Short Report

Autism & Developmental Language Impairments

Autism & Developmental Language Impairments
Volume 9: 1–13

DOI: 10.1177/23969415241227071
journals.sagepub.com/home/dli

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Examining gender effects in autistic written language skills: A small sample exploratory study

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Abstract

Background and aims: Gender differences in the written language of autistic individuals are an overlooked but important area of research. We contend that the gender differences in spoken language of autistic individuals may extend to written language, mirroring the gender differences of writing in the general population and reflecting the shared dimensionality of oral and written language. Our research question was: Do autistic adolescent females demonstrate written language characteristics, across persuasive, expository, and narrative genres, that are distinct from those of autistic adolescent males and non-autistic (NA) adolescent females?

Methods: We performed a secondary, exploratory analysis on writing samples collected from 18 participants (11 autistic males, three autistic females, and four NA females) from a larger investigation of autistic adolescents' writing skills. Each participant completed three writing samples—one persuasive, one expository, and one narrative (for a total of 54 writing samples). We compared sample length (total number of words), writing productivity (words written per minute), syntactic length (mean length of T-unit in words), vocabulary diversity (type-token ratio), and macrostructure of autistic females' samples to autistic males' and NA females' samples.

Results: Based on non-parametric analyses using variable medians, autistic males, but not autistic females, wrote significantly shorter expository samples than NA females. Autistic males' writing productivity was significantly lower in the persuasive and expository genres than both autistic females and NA females. Several other comparisons of sample length, productivity, vocabulary diversity, and persuasive and narrative macrostructure yielded large effect sizes but were not statistically significant.

Conclusions: Though our small sample sizes prevent us from drawing generalizable conclusions, we observed that some gender-specific findings of the current study differ from previous findings based on a single autistic group (females and males combined). Combining data of autistic females with autistic males may cloud the distinct written language characteristics of each group.

Implications: Our findings, especially when situated in the context of relevant literature, suggest that larger-scale investigation of gender differences in written language is essential in order to more fully describe the unique characteristics of autistic females. Clinicians should be prepared to support autistic writers' needs for producing written language to meet their developmental, academic, social, and employment-related goals.

Keywords

Autism, written language, gender differences, adolescence

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Introduction

Growing research evidence indicates that autistic females have a unique phenotype, including oral communication and language characteristics that differentiate them from autistic males (e.g., Wood-Downie et al., 2021). In this article, we contend that gender differences in autism may extend to written language and offer exploratory data supporting this view. Accordingly, we maintain that gender differences in written language processes and products should be investigated in large-scale studies of autistic individuals and that support for written language skills should be tailored to the specific characteristics, needs, and desires of each student. More fully identifying the profiles of autistic females is essential for improving diagnosis, support, and outcomes for this group that is often under-identified, under-served, and under-represented in research (Cariveau et al., 2021; Mandy & Lai, 2017).

Importance of writing

Writing is a skill that is vital for learners across developmental, academic, and employment contexts. The Common Core State Standards (CCSS) delineate learning expectations for students in kindergarten through 12th grade, outlining writing expectations across the narrative, informational/expository, and argument genres (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). In early elementary grades, children begin to write across genres with introductory writing structures. Children learn to use fundamental writing elements such as incorporating a central topic, including supportive reasoning and information, as well as providing a sense of closure. As children progress through grade school, writing demands become increasingly more dynamic. Prior to completing high school, students are expected to write arguments based on analysis and evidence, explanatory texts that accurately portray complex ideas with coherent organization, and narratives that are well developed with details and organization. Writing continues to be important as students transition to adulthood. Written communication has been identified as one of the top five "essential" skills for employment (National Association of Colleges and Employers, 2020).

Writing competencies are not developed in isolation. Writing development is intricately multidimensional, relying on other domains of development such as attention and executive function, as well as language, cognitive, sensorimotor, and social-emotional domains (Bazerman et al., 2017). External variables such as the instructional environment and sociocultural factors shape an individual's writing development (Bazerman et al., 2017; Berninger et al., 1996; Deane, 2018). Therefore, variations in writing development trajectories are to be expected.

