Research in Autism Spectrum Disorders 76 (2020) 101590

Contents lists available at ScienceDirect

Research in Autism Spectrum Disorders

journal homepage: www.elsevier.com/locate/rasd

Task engagement during narrative writing in school-age children with autism spectrum disorder compared to peers with and without attentional difficulties

Matthew Carl Zajic[a,*], Emily Jane Solari[a], Nancy Susan McIntyre[b], Lindsay Lerro[c], Peter Clive Mundy[d,e]

[a] Reading and Academic Development Research Group, Curry School of Education and Human Development, University of Virginia, 405 Emmet St. South, Charlottesville, VA 22904, United States
[b] Frank Porter Graham Child Development Institute, University of North Carolina at Chapel Hill, CB 8180, Chapel Hill, NC 27599, United States
[c] The Swain Center for Listening, Communication and Learning, 795 Farmers Ln #23, Santa Rosa, CA 95405, United States
[d] School of Education, University of California, Davis; One Shields Ave, Davis, CA 95616, United States
[e] MIND Institute, University of California, Davis, 2825 50th St., Sacramento, CA 95817, United States

ARTICLE INFO

Keywords:
Attention-deficit/hyperactivity disorder
Autism spectrum disorder
Education
School-age
Task engagement
Written expression

ABSTRACT

Background: Children with autism spectrum disorder (ASD) demonstrate highly variable writing skills. Few studies have examined if engagement during writing assessments may differ for children with ASD and if task engagement is related to their writing assessment performance. This study examined narrative writing and broad task engagement in children with ASD compared to peers with attention-deficit/hyperactivity disorder (ADHD) and typically developing (TD) peers.

Method: Sixty children with ASD, 32 children with ADHD, and 29 TD children completed assessments of cognitive skills, symptom severity, and spontaneous narrative writing. Time spent engaged during writing was assessed during the spontaneous narrative writing task.

Results: The ASD group performed lowest on text organization and quality scores as well as word production scores while also spending the least time engaged with the writing task. Time spent engaged was most strongly associated with narrative writing scores in the ASD group and explained unique variance in text organization and quality scores and word production scores after controlling for related age, cognitive skills, and symptom severity variables. The ADHD group showed similar associations between time spent engaged and word production scores, and time spent engaged explained unique variance in word production scores.

Conclusions: Time spent engaged completing the writing task appeared lowest for the ASD group and may suggest writing task engagement to be a more prominent difficulty area for children with ASD compared to peers with ADHD and TD peers. Implications for better understanding and supporting the writing skills of children with ASD are discussed.

* Corresponding author.
E-mail addresses: mcz3e@virginia.edu (M.C. Zajic), ejs9ea@virginia.edu (E.J. Solari), nsmcintyre@unc.edu (N.S. McIntyre), lindsay@thelisteningcenter.net (L. Lerro), pcmundy@ucdavis.edu (P.C. Mundy).

https://doi.org/10.1016/j.rasd.2020.101590
Received 6 June 2019; Received in revised form 8 May 2020; Accepted 24 May 2020
Available online 17 June 2020
1750-9467/

1. Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder wherein individuals demonstrate persistent difficulties in social communication and social interaction across multiple contexts alongside the presence of restricted, repetitive patterns of behaviors, interests, or activities (American Psychiatric Association, 2013). In recent years, researchers have expanded beyond clinical understandings of ASD to consider how the social cognitive features of ASD may influence development across different domains, such as academic skill development (Bauminger-Zviely, 2014). Children with ASD without a co-occurring intellectual disability or other severe communication difficulties demonstrate heterogenous academic skills (Ibrahim, 2020; Keen, Webster, & Ridley, 2016; Whitby & Mancil, 2009). Yet, limited research has sought to understand the different factors underlying this heterogeneity (e.g., Corbett & Iqbal, 2018).

An emerging research area falls on understanding the written language skills of school-age children with ASD (e.g., Finnegan & Accardo, 2018; Zajic & Asaro-Saddler, 2019; Zajic & Wilson, 2020). Over the last 20 years, studies have found that children with ASD demonstrate heterogeneous writing skills (e.g., Brown, Johnson, Smyth, & Oram Cardy, 2014; Dockrell, Ricketts, Charman, & Lindsay, 2014; Grace, Enticott, Johnson, & Rinehart, 2017; Griswold, Barnhill, Myles, Hagiwara, & Simpson, 2002; Kushki, Chau, & Anagnostou, 2011; Mayes & Calhoun, 2003a, 2006a; Myles et al., 2003; Zajic et al., 2018) with writing difficulties suggested to occur more frequently than reading or mathematics difficulties (Mayes & Calhoun, 2006a; Mayes, Waschbusch, Calhoun, & Mattison, 2019). While not all children with ASD struggle with the same writing difficulties, empirical studies comparing children with ASD to their typically developing (TD) peers and to their peers with other developmental disorders have suggested a higher prevalence of difficulties in handwriting and text organization and quality (Mayes & Calhoun, 2006a; Zajic & Wilson, 2020) with a lower prevalence of difficulties in spelling, grammar, and punctuation (Finnegan & Accardo, 2018). Empirical studies have offered tentative explanations for some of these difficulties, including factors related to cognition (i.e., IQ; Mayes & Calhoun, 2003b, 2008), language and social communication (Brown et al., 2014; Dockrell et al., 2014; Grace et al., 2017; Hilvert, Davidson, & Gámez, 2020), and attention and executive functions (Dirlikov et al., 2017; Grace et al., 2017; Hilvert, Davidson, & Scott, 2019; Zajic et al., 2018).

Part of the difficulty of understanding the complexity of the writing challenges affecting children with ASD is that writing is a complex, multifaceted set of skills. According to the simple view and the not-so-simple view of writing, writing skills can be broadly conceptualized into transcription (handwriting, keyboarding, and spelling) and text generation (turning ideas into words, sentences, and larger discourse units; Berninger & Amtmann, 2003; Berninger & Winn, 2006). These writing skills rely on additional social and cognitive processes to help navigate different writing scenarios, including executive functions and attention (Berninger & Winn, 2006) as well as motivation (Hayes & Berninger, 2014). These social cognitive processes support self-regulation during writing by managing how writers develop plans, gather content to write about, organize and construct content appropriate to the writing task, and regulate thoughts and behaviors to remain engaged during writing tasks (Graham, 2018; Hayes & Berninger, 2014; Zimmerman & Risemberg, 1997). The importance of self-regulation to writing has been well supported by underlying theories of written language development and has resulted in effective instructional approaches that help struggling writers become more strategic in their writing choices (see Berninger & Winn, 2006; Graham, 2018; Harris & Graham, 2016; Hayes & Berninger, 2014; Zimmerman & Risemberg, 1997). Writers remain strategically engaged with the writing process through formulating intentions, planning, monitoring, and reacting in order to gather, organize, write, and revise across most writing activities (see Graham, 2018). Children experiencing difficulties with self-regulation and associated skills (e.g., control mechanisms; Graham, 2018) may have challenges with staying engaged with their writing.

Few studies have offered preliminary insights into the roles of these control mechanisms in children with ASD (Hilvert et al., 2019; Zajic & Wilson, 2020). Recent observational and intervention studies have been split regarding the examination of skills associated with attention and self-regulation: observational studies generally focus on attentional difficulties through use of comparison groups (e.g., Dirlikov et al., 2017; Grace et al., 2017; Zajic et al., 2018), while intervention studies prioritize structuring the writing process via self-management interventions (Asaro-Saddler, 2016). The focus on attention across observational studies has suggested that attentional difficulties may play a role in the writing difficulties experienced by some individuals with ASD in handwriting (Dirlikov et al., 2017; Grace et al., 2017) as well as text generation (Zajic et al., 2018). Following this focus on executive function skills, Hilvert et al. (2019) reported that children with ASD with greater executive dysfunction were more likely to exhibit idiosyncratic language use (i.e., greater frequency of long words and rare words).

A limitation of the current research literature is a lack of examination into how children engage with the writing process during writing assessments. A wide array of psychoeducational assessments have been deemed appropriate for use with children with ASD (Corbett & Iqbal, 2018), and the relatively small set of studies that have examined the written language skills of children with ASD have used a very wide array of different assessments (see Zajic & Wilson, 2020). Additionally, these assessments often emphasize scoring written products with less emphasis placed on how children complete the tasks.

Children with ASD demonstrate highly variable engagement patterns in educational settings (Bryan & Gast, 2000; Sparapani, Morgan, Reinhardt, Schatschneider, & Wetherby, 2016; Wilkinson, 2008), yet studies focused on engagement during writing tasks remain limited (e.g., Hilvert et al., 2020). Typically, studies rely on written product measures or examine productivity solely as word production, resulting in few available studies that provide insights into how participants engage during the assessment. Griswold et al. (2002) commented that some of their children with ASD refused to write but offered limited insights into why they refused or how children engaged during the assessment. Dockrell et al. (2014) compared writers and nonwriters with either ASD or specific language impairment to find that nonwriters across groups were younger and demonstrated higher ASD symptom severity scores but were no different from writers on cognitive, language, or transcription skills. In a recent study, Hilvert et al. (2020) reported that school-age children with ASD experience greater difficulties getting started and staying on task during personal narrative writing

compared to their TD peers. Other studies have examined writing skills using designs that did not allow for examining writing engagement. For example, Brown et al. (2014) asked participants to complete a persuasive essay using an unspecified amount of time (reporting that all participants finished within 30 min but with limited additional details).

