASD were also more likely to need additional prompting, $\chi^2(1, N = 52) = 9.72$, $p = .002$, $\Phi = .43$ (ASD = 50%; NT = 10%), and help with idea generation, $\chi^2(1, N = 52) = 7.14$, $p = .03$, $\Phi = .37$ (ASD = 41%; NT = 10%).

Research Aim 2: Examining the Relation between Executive Functioning and Writing in Children with and without ASD

As shown in Table 1, independent samples t-tests revealed that children with ASD showed greater levels of executive dysfunction (i.e., BRIEF-2 GEC) than their NT peers, but children with ASD did not differ in their cognitive flexibility, as measured by the WCST-64.

Correlations between Executive Functioning and Writing Ability—When examining associations with WCST-64 performance, we found that children with ASD with greater cognitive flexibility made fewer grammatical errors, $r(22) = -.46$, $p = .03$. For NT children, those with greater cognitive flexibility used a greater frequency of rare words, $r(26) = .40$, $p = .03$, and were rated higher in writing quality, $r(26) = .48$, $p = .009$.

When using the GEC score from the BRIEF-2, analyses revealed that children with ASD with greater executive dysfunction used a greater frequency of long words, $r(22) = .57$, $p = .$

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02. There was a trends towards children with ASD with greater executive dysfunction also using a greater frequency of rare words, $r(22) = .46$, $p = .06$. In contrast, for NT children, those with less executive dysfunction used a greater frequency of long words, $r(26) = -.50$, $p = .01$, made fewer writing convention errors, $r(26) = .41$, $p = .05$, and wrote texts rated higher in quality, $r(26) = -.42$, $p = .05$. No other significant correlations were found, $r(22\text{–}26) \leq .43$, $ps \geq .08$.

Assessing Predictors of Expository Writing Ability—Linear multiple regression analyses were conducted to determine how diagnostic group (ASD, NT), age, language ability (CELF-5 Core Language Score), executive dysfunction (BRIEF-2 GEC), and cognitive flexibility (WCST-64 Perseverative Errors standard score) uniquely predicted (1) productivity, (2) frequency of rare words, and (3) frequency of grammatical errors. These predictors were entered simultaneously in the model, and separate analyses were conducted for each writing variable. As shown in Table 4, the overall model accounted for a significant amount of variance in children's writing productivity and their use of rare words, respectively. Moreover, the overall model approached significance for grammatical errors. When looking at productivity, chronological age was the only significant predictor. In terms of rare words and grammatical errors, diagnostic group was the only significant predictor.

Discussion

Effective writing skills are essential for successful academic (Graham & Harris, 2004), professional (College Entrance Examination Board, 2004), and social outcomes (Magnifico, 2010). Unfortunately, past research has indicated that writing may be one of the most challenging areas of academic achievement for children with ASD (Mayes & Calhoun, 2006). Although several studies have begun to systematically characterize the writing ability of individuals with ASD (e.g., Brown, 2013; Dockrell et al., 2014; Reilly et al., 2017), they have largely focused on narrative writing. Despite providing valuable information, narrative writing alone does not match up with how children consume information and demonstrate what they have learned in the classroom. Specifically, research has shown that in the upper elementary and secondary grades, expository writing is called upon most heavily (Lundine & McCauley, 2016; Scott, 2010). Thus, the goal of the present study was to use fine-grained linguistic analysis to compare the expository writing of children with and without ASD.

Comparing the Writing Ability of Children with ASD and NT Children

Our findings revealed that the writing ability of children with ASD differed from their NT peers in a number of ways at the microstructural (word and sentence) level, but not the macrostructural level (quality ratings of overall text). Children with ASD wrote texts that were shorter (less productive) and contained more grammatical errors compared to NT children. There was also a general trend that children with ASD used slightly less complex and diverse syntax (i.e., less subordination and fewer different types of clauses). However, the texts of children with ASD were just as lexically diverse and complex as their NT peers, if not more so. Children with ASD did not differ in their lexical diversity or frequency of long words, and they used a greater frequency of rare words (e.g., disrupt, permanently; see Table 3). This particular difference may reflect the idiosyncratic, overly formal, or erudite

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language that is characteristic of some of the children on the spectrum (Rapin & Dunn, 2003; Volden & Lord, 1991).