Rationale for examining written language gender differences in autism

Here, we briefly review literature from multiple perspectives (i.e., written and oral communication skills in autism, the shared dimensionality of spoken and written language, and gender differences in written language in the general/non-autistic [NA] population) that, when integrated, provides our rationale for considering gender differences in written language in autism. According to Finnegan and Accardo's (2018) meta-analysis, autistic students often perform significantly lower than NA students on measures of written language expression. Zajic and Wilson's (2020) systematic review emphasized the individual variability of autistic writing, while also indicating that numerous investigations (of varying quality) of writing in autistic children without co-occurring intellectual disability have been conducted; yet, females have been markedly underrepresented, with an average of only 11% female participants across studies. To the best of our knowledge, gender differences in the written language of autistic individuals have not been investigated. However, gender differences in spoken language have been established. In a recent meta-analysis, Wood-Downie et al. (2021) found that autistic females demonstrated significantly better social interaction and communication skills than autistic males, while their skills were significantly lower than NA females. Importantly, this meta-analysis included only narrow constructs of social interaction and communication, whereas previous meta-analyses that did not find sex/gender differences analyzed broad construct data from diagnostic instruments normed primarily on males and/or collected via parental and observer reports rather than direct assessment (e.g., van Winjngaarden-Cremers et al., 2014). Furthermore, Wood-Downie et al.'s (2021) meta-analysis found that the communication-related gender differences in autistic individuals mirrored differences in the general population.

Language sampling provides an avenue for authentic, detailed assessment of specific aspects of communication skills. As "the gold standard for assessing spoken language production" (Miller et al., 2016, p. 99), it is an important context for examining gender differences. During semi-structured interviews, autistic females produced more social- and friend-related words (Cola et al., 2022) and used filled pauses (i.e., "um" and "uh") differently than autistic males (Parish-Morris et al., 2017). Compared to autistic males, autistic females narrated stories with greater internal state language (Kauschke et al., 2016), cognitive process words (Boorse et al., 2019), story elements, semantic elaborations, and cohesion (Conlon et al., 2019). Utilizing highly specified, experimental measures, Sturrock et al. (2020) found that autistic females outscored autistic males on aspects of figurative language, inferences, and emotion vocabulary.

Gender differences in spoken language suggest the possibility of gender differences in written language. Recent models endorse the shared dimensionality of oral and written language, indicating that speaking and writing depend in part on common linguistic and cognitive mechanisms and knowledge for both typically developing children and children with language-based disabilities (Kim & Graham, 2022; Nelson et al., 2022). This shared dimensionality also likely characterizes the speaking and writing skills of autistic children (Zajic & Brown, 2022). Given the centrality of written language production in developmental, school, and career contexts, as well as the close relationship between oral and written language, a comprehensive conceptualization of possible gender differences in communication skills in autism should include not just oral communication skills, but also written communication skills.

Considerable research on the general population suggests that females surpass males on measures of writing. Although the gender similarities hypothesis (Hyde, 2005) indicates females and males "are more alike than different on most psychological variables [,] … writing is an academic skill that may be an exception" (Reynolds et al., 2015, p. 211). Writing is an integrative task that requires individuals to synthesize language and other abilities; as the complexity of a writing task increases, larger gender differences emerge (Reilly et al., 2019). Achievement trends of the general population in the United States show females have outperformed males in several national writing assessments in fourth, eighth, and 12th grades (Freeman, 2004; National Center for Education Statistics, 2012). In addition, females outperform males on more specific measures of writing, including writing fluency, spelling, and writing quality (Camarata & Woodcock, 2006; Kim et al., 2015; Reynolds et al., 2015). Such gender differences in the general population's written language skills further support the notion that gender differences in writing may exist naturally among autistic students and should be considered.

Purpose of the current study

Given the centrality of writing across life contexts, the established gender differences of autistic individuals' oral language, the shared dimensionality of oral and written language, and gender differences of the general population's writing skills, investigation of gender differences in autistic individuals' written language skills is merited. In the current study, we performed a secondary, exploratory analysis of data from an earlier investigation of autistic adolescents' persuasive, expository, and narrative writing samples (Price et al., 2020), with a specific focus on exploring gender differences. In the original study, we examined written language product differences between diagnostic groups (autistic vs. NA) but not genders. We found that the autistic group (females and males combined) wrote persuasive and expository samples of significantly shorter length with less developed macrostructure, compared to the NA group. The autistic group demonstrated significantly greater lexical diversity in the persuasive genre, compared to the NA group. Several other between-group comparisons across the three genres yielded non-significant differences but large effect sizes. Though these findings contributed to literature regarding autistic individuals' writing skills, potential differences between autistic females and autistic males were obscured. However, the dataset offered an opportunity to explore a new research question that was the basis of the current study: Do autistic adolescent females demonstrate written language skills, across persuasive, expository, and narrative genres, that are distinct from those of autistic adolescent males and NA females?

Methods

We re-examined data from an earlier study of adolescents' persuasive, expository, and narrative writing samples (Price et al., 2020). In order to delineate characteristics aligned with gender and autism status, comparing autistic females to both autistic males and NA females is recommended (Sturrock et al., 2021). For the current analysis, data from a total of 18 participants, separated by gender and autism status (autistic females [$n = 3$], autistic males [$n = 11$], and NA females [$n = 4$]) were analyzed. As small sample sizes precluded parametric inferential statistical analyses, data were examined descriptively and with non-parametric tests.