Examining time spent engaged during writing also may provide further exploration into the role of attentional skills during writing for children with ASD compared to peers with attentional difficulties. Attention is a distinct control mechanism that supports broader executive function and self-regulation skills by helping to regulate the behaviors used during a writing task (see Berninger & Amtmann, 2003; Graham, 2018; Hayes & Berninger, 2014). Studies focused on the attentional skills of children with ASD during writing have used both measures of attentional difficulties as well as comparison groups, commonly incorporating peers with attention-deficit/hyperactivity disorder (ADHD) to offer a multiple group perspective (e.g., Grace et al., 2017; Mayes, Breaux, Calhoun, & Frye, 2019; Mayes & Calhoun, 2006a; Zajic et al., 2018). Individuals with ADHD exhibit patterns of inattentive and/or hyperactive behavior that can impact self-regulation and academic task management (American Psychiatric Association, 2013; DuPaul & Langberg, 2015). Children with ADHD demonstrate similar writing challenges to those noted in children with ASD, with difficulties falling across text organization, production, and construction (DeBono et al., 2012; Mayes & Calhoun, 2006b; Mayes et al., 2019a; Molitor, Langberg, & Evans, 2016). Yet, similar to the findings of children with ASD, the writing skills of children with ADHD appear to be heterogeneous (see Molitor et al., 2016) and have received limited sustained examination (see Graham, Fishman, Reid, & Hebert, 2016). Prevalence estimates of ASD and ADHD comorbidity greatly range in school-age children (16–44 %) with children demonstrating internal distractibility with high ASD symptom severity and high external distractibility with high ADHD symptom severity (see Deprey & Ozonoff, 2018). ADHD symptom severity may play a role in the written language difficulties experienced by children with ASD, as the level of ADHD symptom severity observed in children with ASD has been shown to be predictive of writing challenges that are related to broader cognitive and executive function difficulties (Dockrell et al., 2014; Hilvert et al., 2019; Zajic et al., 2018). Ongoing research is needed that examines children with ASD to peers with ADHD that considers both between-group differences in engagement as well as within-group relationships between task engagement and writing skills.

2. Current study

This study examined narrative writing and broad task engagement in children with ASD compared to children with ADHD and TD children to consider between-group differences in narrative writing and time spent engaged and to explore within-group relationships between narrative writing, time spent engaged, and related factors (i.e., age, cognitive abilities, and ASD and ADHD symptom severity). This study contributes to the literature exploring writing development in children with ASD and offers new insights relative to task engagement during writing that may inform future assessment and instructional research. Importantly, the study used the Test of Written Language, 4th Edition (TOWL-4; Hammill & Larsen, 2009), a standardized, picture-based psychoeducational narrative writing assessment that separates writing into distinct task stages (Scripting, Planning, and Writing). Using the TOWL-4 allowed for examination of broad task engagement during writing where participants received a visual stimulus to write about (which potentially allowed for less ambiguity about the task demands compared to what might be expected with more abstract or non-picture-based writing tasks). The current study focused on task engagement specifically during the Writing Task Stage, and a previous publication examined engagement during the Planning Task Stage with the included participants (see Zajic, Solari, McIntyre, Lerro, & Mundy, 2020). Three research questions guided this study:

1) Do children with ASD differ from peers with ADHD or TD peers a) on narrative writing scores and b) on time spent engaged with a structured, picture-based narrative writing task?
2) Do groups differ in their a) relationships between narrative writing scores and time spent engaged, and b) relationships between these writing task variables and age, cognitive skills, and ASD and ADHD symptom severity?
3) Within groups, does time spent engaged explain additional variance in narrative writing scores after controlling for related variables (i.e., age, cognitive skills, and ASD and ADHD symptom severity)?

3. Methods

All data were collected from children participating in a longitudinal study on academic, cognitive, and social development. Families were recruited through a university-affiliated center's subject tracking system, by fliers through local school districts, and by word of mouth. This research was conducted in compliance with the Institutional Review Board at the University of California, Davis. In order to control for conditions that might significantly impact participants' performance, exclusionary criteria included an identified syndrome other than ASD or ADHD, significant sensory or motor impairment, a neurological disorder, psychotic symptoms, or any major medical disorder that could be associated with extended absences from school. This study included 121 children between 9–17 years old, which included 60 children with ASD (50 male), 32 children with ADHD (25 male), and 29 TD children (18 male). Children with ASD and ADHD came into the study with community diagnoses that were confirmed via trained researcher assessment and parent report.

3.1. Diagnostic and symptom severity measures

The Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2; Lord et al., 2012) confirmed diagnosis (ASD group) and assessed ASD symptom severity (ASD and ADHD groups). The ADOS-2 is a semi-structured, standardized assessment of

communication, social interaction, play, and restricted and repetitive behaviors. A research-reliable team member administered either Module 3 (Child/Adolescent) or Module 4 (Adolescent/Adult) to calculate algorithm-adjusted Total Scores. Modules demonstrate strong interrater reliability via publisher-reported intraclass correlation coefficients (αs = 0.82 − 0.94; Lord et al., 2012). The Social Responsiveness Scale (SRS; Constantino & Gruber, 2005) provided an additional assessment of ASD symptom severity for all groups. Parents/guardians completed the 65-item rating scale that measures ASD symptom severity and general social responsiveness in naturally occurring contexts. The SRS provides a Total Score as a composite of five subscales (Awareness, Cognition, Communication, Motivation, and Mannerisms) and has demonstrated strong internal consistency (αs = 0.93 − 0.97; Constantino & Gruber, 2005).

The Conners 3 (Conners, 2008) confirmed ADHD diagnosis (ADHD group) and assessed ADHD symptom severity across groups. The Conners 3 is a comprehensive assessment for identifying the presence of ADHD symptomatology, and parents/guardians completed the DSM-IV Inattentive Scale and DSM-IV Hyperactive/Impulsive subscales. Both parent-report forms have strong demonstrated internal consistency (αs > 0.90; Conners, 2008).

3.2. Cognitive measures

The Wechsler Abbreviated Scale of Intelligence, 2nd Edition (WASI-II; Wechsler, 2011) assessed cognitive abilities. Two verbal (Vocabulary and Similarities) and two nonverbal (Block Design and Matrix Reasoning) subtests were administered to compute verbal reasoning (Verbal Comprehension Index [VCI]), nonverbal reasoning (Perceptual Reasoning Index [PRI]), and Full-Scale IQ (FIQ) estimates (*Ms* = 100, *SDs* = 15). Internal consistency Cronbach's alpha coefficients for the sample demonstrated great-to-excellent subtest reliabilities (αs = 0.87 − 0.93) and were consistent with publisher-reported alphas (α = 0.96; Wechsler, 2011). All participants had an estimated FIQ of at least 73.

3.3. Writing measures

The TOWL-4 assessed narrative writing via the Spontaneous Writing subtest where participants produced a handwritten, fictional narrative about a provided picture. During the assessment, participants listen to a sample story about an example picture (Scripting), plan their own story about a new picture (Planning), and draft their story (Writing). Written responses are evaluated based on Contextual Conventions (21 items; spelling, morphological, and grammatic writing conventions) and Story Composition (11 items; text organization and quality via vocabulary, plot, prose, character development, and reader interest). These scaled scores (*M* = 10, *SD* = 3) are used to calculate a Spontaneous Writing Index composite score (*M* = 100, *SD* = 15). As no standardized score for word production is provided, the total number of words produced were counted for each sample. Though word production may serve as a proxy for handwriting, this measure of word production is impacted by task demands. Therefore, word production is used as a measure of text production and should not be interpreted as an isolated handwriting or fluency measure.

All writing samples were scored by two research assistants trained by the first author using the TOWL-4 scoring guidelines (Hammill & Larsen, 2009). Training was completed when research assistants reached 100 % agreement across example samples and could articulate rationales for all scoring decisions. Interrater reliability was calculated on a random selection of writing samples (*n* = 34) using intraclass correlation coefficients treated as two-way random (Shrout & Fleiss, 1979). Interrater reliability was great-to-excellent for Contextual Conventions (α = 0.94), Story Composition (α = 0.84), and word production (α = 1.00).

3.4. Task time spent engaged

Time spent engaged was operationalized as the total duration (in seconds) participants spent completing the TOWL-4 Writing Task Stage. Participants were provided a maximum of 10 min (600 s) to complete their written narratives (which was reduced from the recommended 15 min due to larger study visit time constraints). The start point for calculating time spent engaged began after a trained research team member explained the writing task and answered any clarifying questions from the participant. Participants received reminders at five and nine minutes to continue writing. If a participant used the entire time and was still writing when time was up, they could finish their current sentence. The stop point for calculating time spent engaged differed depending on individual behaviors. If a participant remained engaged with the task for the full 10 min, then the stop point was the end of the task (with 600 s recorded for time spent engaged). If participants said they were finished before the task was done, then a research team member encouraged participants to try to write a full page and prompted participants to think about the details in the task picture. If participants then refused to write more or said they had written as much as they could, then the task was ended, and the stop time was recorded.

4. Data analysis

Analyses were conducted using SPSS 25 (IBM Corp., 2018). Groups were matched on age but differed on IQ (ASD = ADHD, ASD < TD, and ADHD < TD; Table 1). To account for this difference, group comparisons covaried for FIQ. To address the research questions, three sets of analyses were conducted. First, a univariate analysis of covariance (ANCOVA) with follow-up pairwise comparisons with a Bonferroni adjustment examined overall group differences on the TOWL-4 Spontaneous Writing Index. Second, a multivariate analysis of covariance (MANCOVA) followed by ANCOVAs with a Bonferroni adjustment examined group differences on TOWL-4 writing scores (Contextual Conventions, Story Composition, and word production) and task time spent engaged. Third,

Table 1
Descriptive Statistics and Group Comparisons for Age, Cognitive Abilities, and Symptom Severity.