At this micro level, our findings mirror those of Brown et al. (2014), who examined persuasive writing in children with ASD. As mentioned previously, this is of interest as persuasive text structure is similar to expository text structure, although the two genres differ in their overall goal (describe vs. persuade). Brown et al. (2014) found that children with ASD wrote persuasive essays that were slightly shorter and less syntactically complex than the essays produced by NT children. However, they also found that children with ASD used a greater frequency of unique and rare words in their persuasive essays than the control group. Taken together, these findings suggest there may be a particular profile for children with ASD when writing essays across contexts, i.e., difficulties with grammatical accuracy and complexity, but average, or advanced vocabulary abilities.

Unexpectedly, at the macrostructure level, the expository texts of children with ASD did not differ from their NT peers in terms of coherence, structure, or inclusion of appropriate content. Indeed, both groups of children showed quite a wide range of heterogeneity or ability level in their writing quality, ranging from poor to exceptional. This similarity in overall writing quality contradicts our predictions as well as Brown and Klein (2011), who found that adults with ASD wrote expository texts that were rated lower in overall quality, particularly coherence. This may be because expository writing quality is a relative writing strength for children with ASD, once age and FSIQ are controlled for in the comparison. However, there may be additional explanations for this finding. Previous research with NT children has shown that expository text organization does not develop fully until adolescence, or even adulthood (see Berman, 2008). It may be that the NT children in this study are still developing their ability to appropriately structure and incorporate necessary content in their expository essays, and that group differences in quality may emerge later in development (e.g., adolescence). In support of this assertion, a number of children in both groups simply listed what they knew about a topic instead of organizing information around a thesis statement and specific supporting categories.

The similarity in quality scores across diagnostic groups may also be a reflection of the specific prompt used. In particular, the expository prompt used in the present study may have played on the strengths of the children with ASD by allowing them to pick a topic that they were interested in and knew something about, which can help children to be more engaged when writing and produce better texts (e.g., Hidi & McLaren, 1991; Olinghouse et al., 2015). Indeed, Sivertson (2010) found that, in a small sample of children with ASD, students' special interest area positively affected the quality of their writing. In contrast, macrostructural differences may be more likely to emerge when the selected topic is more abstract, as was the case for Brown and Klein (2011), which had adults write an essay about "problems between people".

Differences in the Writing Process

In addition to microstructural text differences, several interesting findings emerged regarding the writing process of children with ASD. First, 17% of the children with ASD were unable to produce texts independently on the computer. This finding is similar to that of Dockrell et

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al. (2014) who found that 19% of the children with ASD and children with language impairments refused to write by hand in their study. Second, experimenter observations revealed that among the writers, children with ASD were more likely to need help with idea generation, reminders to focus or attend to the writing task, and neutral prompting to continue writing. Sivertson (2010) also observed that the children with ASD in their study had “great difficulties with initiating and completing writing tasks in the classroom” (p. 24), despite receiving standardized writing scores in the average range. Anecdotally, in terms of idea generation, the children with ASD in our study were not only more likely to need help, but it often took them longer to come up with their topic, even when help wasn’t needed.

Executive Functioning and Writing Ability in Children with and without ASD

The present study also set out to examine whether impairments in EF could serve as a potential barrier to text production for children with and without ASD. In line with previous research (Dockrell et al., 2014; Zajic et al., 2018), we found that EF impacted the writing process in several ways. For children with ASD, greater cognitive flexibility was related to fewer grammatical errors. However, unexpectedly, children with ASD with greater executive dysfunction used a significantly greater frequency of long words, and a marginally greater frequency of rare words. Although it was beyond the scope of the study to examine whether children’s use of rare and long words was unusual within the context of the text, children with poorer EF skills were more likely to use this style of idiosyncratic language.

A slightly different pattern of relations was found for NT children. As expected, better EF was associated with using more lexically complex language (rare words, long words), making fewer writing convention errors, and receiving higher ratings of writing quality. It may be that NT children are recruiting and utilizing their EF skills more readily than children with ASD while writing, or that other facets of EF (e.g., inhibition, planning, etc.) play a stronger role in the writing ability of children with ASD. Additional research is needed to explore this possibility. Still, our regression analyses revealed that EF did not uniquely predict writing ability when taking diagnostic group, chronological age, and oral language ability into account. Instead, we found that chronological age accounted for a significant amount of variation in children’s text productivity, with older children with and without ASD writing longer texts. This is not surprising given that children become more fluent at translating their thoughts into compositions as they get older (McCutchen, 1996). Regression analyses also revealed that diagnostic group predicted the frequency of rare words and grammatical errors used in expository texts, further indicating that these aspects of writing distinguished children with ASD from NT children.