Participants

The investigation was approved by the university's Institutional Review Board. Full descriptions of participants and procedures are provided in Price et al. (2020). Participants ranged in age from 10 to 16 years, used English as their primary language, and did not have intellectual disability. Among autistic participants, 79% ($n = 11$) were males and 21% ($n = 3$) were females, as categorized by their caregiver. These percentages of males to females reflect the reported overall male-to-female ratio of 4:1 in autism (Centers for Disease Control and Prevention, 2023).

As reported in Table 1, the groups did not differ significantly in age ($H(2) = 0.71$, $p = .70$, $\varepsilon^2 = .04$), full-scale IQ ($H(2) = 0.57$, $p = .75$, $\varepsilon^2 = .03$), or verbal IQ ($H(2) = 3.02$, $p = .22$, $\varepsilon^2 = .18$). The median age of autistic females was 15;2, autistic males was 12;5, and NA females was 13;0. All groups' median full-scale and verbal IQ scores, as measured by the Wechsler Abbreviated Scales of Intelligence, Second Edition (WASI-II; Wechsler, 2011), were in the average range. The WASI-II is a valid and reliable measure of IQ for

Table 1. Participant characteristics.

	Autistic		Non-autistic	Kruskal–Wallis test			Autistic females vs. autistic males	Autistic females vs. non-autistic females	Autistic males vs. non-autistic females
	Females $n = 3$ Median Range	Males $n = 11$ Median Range	Females $n = 4$ Median Range	*H*-statistic	*p*	ε^2	*p*	*p*	*p*
Age	15;2 10;10–15;2	12;5 10;0–15;9	13;0 10;10–15;2	0.71	.70	.04	1	1	1
Full scale IQ	103 90–111	103 75–130	104.5 97–138	0.57	.75	.03	1	1	1
Verbal IQ	104 81–110	90 74–137	109 97–129	3.02	.22	.18	1	.92	.25
CCC-2 general composite	75 74–80	77 65–88	115 111–119	8.95	.01*	.53	1	.05	.01*
CCC-2 subscales									
Speech	12 9–12	9 6–12	12 12	6.15	.046*	.36	.52	1	.06
Syntax	10 8–12	8 7–12	12 12	5.58	.06	.33	1	.73	.06
Semantics	7 4–8	8 5–10	13 10–13	9.03	.01*	.53	1	.03*	.02*
Coherence	5 4–7	5 1–10	12 10–13	8.78	.01*	.52	1	.05*	.02*
Initiation	3 1–4	6 4–9	12 11–15	12.59	.002*	.74	.19	.001*	.04*
Scripted language	4 3–5	5 1–8	11.5 10–12	9.19	.01*	.54	1	.04*	.02*
Context	6 2–6	6 2–7	11 10–13	9.23	.01*	.54	1	.04*	.01*
Nonverbal communication	5 3–7	4 1–6	13 12–13	9.78	.008*	.58	1	.30	.005*

Note. CCC-2 = Children's Communication Checklist-2.
*$p < .05$.

children ages 6–16 years, highly correlated ($r = .83–.85$) with other well-established IQ tests, with high internal consistency (split-half reliability $r = .87–.91$ on subtests and .92–.96 on composite scores).

The Children's Communication Checklist-2 (CCC-2; Bishop, 2006) is a valid and reliable measure of the oral communication skills of children ages 4–16. It has high internal consistency reliability (.94–.96). Sample-specific reliability is not available. Groups differed in their overall oral communication skills ($H(2) = 8.95$, $p = .01$, $\varepsilon^2 = .57$), with both autistic groups' median scores below average (autistic female $Mdn = 75$; autistic male $Mdn = 77$) and autistic males scoring significantly lower than NA females ($p = .01$). The difference between the autistic females and NA females was not significant ($p = .052$). The autistic groups' performance diverged from the NA group's on some subscales of oral communication. For both autistic groups, most oral communication subscale median scores related to structural aspects of language (i.e., Speech and Syntax, but not Semantics) were within the average range of the CCC-2's normative sample and did not differ significantly from the NA female group, while all median scores for subscales related to pragmatics (i.e., Coherence, Initiation, Scripted Language, Context, and Nonverbal Communication) were below the average range. Semantics and all pragmatic subscales, with one exception (autistic females' Nonverbal Communication subscale scores), were also significantly lower in both autistic groups than the NA female group.