	ASD		ADHD		TD				
	n = 60		n = 32		n = 29				
	M (SD)	Range	*M (SD)*	Range	*M (SD)*	Range	*F*	*p*	η_p^2
Age	12.63 (2.11)	9.33 – 17.17	13.13 (2.30)	9.64 – 17.31	12.74 (2.29)	9.35 – 17.02	0.55	0.58	0.01
VCI[b]	95.92 (15.48)	60 – 136	98.84 (14.33)	72 – 128	111.24 (13.79)	81 – 138	10.72	< 0.001	0.15
PRI[b]	102.25 (16.86)	70 – 150	99.94 (15.81)	74 – 126	116.83 (14.14)	91 – 160	10.44	< 0.001	0.15
FIQ[b]	98.73 (15.13)	73 – 132	99.31 (15.00)	74 – 131	115.62 (12.82)	90 – 150	14.46	< 0.001	0.20
ADOS-2[a,c]	10.75 (3.61)	7 – 24	4.14 (3.81)	0 – 13	–	–	62.80	< 0.001	0.42
SRS[d]	82.49 (10.24)	52 – 91	61.29 (14.66)	42 – 91	43.69 (7.50)	34 – 66	127.01	< 0.001	0.69
Inatten[b]	73.97 (11.19)	50 – 90	77.63 (10.57)	54 – 90	46.90 (10.67)	35 – 90	75.60	< 0.001	0.56
Hyper[b]	71.40 (15.52)	39 – 90	71.13 (17.27)	40 – 90	47.14 (8.93)	38 – 73	29.58	< 0.001	0.33

Note. [a]Only the ASD and ADHD groups received the ADOS-2. [b]ASD = ADHD, ASD < TD, ADHD < TD. [c]ASD > ADHD. [d]ASD > ADHD, ASD > TD, ADHD > TD. ASD = autism spectrum disorder. ADHD = attention-deficit/hyperactivity disorder. TD = typically developing. VCI = Verbal Comprehension Index. PRI = Perceptual Reasoning Index. FIQ = Full-Scale IQ. ADOS-2 = Autism Diagnostic Observation Schedule, 2nd Edition Total Score. SRS = Social Responsiveness Scale Total Score. Inatten = Conners 3 DSM-IV Inattentive Parent Report Scale. Hyper = Conners 3 DSM-IV Hyperactive/Impulsive Parent Report Scale. Reprinted from Zajic, Solari, McIntyre, Lerro, & Mundy (2020) with permission from Elsevier with effect size calculations added.

Pearson product-moment correlations were conducted separately for each group to examine a) the relationships between narrative writing scores and time spent engaged and b) the relationships between writing and task engagement variables and age, cognitive skills (VCI, PRI, and FIQ), and symptom severity (ADOS-2, SRS, and Conners 3). These interrelationships guided the building of group-specific hierarchical multiple regressions predicting Contextual Conventions, Story Composition, and word production scores that included variables at Step 1 (age, cognitive skills, and symptom severity estimates related to that TOWL-4 score) and Step 2 (time spent engaged). Models were examined for variance explained (R^2) and change in variance explained between steps (ΔR^2) with contribution from individual predictors assessed via standardized beta coefficients (β).

5. Results

Descriptive statistics are reported in Table 1. As mentioned, groups were matched on age but differed on cognitive abilities (ASD = ADHD, ASD < TD, and ADHD < TD; Table 1). The ASD group demonstrated elevated symptom severity on the ADOS-2 compared to the ADHD group and on the SRS compared to ADHD and TD groups. The ASD and ADHD groups demonstrated elevated ADHD symptom severity relative to the TD group but did not differ themselves. Norm-referenced scores for the TOWL-4 scores for the ASD and ADHD groups predominantly fell in the below average to average ranges (TD fell in the average range), and groups demonstrated wide ranges for the total number of words produced (Table 2).

5.1. Group comparisons for TOWL-4 scores and time spent engaged

Groups differed on the Spontaneous Writing Index, $F(2, 117) = 7.96$, $p < 0.001$, $\eta_p^2 = 0.12$. The ASD group performed lower than

Table 2
Multivariate and Univariate Between-Group Effects for Group by TOWL-4 Writing Scores and Time Spent Engaged.

	ASD		ADHD		TD				
	n = 60		n = 32		n = 29				
	M (SE)	Range	*M (SE)*	Range	*M (SE)*	Range	*F*	*p*	η_p^2
Spontaneous Writing Index	101.09 (2.18)	55 – 128	106.79 (2.95)	58 – 135	117.54 (3.35)	93 – 158	7.96	0.001	0.12
Contextual Conventions[a]	10.10 (0.33)	2 – 15	10.15 (0.45)	2 – 15	12.08 (0.51)	8 – 18	5.28	0.006	0.08
Story Composition[a]	9.36 (0.42)	2 – 16	11.13 (0.57)	2 – 15	12.52 (0.65)	8 – 20	8.68	< 0.001	0.13
Word Production[a]	82.52 (5.67)	2 – 183	107.75 (7.67)	2 – 186	135.32 (8.70)	74 – 230	12.78	< 0.001	0.18
Time Spent Engaged (s)[a]	460.23 (16.11)	112.48 – 600.00	537.77 (21.79)	254.72 – 600.00	544.56 (24.73)	421.08 – 600.00	6.10	0.003	0.09

Note. ASD = autism spectrum disorder. ADHD = attention-deficit/hyperactivity disorder. TD = typically developing. TOWL-4 = Test of Written Language, 4th Edition. SWI = Spontaneous Writing Index. CC = Contextual Conventions. SC = Story Composition. FIQ included as a covariate for all analyses (FIQ = 102.93).

[a] $V = 0.26$, $F(8, 230) = 4.24$, $p < 0.001$, $\eta_p^2 = 0.13$.

Table 3
Pearson Product-Moment Correlation Coefficients between TOWL-4 Writing Scores and Writing Task Stage Time Spent Engaged with Age, Cognitive Skills, and ASD and ADHD Symptom Severity across ASD, ADHD, and TD Groups.

		ASD					ADHD					TD				
	Variable	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	CC	–	0.77***	0.92***	0.75***	0.35**	–	0.56**	0.87***	0.64***	0.35*	–	0.53**	0.85***	0.46*	0.30
2	SC	0.77***	–	0.96***	0.80***	0.49***	0.56**	–	0.89***	0.74***	0.03	0.53**	–	0.89***	0.69***	0.33
3	SWI	0.92***	0.96***	–	0.83***	0.46***	0.87***	0.89***	–	0.78***	0.34	0.85***	0.89***	–	0.65***	0.36
4	Word Production	0.75***	0.80***	0.83***	–	0.54***	0.64***	0.74***	0.78***	–	0.57**	0.46*	0.69***	0.65***	–	0.31
5	Time Spent Engaged	0.35**	0.49***	0.46***	0.54***	–	0.35*	0.26	0.34	0.57**	–	0.30	0.33	0.36	0.31	–
6	Age	0.28*	0.33**	0.33*	0.46***	0.12	0.38*	0.41*	0.45*	0.54**	0.33	−0.02	0.20	0.09	0.42*	0.20
7	VCI	0.46***	0.45***	0.49***	0.47***	0.43**	0.45*	0.25	0.39*	0.31	0.13	0.23	0.16	0.23	0.17	0.22
8	PRI	0.34**	0.27*	0.32*	0.26*	0.27*	0.00	−0.03	−0.02	−0.06	−0.02	0.13	0.15	0.16	0.22	0.18
9	FIQ	0.47***	0.43**	0.48***	0.43**	0.42**	0.24	0.12	0.20	0.14	0.07	0.23	0.19	0.24	0.24	0.24
10	ADOS-2	−0.09	−0.25	−0.19	−0.13	−0.13	−0.24	−0.29	−0.31	−0.18	−0.16	–	–	–	–	–
11	SRS	−0.11	−0.39**	−0.29*	−0.19	−0.20	−0.22	−0.46**	−0.39*	−0.44*	−0.26	−0.11	0.14	0.03	0.02	0.22
12	Inatten	−0.11	−0.13	−0.13	−0.04	0.11	0.21	−0.02	0.10	0.12	0.18	−0.03	−0.09	−0.08	−0.05	0.06
13	Hyper	−0.12	−0.10	−0.12	−0.06	0.04	−0.02	−0.33	−0.20	−0.26	−0.32	−0.13	0.04	−0.06	−0.01	−0.08

Note. ASD = autism spectrum disorder. ADHD = attention/deficit-hyperactivity disorder. TD = typically developing. TOWL-4 = Test of Written Language, 4th Edition. CC = TOWL-4 Contextual Conventions. SC = TOWL-4 Story Composition. SWI = TOWL-4 Spontaneous Writing Index. VCI = Verbal Comprehension Index. PRI = Perceptual Reasoning Index. FIQ = Full-Scale IQ. ADOS-2 = Autism Diagnostic Observation Schedule, 2nd Edition Total Score. SRS = Social Responsiveness Scale Total Score. Inatten = Conners 3 DSM-IV Inattentive Parent Report Scale. Hyper = Conners 3 DSM-IV Hyperactive/Impulsive Parent Report Scale.
***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

the TD group ($p < 0.001$) but no different from the ADHD group ($p = 0.36$). The TD and ADHD groups did not differ ($p = 0.06$).

The MANCOVA for the TOWL-4 subtest scores, word production, and time spent engaged demonstrated heterogeneity of variance-covariance matrices (Box's M = 62.02, $p < 0.001$). Groups differed on these scores, $V = 0.26$, $F(8, 230) = 4.24$, $p < 0.001$, $\eta_p^2 = 0.13$, with follow-up ANCOVA pairwise comparisons showing group differences across variables ($ps < 0.01$; Table 2). On Contextual Conventions, the ASD group performed lower than the TD group ($p = 0.007$) but no different from the ADHD group ($p = 1.00$). The ADHD group performed lower than the TD group ($p = 0.02$). On Story Composition, the ASD group performed lower than the ADHD ($p = 0.04$) and TD groups ($p < 0.001$). The ADHD and TD groups did not differ ($p = 0.36$). On word production, the ASD group produced fewer words than the ADHD ($p = 0.03$) and TD groups ($p < 0.001$). The ADHD and TD groups did not differ ($p = 0.07$). On time spent engaged, the ASD group spent less time engaged with the task than the ADHD ($p = 0.01$) and TD groups ($p = 0.02$). The ADHD and TD groups did not differ ($p = 1.00$).