Limitations and Future Directions

Although we believe these findings enhance our understanding of expository writing in children with ASD, several limitations should be noted. Similar to previous reports (Brown, 2013; Dockrell et al., 2014), there was substantial heterogeneity in the writing ability of children with ASD and NT children, especially when it came to text productivity. A subset of participants in both groups produced short texts of fewer than 50 words. This variability may have also limited our ability to detect true group differences in composition abilities (e.g. quality). Although the present study used a fairly comprehensive approach (i.e.,

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utilizing multiple EF and linguistic measures), it was not an exhaustive look at these domains. With regards to EF, additional research is needed to examine how other dimensions of EF (e.g., inhibition, working memory) measured via behavioral observation may impact written expression in children with ASD. Moreover, the current study did not address the association between other linguistic factors such as reading ability and written expression in children with ASD. Finally, it may be that our results are unique to the specific writing task employed in this study. In addition to variations in the particular writing topic, expository prompts may vary in their goal or purpose, which can affect the organization and complexity of linguistic devices used (Scott, 2010). Future studies should examine whether children with ASD show a similar profile of expository writing when other topics, text styles, and prompts are utilized.

Conclusions and Implications

Although there is a pressing need for additional research on the writing ability of individuals on the spectrum, this study provides a detailed profile of expository writing in children with ASD. Using nuanced linguistic analysis, we were able to capture a number of barriers that children with ASD seem to be experiencing when writing expository texts. Children with ASD not only had problems with productivity and grammaticality, but they also had more trouble generating ideas and maintaining focus on the writing task than NT children. Nevertheless, children with ASD did demonstrate several relative strengths in writing. More specifically, children with ASD were similar to NT children in their use of complex vocabulary, writing conventions, and writing quality. Overall, greater EF was associated with better writing ability, particularly for NT children.

Based on our current findings, educational staff should consider using writing assessments that include measures of microstructure as well as macrostructure, and utilize a variety of prompt topics, in order to obtain a more thorough understanding of a child’s written language impairments. By doing so, professionals may be able to provide more effective, targeted curricula and interventions, designed specifically with those components in mind, and successfully increase the writing skills of children with ASD. Based on group findings, children with ASD could also benefit from explicit lessons centered on raising the awareness of sentence grammaticality and making appropriate revisions. One approach may be to incorporate sentence combining training, which is an alternative approach to traditional grammar instruction that teaches children to construct more well-structured and complex sentences through exercises in which two or more basic sentences are combined into a single sentence (Saddler, 2012; Graham & Perin, 2007). Productivity limitations might be addressed with explicit lessons on what constitutes adequate detail, elaboration, etc., as well as peer evaluations or peer-mediated instruction focused on the same processes (Asaro-Saddler, 2016). At least in NT children, the relations found between EF and writing also provide support for the use of writing interventions, such as the self-regulated strategy development method (SRSD; Graham & Harris, 1993; Graham & Perin, 2007). The SRSD method aims to improve the cognitive and self-regulation (EF) strategies that children need to utilize during the writing process. Although we did not find strong associations between writing ability and EF in children with ASD, studies have shown that the SRSD method can also work with this population (Asaro-Saddler, 2016; Pennington & Delano, 2012).

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References

American Psychiatric Association (2013). Diagnostic and Statistical Manual of Mental Disorders (5th ed.). Washington, DC: Author.

Asaro-Saddler K (2016). Evidence-based practices and writing instruction for children with autism spectrum disorder. Preventing School Failure, 60, 79–85.

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

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

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]

Berninger V, Abbott R, Cook CR, & Nagy W (2017). Relationships of attention and executive functions to oral language, reading, and writing skills and systems in middle childhood and early adolescence. Journal of Learning Disabilities, 50, 434–449. doi:10.1177/0022219415617167 [PubMed: 26746315]

Boucher C, & Oehler K (2013). "I hate to write!": Tips for helping students with autism spectrum and related disorders increase achievement, meet academic standards, and become happy, successful writers. Shawnee Mission, KS: AAPC Publishing.