Procedures and variables

Each participant completed three writing samples (one from each genre—persuasive, expository, and narrative), with order counterbalanced. For each genre, participants were given a prompt and then up to 20 min to handwrite their

response. For the persuasive sample, participants argued for or against students attending school in the summer. The expository prompt asked participants to describe a person they admired. For the narrative sample, participants wrote about a memorable family experience. Written samples were transcribed and analyzed by trained research assistants using the Systematic Analysis of Language Transcripts (http://www.saltsoftware.com). The following variables are reported here: (a) *length of writing sample*, calculated as the total number of words per sample; (b) *productivity*, computed as the number of words written per minute; (c) *syntactic length*, which was the mean length of T-units in words; (d) *type-token ratio (TTR)*, a measure of vocabulary diversity calculated by dividing the number of different words by the total number of words per sample; and (e) *macrostructure scores*, derived from genre-specific rubrics that quantified overall organization and quality of the writing samples. Macrostructure scores ranged from 0 to 13 points on the persuasive rubric, 0 to 12 points on the expository rubric, and 0 to 21 points on the narrative rubric.

In the original study, inter-reliability between two raters for segmentation into T-units (90.2% agreement) and coding macrostructure (weighted kappa = .63–.76) was good (Price et al., 2020).

Statistical analysis

A Kruskal–Wallis test was used to determine significant median differences between the three groups in participant characteristics (e.g., IQ scores and overall oral communication skills), writing skills across the genres (e.g., length of sample in words, words written per minute), and macrostructure scores (e.g., using scores from the persuasive, expository, and narrative rubrics). Epsilon-squared (ϵ^2; King et al., 2018) was calculated to estimate the effect size of the Kruskal–Wallis test. ϵ^2 is in the *r* family of effect size measures and estimates the strength of association between two variables, ranging from 0 (no association) to 1 (perfect association) (Grissom & Kim, 2012). Based on Mangiafico's (2016) guidelines, ϵ^2 values < .08 were considered small, ϵ^2 values between .08 and .26 were considered medium, and ϵ^2 values > .26 were interpreted as large. A Dunn's test with the Bonferroni adjustment was used for all pairwise comparisons. A Friedman's test was used to examine differences within each of the three groups in writing samples across the genres. An exact test with the Bonferroni adjustment developed by Eisinga et al. (2017) was used as a post hoc test for the Friedman's test. An alpha level of .05 was used to determine statistical significance. All statistical analyses were conducted using R (version 4.2.2; R Core Team, 2022) in RStudio (version 2023.06.1, build 524; Posit Team, 2023), with the rstatix (Kassambara, 2023), the PMCMRplus (Pohlert, 2023), and the rcompanion (Mangiafico, 2023) packages.

Results

Tables 2 and 3 display the medians and ranges for each group on each written language variable, as well as the results of tests for between- and within-group differences. Box plots in Figures 1 and 2 depict the distributions of each group's performance on the written language variables.

As shown in Table 2 and Figure 1(a), wide variability characterized the length of participants' written language samples. One between-group significant difference was detected on this variable with a large effect size ($H(2) = 7.35$, $p = .025$, $\varepsilon^2 = .43$) in the expository genre. Post hoc comparisons indicated that autistic males ($Mdn = 26$ words) wrote significantly shorter expository samples ($p = .041$) than NA females ($Mdn = 163.5$ words). Additionally, there was a large effect size for narrative sample length ($\varepsilon^2 = .30$), despite a non-significant group difference. Though the distribution of autistic females' scores did not differ significantly from either the autistic males or the NA females, Table 2 and Figure 1(a) show that when individual performances are considered, an autistic female wrote longer persuasive and expository samples than any NA females or autistic males. No significant within-group differences were found across the genres.

Writing productivity was also characterized by variability across individuals and groups. As shown in Table 2, two between-group differences were significant with large effects in the persuasive ($H(2) = 12.03$, $p = .002$, $\varepsilon^2 = .71$) and expository ($H(2) = 11.78$, $p = .003$, $\varepsilon^2 = .69$) genres. Post hoc comparisons indicated that in the persuasive genre, both the autistic females ($Mdn = 23.7$ words per minute, $p = .01$) and the NA females ($Mdn = 15.2$, $p = .04$) wrote significantly faster than the autistic males ($Mdn = 7.0$). Parallel results were found in the expository genre, with autistic females ($Mdn = 21.1$, $p = .01$) and NA females ($Mdn = 13.6$, $p = .03$) writing significantly more words per minute than autistic males ($Mdn = 9.6$). Though a significant difference for productivity was not found in the narrative genre, a large effect was documented ($H(2) = 5.79$, $p = .06$, $\varepsilon^2 = .34$), with autistic females writing a median of 20.0 words per minute, autistic males 7.8, and NA females 15.9. Additionally, one within-group significant difference was found. Writing productivity varied according to genre for the NA female group ($F(2) = 6.5$, $p = .04$) who wrote significantly faster in the narrative ($Mdn = 15.9$) than the expository genre ($Mdn = 13.6$, $p = .042$). The data distributions in Figure 1(b) indicate that while there was some overlap between the writing productivity of autistic females and NA females, at least one autistic female wrote faster than the NA females in each genre.