5.2. Relationships between TOWL-4 scores and time spent engaged

Correlation coefficients are reported in Table 3. For the ASD group, time spent engaged demonstrated moderate associations across TOWL-4 scores ($rs = 0.35-0.54$, $ps < 0.01$). For the ADHD group, time spent engaged was moderately associated with word production ($r = 0.57$, $p = 0.001$) and Contextual Conventions ($r = 0.35$, $p = 0.05$) while not significantly associated with the Spontaneous Writing Index ($r = 0.34$, $p = 0.054$) and Story Composition ($r = 0.26$, $p = 0.15$). For the TD group, time spent engaged was not associated with the TOWL-4 scores ($rs = 0.30-0.36$, $ps > 0.05$).

5.3. Relationships between TOWL-4 scores and time spent engaged with age, cognitive skills and symptom severity

Correlation coefficients are reported in Table 3. For the ASD group, TOWL-4 scores showed weak-to-moderate associations with age ($rs = 0.28-0.46$, $ps < 0.05$) and cognitive abilities ($rs = 0.27$–0.49, $ps < 0.05$). SRS Total score showed a weak association with the Spontaneous Writing Index ($r = -0.29$, $p = 0.03$) and a moderate association with Story Composition ($r = -0.39$, $p = 0.002$). ADOS-2 Total Score showed no significant relationships ($ps > 0.05$). Neither Conners 3 parent report scores showed significant relationships with TOWL-4 scores ($ps > 0.05$). Time spent engaged showed weak-to-moderate correlations with cognitive abilities ($rs = 0.27-0.43$, $ps < 0.05$) and no significant correlations with age and ADOS-2, SRS, or Conners 3 scores ($ps > 0.05$).

For the ADHD group, TOWL-4 scores showed overall moderate associations with age ($rs = 0.38-0.54$, $ps < 0.05$). The Spontaneous Writing Index and Contextual Conventions showed moderate associations with VCI and FIQ ($rs = 0.39-0.45$, $ps < 0.03$) but not PRI ($ps > 0.05$). SRS Total Score showed moderate correlations with the Spontaneous Writing Index, Story Composition, and word production ($rs = -0.39--0.46$, $ps < 0.05$). ADOS-2 Total Score and Conners 3 parent report scores showed no significant associations with TOWL-4 scores ($ps > 0.05$). Time spent engaged showed no significant correlations with age, cognitive abilities, or symptom severity ($ps > 0.05$).

For the TD group, only word production showed a moderate correlation with age ($r = 0.42$, $p = 0.02$) with no significant correlations between TOWL-4 scores and cognitive abilities or symptom severity ($ps > 0.05$). Time spent engaged showed no significant correlations with age, cognitive abilities, or symptom severity ($ps > 0.05$).

5.4. Hierarchical multiple regressions

Regressions were constructed for Contextual Conventions, Story Composition, and word production separately for the ASD and ADHD groups. The TD group was excluded from these analyses due to the limited variability in time spent engaged and limited correlational evidence between time spent engaged and TOWL-4 scores. Step 1 variables for the ASD and ADHD groups were selected based on the significance of their correlation coefficients ($p < 0.05$). Step 2 for both groups included time spent engaged.

Hierarchical regression models for the ASD group are reported in Table 4. For Contextual Conventions, Step 1 (age and FIQ) explained 30 % of the overall variance, $F(2, 57) = 12.05$, $p < 0.001$. FIQ ($\beta = 0.47$, $p < 0.001$) but not age ($\beta = 0.27$, $p = 0.25$) explained unique variance at Step 1. The inclusion of time spent engaged at Step 2 resulted in a non-significant increase in additional variance explained, $\Delta R^2 = 0.02$, $F(1, 56) = 1.24$, $p = 0.27$. For Story Composition, Step 1 (age, FIQ, and SRS) explained 42 % of the overall variance, $F(3, 55) = 13.08$, $p < 0.001$. The inclusion of time spent engaged at Step 2 accounted for an increase in overall variance explained, $\Delta R^2 = 0.06$, $F(1, 54) = 6.15$, $p = 0.016$. Age ($\beta = 0.33$, $p = 0.002$), FIQ ($\beta = 0.24$, $p = 0.035$), SRS Total Score ($\beta = -0.33$. $p = 0.002$), and time spent engaged ($\beta = 0.27$, $p = 0.016$) each explained unique variance at Step 2. For word production, Step 1 (age and FIQ) explained 39 % of the overall variance, $F(2, 57) = 18.14$, $p < 0.001$. The inclusion of time spent engaged at Step 2 accounted for an increase in overall variance explained, $\Delta R^2 = 0.11$, $F(1, 56) = 12.84$, $p = 0.001$. Age ($\beta = 0.41$, $p < 0.001$), FIQ ($\beta = 0.26$, $p = 0.02$), and time spent engaged ($\beta = 0.37$, $p = 0.001$) explained unique variance at Step 2.

Hierarchical regression models for the ADHD group are reported in Table 4. For Contextual Conventions, Step 1 (age and VCI) explained 27 % of the overall variance, $F(2, 29) = 5.47$, $p = 0.01$. VCI ($\beta = 0.37$, $p = 0.03$) but not age ($\beta = 0.28$, $p = 0.10$) explained unique variance at Step 1. The inclusion of time spent engaged at Step 2 accounted for a non-significant increase in additional variance explained, $\Delta R^2 = 0.05$, $F(1, 28) = 2.17$, $p = 0.15$. For Story Composition, Step 1 (age and SRS) explained 29 % of the overall variance, $F(2, 28) = 5.59$, $p = 0.01$. SRS Total Score ($\beta = -0.36$, $p = 0.04$) but not age ($\beta = 0.23$, $p = 0.10$) explained unique variance at Step 1. The inclusion of time spent engaged at Step 2 accounted for a non-significant increase in additional variance explained, $\Delta R^2 = 0.00$, $F(1, 27) = 0.34$ $p = 0.56$. For word production, Step 1 (age and SRS) explained 38 % of the overall

Table 4
Hierarchical Multiple Regressions for TOWL-4 Writing Scores for the ASD and ADHD Groups.

ASD			Model 1					Model 2				
	R^2	ΔR^2	B	SE	β	*t*	*p*	B	SE	β	*t*	*p*
Contextual Conventions												
Step 1	0.30	–										
Age			0.36	0.15	0.27	−1.16	0.25	0.34	0.15	0.26	2.28	0.03
FIQ			0.09	0.02	0.47	4.20	< 0.001	0.08	0.02	0.41	3.33	0.002
Step 2	0.31	0.02[d]										
Time Spent Engaged								0.00	0.00	0.14	1.12	0.27
Story Composition												
Step 1	0.42	–										
Age			0.66	0.19	0.37	3.53	< 0.001	0.59	0.18	0.33	3.26	0.002
FIQ			0.09	0.03	0.34	3.25	0.002	0.06	0.03	0.24	2.16	0.035
SRS			−0.13	0.04	−0.37	−3.48	< 0.001	−0.12	0.04	−0.33	−3.22	0.002
Step 2	0.48	0.06[a]										
Time Spent Engaged								0.01	0.00	0.27	2.48	0.016
Word Production												
Step 1	0.39	–										
Age			9.29	2.13	0.45	4.37	< 0.001	8.41	1.95	0.41	4.31	< 0.001
FIQ			1.20	0.30	0.42	4.04	< 0.001	0.74	0.30	0.26	2.48	0.02
Step 2	0.50	0.11[b]										
Time Spent Engaged								0.10	0.03	0.37	3.58	0.001

ADHD			Model 1					Model 2				
	R^2	ΔR^2	B	SE	β	*t*	*p*	B	SE	β	*t*	*p*
Contextual Conventions												
Step 1	0.27	–										
Age			0.35	0.20	0.28	1.72	0.10	0.24	0.21	0.19	1.11	0.28
VCI			0.07	0.03	0.37	2.28	0.03	0.07	0.03	0.37	2.27	0.03
Step 2	0.33	0.05[d]										
Time Spent Engaged								0.01	0.00	0.25	1.47	0.15
Story Composition												
Step 1	0.29	–										
Age			0.40	0.23	0.29	1.71	0.10	0.36	0.25	0.26	1.46	0.16
SRS			−0.08	0.04	−0.36	−2.15	0.04	−0.08	0.04	−0.35	−1.99	0.06
Step 2	0.29	0.00[d]										
Time Spent Engaged								0.00	0.01	0.10	0.59	0.56
Word Production												
Step 1	0.38	–										
Age			9.33	3.24	0.45	2.88	0.01	7.12	3.04	0.35	2.34	0.03
SRS			−0.96	0.52	−0.29	−1.87	0.07	−0.75	0.47	−0.23	−1.58	0.13
Step 2	0.51	0.13[c]										
Time Spent Engaged								0.18	0.07	0.39	2.70	0.01

Note. TOWL-4 = Test of Written Language, 4th Edition. ASD = autism spectrum disorder. ADHD = attention-deficit/hyperactivity disorder. FIQ = Full-Scale IQ. Time Spent Engaged = Time spent completing the TOWL-4 spontaneous writing subtest. VCI = Verbal Comprehension Index. SRS = Social Responsiveness Scale Total Score.