Brown HM (2013). Academic achievement of children and adolescents with high-functioning autism spectrum disorder with in-depth focus on written expression (Unpublished doctoral dissertation). University of Western Ontario, London, Ontario.

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. doi:10.1177/0734282913517525

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

Coffin AB, Smith Myles B, Rogers J, & Szakacs W (2016). Supporting the writing skills of individuals with autism spectrum disorder through assistive technologies In Cardon TA (Ed.), Technology and the treatment of children with autism spectrum disorder (pp. 59–74). Switzerland: Springer International Publishing.

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.

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Davies M (2010). The corpus of contemporary American English as the first reliable monitor corpus of English. Literary and Linguistic Computing, 25, 447–65. doi:10.1093/llc/fqq018.

Demetriou EA, Lampit A, Quintana DS, Naismith SL, Song YJC, Pye JE … & Guastella AJ (2018). Autism spectrum disorders: A meta-analysis of executive function. Molecular Psychiatry, 23, 1198–1204. doi:10.1038/mp.2017.75 [PubMed: 28439105]

Diamond A (2013). Executive functions. Annual Reviews of Psychology, 64, 135–168. doi:10.1146/annurev-psych-113011-143750

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

Eigsti IM, de Marchena AB, Schuh JM, & Kelley E (2011). Language acquisition in autism spectrum disorders: A developmental review. Research in Autism Spectrum Disorders, 5, 681–691. doi:10.1016/j.rasd.2010.09.001

Gioia GA, Isquith P, Guy SC, & Kenworthy L (2015). Behavior Rating Inventory of Executive Function, Second Edition Odessa, FL: Psychological Assessment Resources.

Graham S, & Harris KR (1993). Self-regulated strategy development: Helping students with learning problems develop as writers. The Elementary School Journal, 94, 169–181. doi:10.1086/461758

Graham S, & Harris KR (2004). Writing instruction In Wong B (Ed.), Learning about learning disabilities (3rd ed., pp. 281–313). San Diego, CA: Elsevier Science

Graham S, Harris KR, & Olinghouse N (2007). Addressing executive function problems in writing In Meltzer L (Ed.), Executive function in education: From theory to practice (pp. 216–236). New York: Guilford.

Graham S, & Perin D (2007). A meta-analysis of writing instruction for adolescent students. Journal of Educational Psychology, 99, 445–476. doi:10.1037/0022-0663.99.3.445

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

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

Individuals with Disabilities Education Act, 20 U.S.C. § 1400 (2004).

Kenworthy L, Yerys BE, Anthony LG, & Wallace GL (2008). Understanding executive control in autism spectrum disorders in the lab and in the real world. Neuropsychological Review, 18, 320–338. doi:10.1007/s11065-008-9077-7

Kongs SK, Thompson LL, Iverson GL, & Heaton RK (2000). Wisconsin Card Sorting Test – 64 Card Version. Lutz, Fl: Psychological Assessment Resources, Inc.

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]

Levy A, & Perry A (2011). Outcomes in adolescents and adults with autism: A review of the literature. Research in Autism Spectrum Disorders, 5, 1271–1282. doi:10.1016/j.rasd.2011.01.023

Lord C, Rutter M, DiLavore PC, & Risi S (1999). Autism Diagnostic Observation Schedule (ADOS). Los Angeles, CA: Western Psychological Services.

Lundine JP, & McCauley RJ (2016). A tutorial on expository discourse: Structure, development, and disorders in children and adolescents. American Journal of Speech-Language Pathology, 25, 306–320. doi:10.1044/2016_AJSLP-14-0130 [PubMed: 27537697]

Magnifico AM (2010). Writing for whom? Cognition, motivation, and a writer's audience. Educational Psychologist, 45, 167–184. doi:10.1080/00461520.2010.493470

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]

McCutchen D (1996). A capacity theory of writing: Working memory in composition. Educational Psychology Review, 8, 299–325.

Miller J, & Iglesias A (2018). Systematic Analysis of Language Transcripts (SALT), Research Version. Middleton, WI: SALT Software, LLC.

Nippold MA (2016). Later language development: School-age children, adolescents, and young adults (4th ed.). Austin, TX: PRO-ED Inc.