No significant differences were found between groups or within groups on either syntactic length (mean length of T-unit) or vocabulary diversity (TTR). Regarding syntactic length, the descriptive data in Table 1 and box plots in

Table 2. Writing variables across genres.

	Autistic		Non-autistic	Kruskal–Wallis test			Autistic females vs. autistic males	Autistic females vs. non-autistic females	Autistic males vs. non-autistic females
	Females Median Range	Males Median Range	Females Median Range	*H*-statistic	*p*	ε^2	*p*	*p*	*p*
Length in words									
Persuasive	92 23–248	28.5 15–153	103 52–204	4.13	.13	.24	.61	1	.19
Expository	91 49–314	26 13–111	163.5 55–196	7.35	.03*	.43	.28	1	.04*
Narrative	183 46–245	44 8–162	83 49–269	5.17	.08	.30	.21	1	.23
Within-group test									
χ^2 statistic	.7	1.0	2.0						
p	.72	.61	.37						
Productivity (words per minute)									
Persuasive	23.7 16.4–25.3	7.0 2.8–12.3	15.2 13.3–18.8	12.03	.002*	.71	.01*	1	.04*
Expository	21.1 13.1–25.9	9.6 2.7–12.7	13.6 12.7–18.4	11.78	.003*	.69	.01*	1	.03*
Narrative	20.0 10.9–25.3	7.8 1.4–26.0	15.9 13.7–21.8	5.79	.06	.34	.18	1	.17
Within-group test									
χ^2 statistic	.7	.2	6.5						
p	.72	.91	.04*						
Mean length of T-unit in words									
Persuasive	11.5 7.7–17.7	10.4 7.5–13.9	14.0 10.4–15.2	2.16	.34	.13	1	1	.44
Expository	9.1 7.0–19.6	8.9 5.0–13.9	11.0 8.4–13.8	.32	.85	.02	1	1	1
Narrative	12.3 9.2–13.1	8.7 5.5–12.1	12.3 6.1–19.2	3.60	.17	.21	.30	1	.56
Within-group test									
χ^2 statistic	.7	2.6	.5						
p	.72	.28	.79						
Type-token ratio									
Persuasive	0.71 0.61–0.96	0.80 0.54–1.0	0.61 0.58–0.69	4.18	.12	.25	1	.46	.13
Expository	0.57 0.52–0.68	0.84 0.38–1.0	0.60 0.57–0.76	5.92	.05	.35	.13	1	.23
Narrative	0.68 0.55–0.83	0.77 0.61–1.0	0.69 0.52–0.78	2.00	.37	.12	1	1	.63
Within-group test									
χ^2 statistic	5.7	2.0	.9						
p	.06	.38	.62						

*$p < .05$.

Figure 1(c) indicate notable variability in individual performance, particularly in the expository genre for both autistic groups and in the narrative genre for the NA female group. Regarding vocabulary diversity, we note that TTR in the expository samples was not significant but had a large effect size ($H(2) = 5.915$, $p = .05$, $\varepsilon^2 = .35$), with the autistic males ($Mdn = .84$) leading the autistic females ($Mdn = 0.57$) and the NA females ($Mdn = 0.60$).

Table 3. Macrostructure variables.

	Autistic		Non-autistic	Kruskal–Wallis test			Autistic females vs. autistic males	Autistic females vs. non-autistic females	Autistic males vs. non-autistic females
	Females Median Range	Males Median Range	Females Median Range	*H*-statistic	*p*	ε^2	*p*	*p*	*p*
Persuasive									
Intro (max = 4)	1 1–3	1 1–2	1 0–1	3.23	.20	.19	1	.37	.32
Body (max = 7)	1 1–4	1 0–2	2.5 1–6	2.51	.29	.15	1	1	.37
Concl (max = 2)	1 1–2	0 0–2	1 1	4.76	.09	.28	.16	1	.43
Total (max = 13)	4 3–8	2.5 2–5	4 3–8	4.61	.10	.27	.26	1	.27
Expository									
Intro (max = 3)	1 1	1 0–1	1 1	.64	.72	.04	1	1	1
Body (max = 6)	3 0–4	1 0–3	3.5 1–5	4.06	.13	.24	1	1	.15
Concl (max = 3)	0 0	0 0–3	0.5 0–2	2.37	.30	.14	1	.42	.71
Total (max = 12)	4 1–5	2 1–7	5 2–8	3.22	.20	.19	1	1	.23
Narrative									
Setting (max = 6)	4 4–5	3 2–6	4 2–5	3.62	.16	.21	.20	1	1
Plot (max = 13)	7 6–9	4 0–8	5.5 2–12	3.83	.15	.23	.20	1	.80
Dialog (max = 1)	0 0–1	0 0	0 0–1	3.45	.18	.20	.34	1	.56
Total (max = 20)	12 11–13	7 2–12	9.5 4–18	4.91	.09	.29	.11	1	.66