[a] $p = 0.016$.
[b] $p = 0.001$.
[c] $p = 0.012$.
[d] $p > 0.05$.

variance, $F(2, 28) = 8.62$, $p = 0.001$. The inclusion of time spent engaged at Step 2 accounted for an increase in overall variance explained, $\Delta R^2 = 0.13$, $F(1, 27) = 7.25$, $p = 0.012$. Time spent engaged ($\beta = 0.39$, $p = 0.01$) and age ($\beta = 0.35$, $p = 0.03$) but not SRS Total Score (β = -0.22, $p = 0.13$) explained unique variance at Step 2.

6. Discussion

This study had three main goals to understand differences and relationships in narrative writing and time spent engaged in children with ASD compared to peers with ADHD or TD peers: 1) examine group-level differences in narrative writing and time spent engaged; 2) examine group-specific relationships between narrative writing and time spent engaged as well as to age, cognitive skills, and symptom severity; and 3) examine if time spent engaged explains additional variance in narrative writing after controlling for related variables (age, cognitive skills, and symptom severity).

Group-level differences in narrative writing showed the ASD group generally performed lower than the ADHD and TD groups (i.e., Spontaneous Writing Index, Story Composition, and word production). This pattern differed for Contextual Conventions, where the

ASD and ADHD groups did not significantly differ but performed lower than the TD group. In only one score (Spontaneous Writing Index) was there differentiation between the ASD and TD groups while the ADHD group did not differ from either group. Group-level differences in time spent engaged showed the ASD group spent less time engaged relative to the ADHD and TD groups. Within-group relationships showed time spent engaged was associated more strongly to a wider array of narrative writing scores in the ASD group compared to the ADHD and TD groups. Time spent engaged explained additional variance in Story Composition and word production scores in the ASD group but only in word production scores for the ADHD group (after including associated factors).

6.1. Narrative writing scores

The ASD group scored around average on the Spontaneous Writing Index and Contextual Conventions with slightly lower than average performance on Story Composition. However, not all children scored in the average ranges, as seen by the wide scoring ranges that varied from very low to very high (Table 2). The ADHD group performed similarly to the ASD group (with overall scores around average but with very wide scoring ranges). These findings support previous findings from both groups that have shown heterogeneous group-level writing skills where children often score as a group in the average range but show highly variable scoring ranges (Grace et al., 2017; Graham et al., 2016; Mayes & Calhoun, 2006a, 2006b, 2008; Zajic & Wilson, 2020).

Overall findings of lower scores for text organization and quality and average scores for spelling, grammar, and punctuation for the ASD group align with previous research findings (Brown et al., 2014; Dockrell et al., 2014; Mayes & Calhoun, 2006a; Price, Martin, Chen, & Jones, 2020; Zajic et al., 2018). The ADHD group, in contrast, demonstrated average spelling, grammar, and punctuation skills while showing slightly elevated group-level text generation and organization skills. These findings deviate from some past research findings that highlighted text organization and quality as areas of concern using different writing tasks (e.g., DeBono et al., 2012; Mayes & Calhoun, 2006a). Additionally, while some prior research has found children across both groups to demonstrate challenges with skills like spelling that were assessed as part of Contextual Conventions (e.g., DeBono et al., 2012; Finnegan & Accardo, 2018), current findings of no group-level deficits may be partially due to the lack of isolated skill assessments.

The ASD group scored lower in text organization and quality relative to both the ADHD and TD groups, highlighting a potential area of difficulty on this assessment in relation to the comparison groups. This moderate group-level difference is supported by prior research highlighting text generation as an area of difficulty for some children with ASD (Brown et al., 2014; Dockrell et al., 2014; Price et al., 2020). Furthermore, the ASD group produced the fewest number of words relative to both comparison groups, and the ADHD group produced fewer words relative to the TD group. Difficulties with word production may be related to handwriting and graphomotor difficulties noted as common in children with ASD and ADHD (e.g., Dirlikov et al., 2017; Mayes et al., 2019a). However, without an isolated assessment of handwriting skills, these differences may have also been due to difficulties related to generating text in line with narrative task demands in addition to potential transcription difficulties (see Berninger & Amtmann, 2003; Berninger & Winn, 2006).

Findings differ from three studies implementing an earlier version of the TOWL (TOWL-3; Hammill & Larsen, 1996) with children with either ASD or ADHD. A key difference between the two versions is the TOWL-3 produced three scores for the spontaneous writing subtest: Contextual Conventions, Contextual Language, and Story Construction. Troyb et al. (2014) found no group differences between their ASD and TD groups in word production, Contextual Conventions, Contextual Language, and Story Construction. Myles et al. (2003) found no group differences between their ASD and TD groups in Contextual Conventions, Contextual Language, and Story Construction, however, they noted a significant difference in word production (TD > ASD). DeBono et al. (2012) found no group differences across subscales between their ADHD group and their subclinical ADHD group while also reporting no group differences in word production. The differences between these studies and the current study may be due to scoring sensitivity concerns present in the TOWL-3 that were better addressed by the TOWL-4 (see Hammill & Larsen, 2009). However, these differences may also be due to sample demographics, shortening of the allotted Spontaneous Writing Task administration time for this study, or statistical power due to limited sample sizes.

6.2. Time spent engaged

The ASD group spent less time engaged with the overall writing task compared to the ADHD and TD groups. On average, the ASD group engaged for 460 s (7 min, 40 s) while the ADHD group engaged for 537 s (8 min, 57 s) and the TD group engaged for 544 s (9 min, 4 s). Though the ASD and ADHD groups showed a wider range of durations for time spent engaged with the task relative to the TD group, the ASD group remained lowest in terms of overall time spent engaged. The low engagement noted in the ASD group appears similar to recent findings showing that children with ASD demonstrate greater difficulties getting started with and staying on task during expository writing (Hilvert et al., 2020). Time spent engaged appeared most strongly associated with cognitive skills (predominantly verbal skills) only for the ASD group, as no other relationships appeared significant across other variables or other groups. This finding suggests that verbal knowledge and task engagement may be positively related, which aligns with prior research finding relationships between linguistic processes and writing skills in children with ASD (e.g., Brown et al., 2014; Dockrell et al., 2014; Hilvert et al., 2020). Additionally, the lack of significant associations between time spent engaged with age and symptom severity also suggest that task engagement was not related to the age of the participants or the degree of either ASD or ADHD symptom severity. However, it is important to consider that these relationships may differ in a non-picture-based task, given that children would not have a visual stimulus to focus on. Additionally, the relationships for the ADHD and TD groups remained non-significant. One explanation for the lack of significant relationships in these groups may be due to less heterogeneity observed in time spent engaged with the task (as average times for both groups appeared closer to the overall total allotted time).

Lower time spent engaged with the task suggests potential challenges for the ASD group that may be representative of struggling writers, such as difficulty with assessing completeness of task demands, navigating the goals of the task, or feeling overwhelmed by the demands of the task (Graham & Perin, 2007; Harris & Graham, 2016). Lower time spent engaged may also suggest motivation difficulties with completing the task demands that may be related to frustrations with transcription or text generation. Motivation towards writing influences how individuals see themselves as writers (Graham, 2018) and has been suggested as an area of difficulty for some writers with ASD (e.g., Boucher & Oehler, 2013) but with little current empirical examination. However, not all individuals with ASD ended the task before the end of the allotted time, suggesting that remaining engaged for the duration of the writing task is not a difficulty for all children with ASD. It is also important to note that while the ADHD group spent more time engaged overall with the task that did not significantly differ from the TD group, there were children with ADHD who ended the task well before the alloted time.

6.3. Relationships between writing, time spent engaged, age, cognitive abilities, and symptom severity

Results indicated that related factors like age, cognitive skills, and symptom severity accounted for 30–42 % and 27–39 % of the variance in the writing scores for the ASD and ADHD groups, respectively. The addition of time spent engaged accounted for additional variance explained for two scores for the ASD group (Story Composition: 42 % increased to 48 %; word production: 39 % increased to 50 %) and one score for the ADHD group (word production: 38 % increased to 51 %). Models for both groups included age while most included cognitive skills and ASD symptom severity. No models included ADHD symptom severity.

6.3.1. Age

Initial correlational analyses showed weak-to-moderate associations for age across all norm-referenced narrative writing scores in the ASD and ADHD groups while showing non-significant associations for the TD group. All groups showed a moderate-to-strong relationship between age and word production and non-significant associations between age and time spent engaged in the task. However, when accounting for additional factors, age remained a significant predictor for the ASD group for only Story Composition and word production (without and with time spent engaged) and for the ADHD group for word production (without and with time spent engaged).

Given that word production is expected to increase with age (as the involved processes become more automatic; Berninger & Amtmann, 2003), the associations between age and word production were expected across groups. Furthermore, as the narrative writing scores were norm-referenced by age groups, the lack of association between age and Contextual Conventions was also expected. Unexpected, however, was the significant association between age and Story Composition for the ASD group. Prior studies involving children with ASD have often included age as a variable of interest or as a control variable due to the use of non-standardized writing measures or wide sample age ranges (e.g., Brown et al., 2014; Dockrell et al., 2014; Hilvert et al., 2019). Findings from the current study, however, suggest that age explained unique variance in text quality and organization for the ASD group in a norm-referenced narrative writing score while accounting for cognitive skills and symptom severity. This distinction for Story Composition is important given that the TOWL-4 has been a recommended assessment of narrative written language skills of children with ASD (Corbett & Iqbal, 2018). Possible explanations for this association might include transcription, text generation, and executive function skill differences across the included age ranges (e.g., older children wrote text more fluently that met the narrative task demand due to understanding the underlying narrative story structure) as well as the potential for this to be due to shortening the overall task-time length (e.g., older children are more able to meet the task demands in the shortened duration compared to younger children). Understanding the influence of age requires further insights across the school-age years (see Zajic, Dunn, & Berninger, 2019 for further discussion).