Nippold MA, & Ward-Lonergan JM (2010). Argumentative writing in pre-adolescents: The role of verbal reasoning. Child Language Teaching and Therapy, 26, 238–248. doi: 10.1177/0265659009349979

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

Pennington RC, & Delano ME (2012). Writing instruction for students with autism spectrum disorders: A review of literature. Focus on Autism and Other Developmental Disabilities, 27, 158–167. doi:10.1177/1088357612451318

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

Saddler B (2012). Teacher's guide to effective sentence writing. What works for special-needs learners series. New York: Guilford Publications, Inc.

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

Scott CM (2010). Assessing expository texts produced by school-age children and adolescents In Nippold MA & Scott CM (Eds.), Expository discourse in children, adolescents, and adults (pp. 191–213). New York: Psychology 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.

Sivertson 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, Duluth, Minnesota.

Tager-Flusberg H, Edelson L, & Luyster R (2011). Language and communication in autism spectrum disorders In Amaral D, Geschwind D, & Dawson G (Eds.), Autism spectrum disorders (pp. 172–185). London: Oxford University Press.

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.

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:10.1177/1362361316675121

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Table 1

Participant Characteristics

	Children with ASD	NT Children	t/χ^2	*P*	*d/phi*
Chronological age	10;09 (2;00)	10;08 (1;07)	0.87	.39	.01
Male: female	22:2	20:8	3.40	.07	.26
Racial/ethnic identity			5.33	.38	.32
Black	10.7%	10.3%			
Asian/Pacific Islander	3.6%	6.9%			
White	60.7%	65.6%			
Hispanic/Latino	14.3%	17.2%			
More than one race	10.7%	0%			
Average age of ASD diagnosis	4;03 (1;09)	-------			
CARS-2 T-score	51.09 (7.13)	-------			
SRS-2 Total T-score	72.44 (10.53)	47.76 (11.27)	7.03	.0001	2.26
WASI-II					
FSIQ-2	92.67 (13.50)	100.96 (9.16)	−2.63	.01	.72
Vocabulary subtest	45.25 (10.67)	51.64 (6.41)	−2.66	.01	.73
Matrix Reasoning subtest	45.75 (8.71)	50.04 (7.56)	−1.90	.07	.53
CELF-5 Core Language Score	92.42 (19.20)	103.68 (12.47)	−2.54	.01	.70
BRIEF-2 Global Executive Composite	66.06 (11.87)	53.65 (19.29)	2.35	.02	.77
WCST-64 Perseverative Errors standard score	105.45 (39.13)	111.00 (21.12)	−0.64	.52	.18

Note. CARS-2 = Childhood Autism Rating Scale, Second Edition. SRS-2 = Social Responsiveness Scale, Second Edition. WASIII = Wechsler Abbreviated Scale of Intelligence, Second Edition. CELF-5 = Clinical Evaluation of Language Fundamentals, Fifth Edition. BRIEF-2 = Behavior Rating Inventory of Executive Function, Second Edition. WCST-64 = Wisconsin Card Sorting Task-64 Card Version.

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Table 2

Comparison of Expository Writing in Children with and without ASD

Variable	Description	Children with ASD M (SE)	NT Children M (SE)
*Productivity[a]	Total words	75.83 (11.12)	112.82 (10.22)
	Total T-units	8.38 (1.20)	11.50 (1.10)
Lexical Complexity[b]	NDW/50 words[c]	36.70 (1.33)	33.70 (1.05)
	Long words/total words[d]	0.13 (.02)	0.12 (.02)
	* Rare words/total words[d]	0.14 (.01)	0.08 (.01)
Syntactic Complexity[b]	Subordination index	1.49 (.14)	1.83 (.13)
	Diversity of complex syntax (out of 4)	2.01 (.23)	2.63 (.21)
*Grammatical Errors	Grammatical errors/T-unit	0.26 (.32)	0.07 (.11)
Writing Conventions[a]	Punctuation errors/T-unit	0.52 (.09)	0.31 (.08)
	Spelling errors/T-unit	1.10 (.26)	0.44 (.23)
	Capitalization errors/T-unit	0.60 (.17)	0.39 (.16)
Quality[a] (score 0–4)	Coherence	2.35 (.22)	2.74 (.21)
	Structure	1.33 (.17)	1.73 (.15)
	Content	1.75 (.24)	2.08 (.21)

Note. Adjusted means that partial out the effect of the covariates are reported.