When examining macrostructure in the three genres, we did not find any significant between-group differences, as shown in Table 3. However, there were large effect sizes for some macrostructure variables. In the persuasive genre, there were large effect sizes for conclusion ($H(2) = 4.76$, $p = .09$, $\varepsilon^2 = .28$) and total scores ($H(2) = 4.61$, $p = .100$, $\varepsilon^2 = .27$). For persuasive conclusion, autistic females' and NA females' median score was 1 point, whereas autistic males' was 0 points. On the persuasive total score, autistic females' and NA females' median score was 4 points, compared to autistic males' median score of 2.5 points. In the narrative genre, there was a large effect for total scores ($H(2) = 4.91$, $p = .09$, $\varepsilon^2 = .29$), with autistic females' median score of 12 points, autistic males' median of 7 points, and NA females' median of 9.5 points.

Discussion

In this study, we explored possible gender differences in the writing skills of autistic adolescents. We conducted an exploratory, secondary analysis of persuasive, expository, and narrative writing samples produced by small samples of autistic females, autistic males, and NA females. Whereas the original investigation focused on written language differences based only on autism status (Price et al., 2020), the current study explored the possibility that autistic females' and autistic males' written language characteristics may differ. The current analysis suggests that the unique profile of autistic females found in other aspects of communication (e.g., Wood-Downie et al., 2021) may extend to written language, mirroring gender differences in writing of the general population (e.g., Reynolds et al., 2015). Our findings also reflect wide individual variability of writing skills for autistic

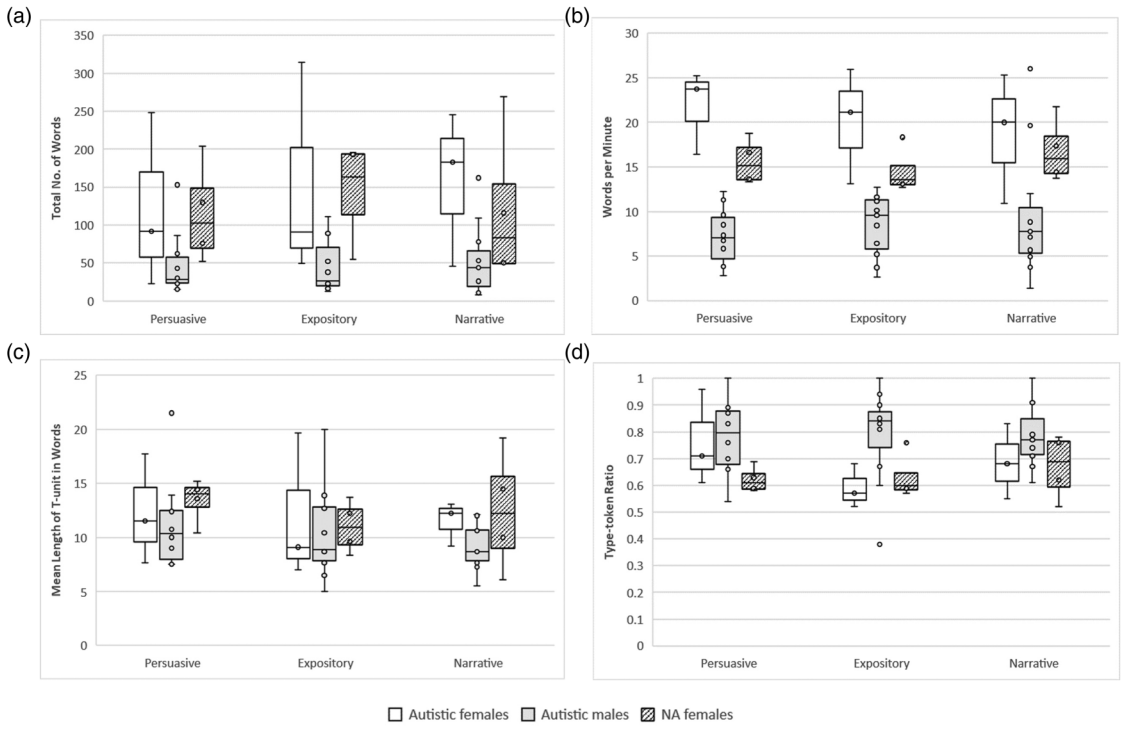

Figure 1. Writing sample variables across genres by gender and autism status. (a) Sample length, (b) Writing productivity, (c) Length of T-unit, and (d) Type-token ratio.

individuals, consistent with previous work (Zajic & Wilson, 2020). Further investigation with larger samples is warranted.