6.3.2. Cognitive skills

Initial correlational analyses showed overall cognitive skills to be most strongly related to narrative scores in the ASD group compared to the ADHD and TD groups. The ASD group showed moderate relationships between verbal skills and narrative scores and weak relationships between perceptual skills and narrative scores. Across models, overall cognitive skills remained a unique predictor of narrative writing scores (without and with the inclusion of time spent engaged). In contrast, the ADHD group showed moderate relationships between verbal skills and Contextual Conventions with no significant relationships between perceptual skills and narrative scores. Verbal skills were only included in the model explaining Contextual Conventions (where they explained unique variance). The TD group, in contrast to both other groups, showed no significant relationships between verbal or perceptual skills and narrative scores.

Current results support prior findings of the relationships between verbal and perceptual skills in relation to writing skills in children with ASD and ADHD. In one prior study, Mayes and Calhoun (2008) reported a similar finding that written language skills in children with ASD were related similarly to both verbal and perceptual skills. The stronger relationship found for verbal skills rather than perceptual skills may also be related to recent findings of the importance of language to the written language skills of children with ASD (e.g., Brown et al., 2014; Dockrell et al., 2014; Price et al., 2020). Turning to children with ADHD, Mayes and Calhoun (2006b) found verbal skills to be more strongly related to writing scores than perceptual skills in children with ADHD, which is similar to the current findings. However, Mayes and Calhoun (2006b) reported overall cognitive skills to have the strongest association with writing for children with ADHD, which was not the case for the current study. One reason for this difference may be the use of the WASI-II rather than the Wechsler Intelligence Scale for Children (WISC; Wechsler, 2003). The FIQ estimate from the WASI-II is derived from verbal and perceptual reasoning abilities that do not assess working memory and processing speed skills that have

been shown to be related to the writing skills of children with ASD and ADHD (Mayes & Calhoun, 2006b, 2008).

6.3.3. Symptom severity

Across groups, initial correlational analyses showed moderate associations for ASD symptom severity and non-significant associations for ADHD symptom severity with narrative writing scores. In the ASD and ADHD groups, parent report of ASD symptom severity via the SRS was negatively, moderately associated with text organization and quality (as well as overall narrative writing, though this relationship appeared driven by text organization and quality) while direct observation of ASD symptoms via the ADOS-2 was not significant. In the ASD group, SRS was only included in the model for Story Composition, where it explained unique variance without and with time spent engaged. In the ADHD group, SRS was included in the model for Story Composition as well as word production, though it only explained unique variance in Story Composition. Neither ASD nor ADHD symptom severity was associated with any narrative writing scores in the TD group.

In previous studies of children with ASD, relationships between the SRS and writing scores have been mixed. While Dockrell et al. (2014) reported teacher report on the SRS to show negative relationships with writing scores, Brown et al. (2014) found parent report on the SRS to not explain unique variance after accounting for linguistic and cognitive skills. Further, Dirlikov et al. (2017) reported no significant relationship between parent report on the SRS and handwriting skills. Current findings suggest that parent report of ASD symptom severity may be related to difficulties with text organization and quality but not with spelling, grammar, and morphological skills. Additionally, direct observation of behaviors via the ADOS-2 showed no significant relationships with narrative writing scores. As prior studies of writing skills in children with ASD have relied on the use of parent report rather than direct observation (see Zajic & Wilson, 2020), these findings suggest that parent report via the SRS may be a stronger predictor of writing skills compared to direct observation via the ADOS-2. Parent report via the SRS may also be helpful in examining the role of social difficulties in the text organization and quality challenges of children with ADHD, as observed in the current findings. Findings for the ADHD group suggest that increased risk for ASD symptom severity may be associated with poorer text organization and quality as well as word production scores. These findings align with recent findings suggesting children with elevated ASD and ADHD symptom severity show greater risks for expository writing difficulties (Zajic et al., 2018). Elevated ratings of ASD symptom severity in children with ADHD have been found in other studies using the SRS (e.g., Bölte, Poustka, & Constantino, 2008), and additional research is needed to explore the relationships between ASD symptom severity and writing skills in children with ADHD.

ADHD symptom severity was not significantly associated with narrative writing scores in any group. Prior research has highlighted that children with ASD with elevated ADHD symptoms may be at a higher risk for writing difficulties due to underlying challenges with attention and executive functions (Hilvert et al., 2019; Zajic et al., 2018). However, a distinction in the current study from these previous studies is the use of a picture-based narrative writing task compared to non-picture-based expository tasks. The non-significant findings suggest that the role of attention in assisting with the regulation of other writing processes (e.g., Berninger & Amtmann, 2003; Graham, 2018) may be writing-task specific. The implemented task required drafting a narrative story about a picture, a task much different from creating an expository text with no picture (Hilvert et al., 2019; Zajic et al., 2018) and isolated handwriting or graphomotor tasks (Dirlikov et al., 2017; Grace et al., 2017). A prior study using the TOWL-3 that involved children with ADHD found similar non-significant results when examining their writing scores in relation to ADHD symptom severity (DeBono et al., 2012). Findings suggest that more specific research is needed to examine if the role of ADHD symptom severity may be differentially related to writing scores based on task demands.

6.3.4. Time spent engaged

Initial correlational analyses showed time spent engaged to be most strongly related to narrative writing scores for the ASD group in contrast to the ADHD and TD groups. For the ASD group, time spent engaged showed moderate-to-strong associations across narrative writing scores. Time spent engaged explained additional variance beyond associated factors in text organization and quality scores as well as word production scores for the ASD group. For the ADHD group, time spent engaged was most strongly related to word production scores (with a weak association to spelling, morphological, and grammar skills) and explained additional variance in predicting word production scores above and beyond age and SRS parent report scores. For the TD group, time spent engaged showed no significant associations with narrative writing scores (though all estimates fell within the weak-to-moderate range).

Time spent engaged provided little additional information about Contextual Conventions scores but significantly more information about word production for the ASD and ADHD groups. In these groups, time spent engaged initially appeared weakly associated with Contextual Conventions and explained limited additional variance in grammar, morphological, and spelling skills beyond age and cognitive skills (FIQ and VCI for the ASD and ADHD groups, respectively). Contextual Conventions measures linguistic features of writing that may be less related to the time spent engaged in the task. Across the 21 items scored on the subtest, only three items (the number of paragraphs, the number of the sentences in the paragraph[s], and the number of correctly spelled words with three syllables or more) may be influenced by persisting longer with writing. All remaining items focus, instead, on linguistic or orthographic (e.g., spelling) knowledge about writing that are relatively unimpacted by time (e.g., using specific punctuation, quotation marks, or words correctly). Associated areas of knowledge about these writing features may be better captured by the accounted for factors of age and cognitive abilities.

In contrast, time spent engaged showed a moderate relationship to word production for both groups that explained additional variance beyond age in both groups, cognitive skills in the ASD group, and ASD symptom severity in the ADHD group. These findings suggest that time spent engaged is an important predictor of the number of words produced during the writing assessment. Time spent engaged may provide another perspective into how productivity is measured during a writing assessment, given that word production has been conceived of as a form of productivity in prior research studies (e.g., Brown et al., 2014; DeBono et al., 2012).

However, time spent engaged may refer to a wider array of different activities children participate in during writing than solely the production of written text. These behaviors may differ depending upon task demands, as this task requires children to write about a picture and plan separately from the writing time. Children had access to multiple task components to engage with during the allotted time, so time spent engaged may provide additional information into how children are globally engaging with the writing task. It is also important to note that though both the ASD and ADHD groups showed a wide range for total time spent engaged, the average estimate for the ADHD group was closer to the allotted overall time. This finding should be interpreted with caution until additional research examines the relationships between time spent engaged and word production in longer writing tasks where children with ADHD may show more systematic variability.

Time spent engaged explained additional variance in Story Composition in the ASD group, a relationship not observed in the ADHD group. This finding suggests that children with ASD who engaged with the task for longer also wrote higher quality, organized texts (after controlling for age, cognitive skills, and ASD symptom severity). This distinction from the ASD group compared to the ADHD and TD groups may also be due to the group differences noted in time spent engaged with the task, with the ASD group spending the least amount of time engaged. As time spent engaged measured total task time until a child said they were completed with the task (or when the allotted task time was done), this finding suggests that children with ASD may be choosing to end the task sooner than their peers. Furthermore, the significant relationship between time spent engaged and Story Composition also suggests that ending their task early may be due to difficulties in judging task completeness, as spending longer in the task predicted higher Story Composition and word production scores. Difficulties with these aspects of writing align with the high prevalence of writing difficulties specifically with text organization and quality (e.g., Brown et al., 2014; Mayes & Calhoun, 2006a, 2008), and specific difficulties with engaging globally with the writing task suggests another way in which difficulties with executive functions may impact their writing skills (e.g., Hilvert et al., 2019). The lack of a similar finding in the ADHD group may have been due to less pronounced variability in task engagement (i.e., if all children used most of the fully allotted time, then small fluctuations in time spent engaged may not be as predictive as other underlying factors).

6.4. Implications for instructional practice

Children with ASD demonstrate highly heterogeneous writing skills with difficulties often noted in handwriting and text organization and quality (Brown et al., 2014; Dockrell et al., 2014; Hilvert et al., 2019; Kushki et al., 2011; Zajic & Wilson, 2020). For practitioners, understanding the different factors influencing these writing skills is a necessity in order to develop effective instructional practices to meet the needs of children with ASD. The focus of the current study on time spent engaged showed a distinction in the role that global task engagement may have on narrative writing scores for children with ASD compared to peers with ADHD and TD peers. Given that peers with ADHD commonly experience similar writing difficulties (DeBono et al., 2012; Molitor et al., 2016), current findings highlight that global task engagement may be a more prominent concern for children with ASD compared to children with ADHD. More specifically, time spent engaged also appeared associated with word production and text organization and quality scores but not with grammar, morphological, and spelling scores.