*Significant main effect of Diagnostic Group.

[a]Although means are reported for all writing variables, composites scores were used when analyzing the following aspects of writing: productivity, writing conventions, and quality.

[b]In contrast, all individual variables described as lexical and syntactic complexity were analyzed individually, as inter-item reliability was low for these composites.

[c]NDW/50 = Number of different words out of 50 words. Only 16 children with ASD and 20 NT children produced texts with 50 or more words, and therefore only those children were included in the analysis for NDW/50.

[d]In line with previous empirical work (Brown et al., 2014), long words and rare words were determined using the following online text analyzers, respectively: http://www.usingenglish.com/resources/textstatistics.php; http://www.wordandphrase.info.

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Table 3

Examples of Expository Texts Written by Children with and without ASD

9-year-old Children
NT Child (Quality Score: 3): *ALL ABOUT ME: I like to do math and I like to play sports, all sow I like to run alot, I like art to …*
Child with ASD (Quality Score: 1): *I like to play blocks. I make a tower. I make a big tall tower. I made a tall tower. I make a pizza.*
11-year-old Children
NT Child (Quality Rating: 9): *My favorite sport is soccer because soccer is a very competetive sport and soccer is a very famous sport. I also like soccer because of the World Cup and I love to watch other teams play against eachother to try to score a goal. I also like soccer because I play soccer! Soccer is really fun when your in the action, it is fun to score a goal but how to you score a goal without passing? Well I love to pass it back and forth to my team mates. I love to assist goals and I like soccer because there are a lot of people on the field at once. I like that because I am able to weave through people on the field and pass the ball the my team mates. When I play the sport a get a good feeling of having a good day. I dont know why but it gives me a great feeling, those are the reasons why I like to watch and play soccer.*
Child with ASD (Quality Rating: 10): *I like Transformers. My favorite charaters from greatest to least is Starscream, Grimlock and Soundwave. Starscream has Null rays that can disruspt the flow of energy in any character permanitly. He can also transform into a fighter jet and in jet mode he can shoot cluster bombs wich do the same thing as Null rays but they are temporary and have an explosive force. Grimlock has an extra powerfull blaster that can destoy anyone or anything with onely a few shots he can also transform into a T-Rex. In T-Rex mode he can shoot a flamthrower that is inside his mouth. Soundwave can use a normal blaster and he can deploy 6 different minicons they are Rumble, Frenzy, Ravage, Ratbat, Laserbeak and Buzzsaw he also has a shoulder canon. He transforms into a radio he can deploy minicons in both modes.*

Note. These examples were selected to show similarities in writing quality between children with and without ASD, as well as age related differences in writing. Texts are shown exactly as children typed them, including the grammar, spelling, capitalization, and punctuation errors. Quality ratings ranged from 0 to 12, with higher scores reflecting better quality.

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Table 4

Assessing Predictors of Expository Writing

Predictor	*β*	*t*	Sig.	Model	Adjusted R^2
Productivity					
Diagnostic Group	0.29	1.96	0.06	$F(5, 46) = 6.88$,	.44
Chronological Age	0.54	3.66	0.001	$p = .0001$	
Core Language Score	−0.08	0.51	0.62		
Executive Dysfunction	−0.24	−1.60	0.12		
Cognitive Flexibility	0.27	1.83	0.08		
Frequency of Rare Words					
Diagnostic Group	−0.65	−3.76	0.001	$F(5, 46) = 3.39$,	.24
Chronological Age	−0.30	−1.76	0.09	$p = .014$	
Core Language Score	0.05	0.26	0.79		
Executive Dysfunction	−0.08	−0.44	0.66		
Cognitive Flexibility	0.09	0.47	0.64		
Frequency of Grammatical Errors					
Diagnostic Group	−0.48	−2.64	0.01	$F(5, 46) = 2.41$,	.17
Chronological Age	−0.17	−0.96	0.35	$p = .058$	
Core Language Score	−0.05	−0.24	0.81		
Executive Dysfunction	−0.06	−0.35	0.73		
Cognitive Flexibility	−0.18	−0.97	0.34		

Note. Executive dysfunction was measured using the Global Executive Composite score from the BRIEF-2. Cognitive flexibility was measured using the Perseverative Error standard score from the WCST-64.