Though the small sample sizes of the current exploratory study prevent us from drawing generalizable conclusions, we make some noteworthy observations. Some gender-specific findings of the current study differ from the original study's findings in which autistic females and autistic males were grouped together. In the current study, length of writing sample differed significantly only in the expository genre, with autistic males (but not autistic females) writing fewer words in their expository samples compared to NA females. Visual representation of the data distributions (i.e., box plots in Figure 1(a)) suggested that autistic females' performance overlapped more with that of NA females than autistic males. There was also a large effect size but no significant difference in the narrative genre. However, when gender was not considered (in the original analyses), a significant difference was found only in the persuasive genre, with autistic adolescents writing persuasive samples of significantly fewer words than NA adolescents, with a large effect size (partial $\eta^2 = .24$).

The current results also indicated significant differences for writing productivity. In both the persuasive and expository genres, autistic males wrote fewer words per minute than autistic females and NA females. The data distributions shown in Figure 1(b) indicate that while there was overlap between the autistic and NA females, some autistic females wrote faster than NA females, though the groups did not differ significantly. In the narrative genre, differences were non-significant but had large effect sizes. The current findings contrast with the previous findings that ignored participants' gender, in which no significant differences in writing productivity were found between the autistic and NA groups.

Considering both gender and autism status also influenced findings regarding vocabulary diversity. In the original study, autistic adolescents (females and males combined) demonstrated significantly greater TTR than NA adolescents in their persuasive samples with a large effect size (partial $\eta^2 = .31$). However, when we compared TTR of autistic females, autistic males, and NA females in the current study, we found no significant differences in any genre, but a large effect size in the expository genre. Autistic males' vocabulary diversity led that of the other two groups.

The gender-specific results for macrostructure also diverged from the results of the original analyses. In the persuasive genre, when gender was ignored, autistic adolescents scored significantly lower than NA adolescents on body and total elements, with large effect sizes of partial $\eta^2 = .27$ and .19, respectively. The gender-specific analyses revealed no significant differences in the persuasive genre, though there were large effect sizes for conclusion and total elements. In the expository genre, when gender was ignored, autistic adolescents scored significantly lower on body and total elements, with large effect sizes of partial $\eta^2 = .37$ and .21, respectively.