Practitioners should consider multiple approaches to identify and support the writing skills of struggling writers (see Saddler & Asaro-Saddler, 2013). Children with ASD who demonstrate challenges with word production as well as text organization and quality may benefit from targeted instructional approaches focused on developing engaged, strategic writing processes (e.g., Graham & Perin, 2007). Structured approaches like self-regulated strategy development (SRSD) offer evidence-based writing support to help struggling writers become more strategic in organizing and navigating the writing process (see Harris & Graham, 2016). Numerous studies have shown SRSD to be effective for some school-age children with ASD who struggle with these aspects of writing (see Asaro-Saddler, 2016). In addition to SRSD, practitioners should look to other interventions focused on supporting the writing and broader literacy skills of individuals with ASD (Accardo, Finnegan, Kuder, & Bomgardner, 2019; Finnegan, 2019). This study highlighted that focusing on time spent engaged during a writing task does not remove the need to account for associated language, cognitive, and social factors that may impact writing skills and broader writing development (see Brown et al., 2014; Dockrell et al., 2014; Hilvert et al., 2019; Zajic et al., 2019). This is particularly important given the findings for word production, as difficulties with word production may be due to the high prevalence of handwriting and graphomotor difficulties (Dirlikov et al., 2017; Kushki et al., 2011) as well as to difficulties with comprehending the linguistic and social cognitive demands of different written language tasks.

7. Limitations and future directions

This study includes numerous limitations that should be taken into consideration in future research studies. First, this study relied on time spent engaged at the task level. Attending to time spent explicitly writing or attending to different task components (such as engaged with task components versus disengaged away from the task) may offer further insights into additional group differences (e.g., did groups demonstrate increased within-task disengagement rather than global task disengagement?). Second, additional measures of both written language as well as related skills are needed. This study relied on one picture-based, fictional narrative writing assessment that may not generalize to non-picture-based narrative writing tasks as well as to expository, persuasive, or personal narrative writing. Few studies have considered genre-specific differences in task demands (e.g., Price et al., 2020; Zajic et al., 2019) that require further examination to make more sense of the current findings. Further, future research should make use of additional measures of executive function and attention to provide further insights into relationships between engagement, self-regulation, and writing skills. Third, while this study included age, cognitive skills, and symptom severity, several other important factors need to be more fully considered. For example, few studies have examined transcription and text generation skills

simultaneously (see Zajic & Wilson, 2020), which is a needed consideration to better understand engagement given the elevated risk of handwriting and graphomotor difficulties in children with ASD and ADHD (Mayes et al., 2019a). Numerous studies have used typing rather than handwriting (e.g., Brown et al., 2014; Hilvert et al., 2019) which may lead to further differences in findings across similar writing tasks. Fourth, as the TOWL-4 administration was shorter than recommended, identified differences for time spent engaged may have been minimized. Allowing for the full assessment duration may lead to larger group differences and additional variability in the ADHD and TD groups potentially not observed in the current study. Finally, though the findings are supported by prior research, the limited sample sizes (particularly for the ADHD and TD groups), the elevated cognitive skill scores and lower male participant percentage in the TD group, and the reliance on a diagnostic writing assessment limit certain generalizations. One example of this concern can be seen with the TD group showing few similar relationships between variables of interest as found in the ASD and ADHD groups. The lack of these relationships may have been due to higher and less variable TOWL-4 performance as well as limited variability in ASD and ADHD symptom severity. Subsequent research with larger samples and additional measures sensitive to TD sample heterogeneity are needed to expand upon these initial findings.

8. Conclusion

This study offers an empirical examination of narrative writing skills in children with ASD compared to peers with ADHD and TD peers with a focus on the role of broad task engagement. Children with ASD demonstrated lower group-level text organization and quality scores and word production scores as well as spent less time engaged in the task compared to their peers. Additionally, time spent engaged was more strongly associated with narrative writing scores for children with ASD compared to their peers with ADHD and explained additional variance in both text organization and quality scores and word production scores after accounting for related age, cognitive skills, and symptom severity factors. These findings differed from results for the ADHD group that showed they spent a similar amount of time engaged in the task compared to the TD group and showed meaningful associations only between time spent engaged and word production scores. This study offered novel insights into considering time spent engaged as a measure of productivity in narrative writing in children with ASD and expands upon how researchers can think about assessing writing engagement with children with developmental disabilities. These preliminary findings suggest that continued understanding of task engagement difficulties presented more often by children with ASD may offer new insights into the multifaceted role that engagement has on their transcription and text generation skill development.

CRediT authorship contribution statement

Matthew Carl Zajic: Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft, Writing - review & editing, Project administration. **Emily Jane Solari:** Conceptualization, Writing - original draft, Writing - review & editing, Funding acquisition. **Nancy Susan McIntyre:** Investigation, Project administration. **Lindsay Lerro:** Investigation, Project administration. **Peter Clive Mundy:** Conceptualization, Formal analysis, Writing - original draft, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interest

Authors disclose no personal, financial, or other conflicts of interest.

Acknowledgments

The research reported in this paper was supported by a grant from the Institute of Education Sciences (R324A120168) and the UC Davis Department of Psychiatry Lisa Capps Endowment for Research on Education and Neurodevelopmental Disorders. Matthew Zajic received support from a Postdoctoral Research Training Program in Special Education and Early Intervention Grant from the National Center for Special Education Research at the Institute of Education Sciences (R324B180034) during the drafting of the manuscript. The funding sources were not involved in the study design, data collection and analysis, writing of the report, or decision to submit the article for publication. We are grateful for the time and dedication of our participating families.

References

Accardo, A. L., Finnegan, E. G., Kuder, S. J., & Bomgardner, E. M. (2019). Writing interventions for individuals with autism spectrum disorder: A research synthesis. *Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/s10803-019-03955-9 Advance Online Publication.

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders: DSM-5*. Arlington, VA: American Psychiatric Association.

Asaro-Saddler, K. (2016). Writing instruction and self-regulation for students with autism spectrum disorders: A systematic review of the literature. *Topics in Language Disorders, 36*(3), 266–283. https://doi.org/10.1097/TLD.0000000000000093.

Bauminger-Zviely, N. (2014). School-age children with ASD. In F. R. Volkmar, R. Paul, S. J. Rogers, & K. A. Pelphrey (Eds.). *Handbook of autism and pervasive developmental disorders*(4th ed.). Oxford Press New York: John Wiley Hoboken, NJ.

Berninger, V. W., & Amtmann, D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice. In H. L. Swanson, S. Graham, & K. R. Harris (Eds.). *Handbook of learning disabilities* (pp. 345–363). New York, NY: Guilford.

Berninger, V. W., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In C. MacArthur, S. Graham, & J. Fitzgerald (Eds.). *Handbook of writing research* (pp. 96–114). New York, NY: Guilford.

Bölte, S., Poustka, F., & Constantino, J. N. (2008). Assessing autistic traits: Cross-cultural validation of the social responsiveness scale (SRS). *Autism Research, 1*, 354–363. https://doi.org/10.1002/aur.49.
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, H. M., Johnson, A. M., Smyth, R. E., & Oram Cardy, J. (2014). Exploring the persuasive writing skills of students with high-functioning autism spectrum disorder. *Research in Autism Spectrum Disorders, 8*(11), 1482–1499. https://doi.org/10.1016/j.rasd.2014.07.017.
Bryan, L. C., & Gast, D. L. (2000). Teaching on-task and on-schedule behaviors to high-functioning children with autism via picture activity schedules. *Journal of Autism and Developmental Disorders, 30*(6), 553–567. https://doi.org/10.1023/A:1005687310346.
Conners, C. K. (2008). *Conners third edition (Conners 3).* Los Angeles, CA: Western Psychological Services.
Constantino, J. N., & Gruber, C. P. (2005). *Social responsiveness scale (SRS) manual.* Los Angeles, CA: Western Psychological Services.
Corbett, B. A., & Iqbal, Y. S. (2018). Clinical assessment of neuropsychological functioning in autism spectrum disorder. In S. Goldstein, & S. Ozonoff (Eds.). *Assessment of autism spectrum disorder* (pp. 263–307). (2nd ed.). New York, NY: The Guilford Press.
DeBono, T., Hosseini, A., Cairo, C., Ghelani, K., Tannock, R., & Toplak, M. E. (2012). Written expression performance in adolescents with attention-deficit/hyperactivity disorder (ADHD). *Reading and Writing, 25*(6), 1403–1426. https://doi.org/10.1007/s11145-011-9325-8.
Deprey, L., & Ozonoff, S. (2018). Assessment of comorbid psychiatric conditions in autism spectrum disorder. In S. Goldstein, & S. Ozonoff (Eds.). *Assessment of autism spectrum disorder* (pp. 308–337). (2nd ed.). New York, NY: The Guilford Press.
Dirlikov, B., Younes, L., Nebel, M. B., Martinelli, M. K., Tiedemann, A. N., Koch, C. A., et al. (2017). Novel automated morphometric and kinematic handwriting assessment: A validity study in children with ASD and ADHD. *Journal of Occupational Therapy Schools, & Early Intervention, 10*(2), 185–201. https://doi.org/10.1080/19411243.2017.1304841.
Dockrell, J. E., 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. https://doi.org/10.1016/j.learninstruc.2014.01.008.
DuPaul, G. J., & Langberg, J. (2015). Educational impairments in children with ADHD. In R. A. Barkley (Ed.). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (pp. 169–190). (4th ed.). New York, NY: The Guilford Press.
Finnegan, E. G. (2019). Literacy instruction for students with autism spectrum disorder in inclusive settings. *DADD Online Journal, 6*(1), 72–88.
Finnegan, E., & Accardo, A. (2018). Written Expression in Individuals with Autism Spectrum Disorder: A Meta-Analysis. *Journal of Autism and Developmental Disorders, 48*, 868–882. https://doi.org/10.1007/s10803-017-3385-9.
Grace, N., Enticott, P. G., Johnson, B. P., & Rinehart, N. J. (2017). Do handwriting difficulties correlate with core symptomatology, motor proficiency and attentional behaviors? *Journal of Autism and Developmental Disorders, 47*, 1006–1017. https://doi.org/10.1007/s10803-016-3019-7.
Graham, S., et al. (2018). A writer(s) within community model of writing. In C. Bazerman, A. Applebee, V. W. Berninger, D. Brandt, S. Graham, & J. V. Jeffery (Eds.). *The lifespan development of writing* (pp. 272–325). Urbana, IL: National Council of English.
Graham, S., & Perin, D. (2007). *Writing next: Effective strategies to improve writing of adolescents in middle and high schools.* New York, NY: Carnegie Corporation of New York.
Graham, S., Fishman, E. J., Reid, R., & Hebert, M. (2016). Writing characteristics of students with attention deficit hyperactive disorder: A meta-analysis. *Learning Disabilities Research and Practice, 31*(2), 75–89. https://doi.org/10.1111/ldrp.12099.
Griswold, D. E., Barnhill, G. P., Myles, B. S., Hagiwara, T., & Simpson, R. L. (2002). Asperger syndrome and academic achievement. *Focus on Autism and Other Developmental Disabilities, 17*(2), 94–102. https://doi.org/10.1177/10883576020170020401.
Hammill, D. D., & Larsen, S. C. (1996). *Test of written language* (3rd edition). Austin, TX: Pro-ed.
Hammill, D. D., & Larsen, S. C. (2009). *Test of written language-fourth edition (TOWL-4).* Austin, TX: Pro-ed.
Harris, K. R., & Graham, S. (2016). Self-regulated strategy development in writing: Policy implications of an evidence-based practice. *Policy Insights From the Behavioral and Brain Sciences, 3*(1), 77–84. https://doi.org/10.1177/2372732215624216.
Hayes, J. R., & Berninger, V. W. (2014). Cognitive process in writing: A framework. In J. B. Arfé, J. E. Dockrell, & V. W. Berninger (Eds.). *Writing development in children with hearing loss, dyslexia or oral language problems: Implications for assessment and instruction* (pp. 3–15). New York, NY: Oxford University Press.
Hilvert, E., Davidson, D., & Scott, C. M. (2019). An in-depth analysis of expository writing in children with and without autism spectrum disorder. *Journal of Autism and Developmental Disorders, 49*(8), 3412–3425. https://doi.org/10.1007/s10803-019-04057-2.
Hilvert, E., Davidson, D., & Gámez, P. B. (2020). Assessment of personal narrative writing in children with and without autism spectrum disorder. *Research in Autism Spectrum Disorders, 69*, 101453. https://doi.org/10.1016/j.rasd.2019.101453.
IBM Corp (2018). *IBM SPSS statistics, version 25.0.* Armonk, NY: IBM Corp.
Ibrahim, I. (2020). Specific learning disorder in children with autism spectrum disorder: Current issues and future implications. *Advances in Neurodevelopmental Disorders,* 1–10.
Keen, D., Webster, A., & Ridley, G. (2016). How well are children with autism spectrum disorder doing academically at school? An overview of the literature. *Autism: The International Journal of Research and Practice, 20*(3), 276–294. https://doi.org/10.1177/1362361315580962.
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*(12), 1706–1716. https://doi.org/10.1007/s10803-011-1206-0.
Lord, C., Rutter, M., DiLavore, P., Risi, S., Gotham, K., & Bishop, S. (2012). *Autism diagnostic observation schedule second edition (ADOS-2).* Torrance, CA: Western Psychological Services.
Mayes, S. D., & Calhoun, S. L. (2003a). Ability profiles in children with autism: Influence of age and IQ. *Autism: The International Journal of Research and Practice, 7*(1), 65–80. https://doi.org/10.1177/1362361303007001006.
Mayes, S. D., & Calhoun, S. L. (2003b). Analysis of WISC-III, Stanford-Binet:IV, and academic achievement test scores in children with autism. *Journal of Autism and Developmental Disorders, 33*(3), 329–341.
Mayes, S. D., & Calhoun, S. L. (2006a). Frequency of reading, math, and writing disabilities in children with clinical disorders. *Learning and Individual Differences, 16*(2), 145–157. https://doi.org/10.1016/j.lindif.2005.07.004.
Mayes, S. D., & Calhoun, S. L. (2006b). WISC-IV and WISC-III profiles in children with ADHD. *Journal of Attention Disorders, 9*(3), 486–493. https://doi.org/10.1177/1087054705283616.
Mayes, S. D., & Calhoun, S. L. (2008). WISC-IV and WIAT-II profiles in children with high-functioning autism. *Journal of Autism and Developmental Disorders, 38*(3), 428–439. https://doi.org/10.1007/s10803-007-0410-4.
Mayes, S. D., Breaux, R. P., Calhoun, S. L., & Frye, S. S. (2019a). High prevalence of dysgraphia in elementary through high school students with ADHD and autism. *Journal of Attention Disorders, 23*(8), 787–796. https://doi.org/10.1177/1087054717720721.
Mayes, S. D., Waschbusch, D. A., Calhoun, S. L., & Mattison, R. E. (2019b). How common are academic overachievement and underachievement in children with autism or ADHD? *Journal of Developmental and Physical Disabilities,* 1–9. https://doi.org/10.1007/s10882-019-09719-8.
Molitor, S. J., Langberg, J. M., & Evans, S. W. (2016). The written expression abilities of adolescents with attention-deficit/hyperactivity disorder. *Research in Developmental Disabilities, 51*, 49–59. https://doi.org/10.1016/j.ridd.2016.01.005.
Myles, B. S., Huggins, A., Rome-Lake, M., Hagiwara, T., Barnhill, G. P., & Griswold, D. E. (2003). Written language profile of children and youth with Asperger syndrome: From research to practice. *Education and Training in Developmental Disabilities, 38*(4), 362–369.
Price, J. R., Martin, G. E., Chen, K., & Jones, J. R. (2020). A preliminary study of writing skills in adolescents with autism across persuasive, expository, and narrative genres. *Journal of Autism and Developmental Disorders, 50*(1), 319–332. https://doi.org/10.1007/s10803-019-04254-z.
Saddler, B., & Asaro-Saddler, K. (2013). Response to intervention in writing: A suggested framework for screening, intervention, and progress monitoring. *Reading and Writing Quarterly, 29*(1), 20–43. https://doi.org/10.1080/10573569.2013.741945.
Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin, 86*(2), 420–428. https://doi.org/10.1037/0033-2909.86.2.420.

Sparapani, N., Morgan, L., Reinhardt, V. P., Schatschneider, C., & Wetherby, A. M. (2016). Evaluation of classroom active engagement in elementary students with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 46*(3), 782–796.

Troyb, E., Orinstein, A., Tyson, K., Helt, M., Eigsti, I. M., Stevens, M., et al. (2014). Academic abilities in children and adolescents with a history of autism spectrum disorders who have achieved optimal outcomes. *Autism: The International Journal of Research and Practice, 18*(3), 233–243. https://doi.org/10.1177/1362361312473519.

Wechsler, D. (2003). *Wechsler intelligence scale for children—Fourth edition (WISC-IV) technical and interpretive manual.* San Antonio, TX: The Psychological Corporation.

Wechsler, D. (2011). *Wechsler abbreviated scale of intelligence – Second edition (WASI-II).* San Antonio, TX: The Psychological Corporation.

Whitby, P., & Mancil, G. (2009). Academic achievement profiles of children with high functioning autism and Asperger syndrome: A review of the literature. *Education and Training in Developmental Disabilities, 44*(4), 551–560.

Wilkinson, L. A. (2008). Self-management for children with high-functioning autism spectrum disorders. *Intervention in School and Clinic, 43*(3), 150–157. https://doi.org/10.1177/1053451207311613.

Zajic, M. C., & Asaro-Saddler, K. (2019). Issue editor foreword: Supporting writers across the autism spectrum. *Topics in Language Disorders, 39*(2), 123–127. https://doi.org/10.1097/TLD.0000000000000182.

Zajic, M. C., & Wilson, S. E. (2020). Writing research involving children with autism spectrum disorder without a co-occurring intellectual disability: A systematic review using a language domains and mediational systems framework. *Research in Autism Spectrum Disorders, 70*, 101471. https://doi.org/10.1016/j.rasd.2019.101471.

Zajic, M. C., 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: The International Journal of Research and Practice, 22*(3), 245–258. https://doi.org/10.1177/1362361316675121.

Zajic, M. C., Dunn, M., & Berninger, V. (2019). Case studies comparing learning profiles and response to instruction in autism spectrum disorder and oral and written language learning disability at transition to high school. *Topics in Language Disorders, 39*(2), 128–154. https://doi.org/10.1097/TLD.0000000000000180.

Zajic, M. C., Solari, E., J, McIntyre, N. S., Lerro, L., & Mundy, P. (2020). Overt planning behaviors during writing in school-age children with autism spectrum disorder and attention-deficit/hyperactivity disorder. *Research in Developmental Disabilities, 100*, 103631. https://doi.org/10.1016/j.ridd.2020.103631.

Zimmerman, B. J., & Risemberg, R. (1997). Becoming a self-regulated writer: A social cognitive perspective. *Contemporary Educational Psychology, 22*(1), 73–101. https://doi.org/10.1006/ceps.1997.0919.