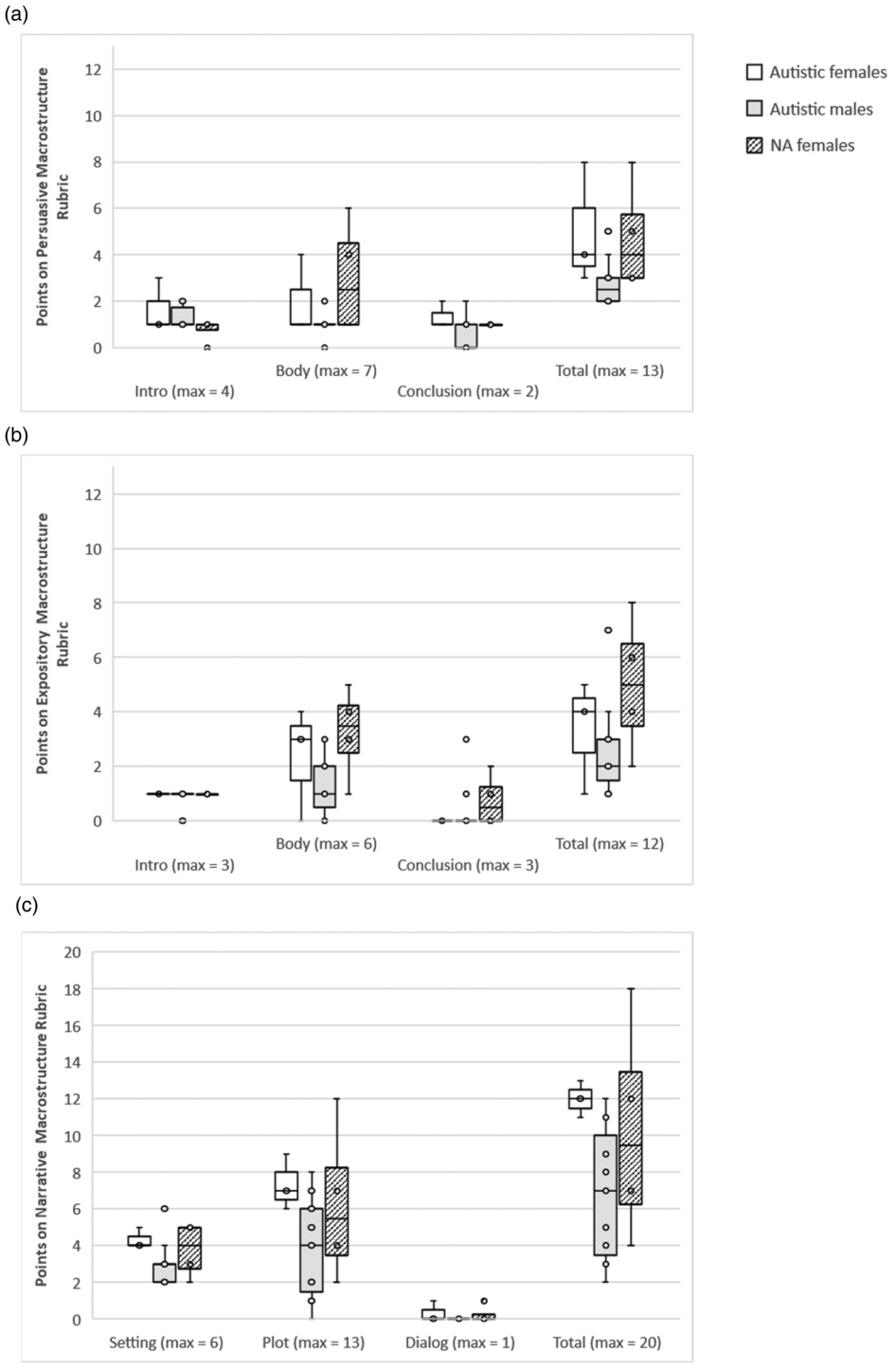

Figure 2. Macrostructure scores by gender and autism status. (a) Persuasive macrostructure, (b) Expository macrostructure, (c) Narrative macrostructure.

However, when gender was considered, there were no significant differences or large effect sizes in any aspect of expository macrostructure. In the narrative genre, the original study found no significant differences between autistic (females and males combined) and NA adolescents. When autistic participants were grouped according to gender for the current study, no significant differences, but a large effect size for total score, were found.

Our current results found no significant differences in syntactic complexity between groups or genres. These

findings are consistent with the original study, in which written syntactic skills of autistic adolescents did not differ from those of NA adolescents.

In summary, we see that combining the autistic females' and autistic males' data clouded some distinct characteristics of both groups. When examined as separate groups, autistic females had significantly greater writing productivity than autistic males in persuasive and expository genres. Additionally, when compared to NA females, autistic males wrote significantly shorter expository samples and wrote significantly fewer words per minute in persuasive and expository samples, whereas the autistic females did not differ significantly from the NA females on these variables. Non-significant differences but large effect sizes were found for several other variables (narrative sample length and writing productivity, and expository TTR), suggesting possible additional meaningful differences between groups. Visual inspection of box plots of these variables suggests that distributions of data collected from autistic females overlapped more with distributions of NA females than autistic males. Data distributions also indicated that at least one individual autistic female wrote longer persuasive and expository samples and wrote at a faster rate in all genres, compared to the NA females.

Limitations and future directions

The small sample size of females (three autistic and four NA) is a notable limitation of this investigation. This limited representation of autistic females is not unique to our research study (see Zajic & Wilson, 2020). Investigations of autistic individuals often include gender only as a lurking variable, equivalent to the reported 4:1 male-to-female ratio (Centers for Disease Control and Prevention, 2023). This impacts participant recruitment, which in turn results in studies that are underpowered for detecting gender-related differences among autistic individuals. Future research should regard gender as an important potential variable to differentiate performance among autistic individuals, which would subsequently increase female sample sizes and power to detect significant differences between and within groups.

Future research with larger sample sizes, across a wider age range, is needed to further explore and confirm gender differences in autistic writing; our current analyses suggest this is a fruitful path for future investigation. The sample sizes of the current study limit the generalizability of our results. However, our findings highlight the possibility that gender differences exist within the written language skills of autistic individuals.

Further research may corroborate our initial exploratory findings suggesting that written language may be a strength for autistic females. Alternatively, additional investigations may suggest a "blended phenotype," in which autistic females' written language characteristics overlap with NA females in some regards, with autistic males in others, and with neither in yet others, a characterization that has been applied to some aspects of oral communication skills of autistic females (e.g., Boorse et al., 2019; Wood-Downie et al., 2021).

Further investigation of the unique linguistic, executive function, emotional, and other processes that drive individual variability in autistic individuals' written language is also essential (Zajic & Brown, 2022). We contend that future studies of both writing products and writing processes should include exploration of gender-based differences. Future research efforts should also seek and prioritize autistic researchers' and writers' perspectives on aspects of written language that are meaningful to explore (Pickard et al., 2022; Zajic & Brown, 2022).

Notably, gender of study participants was classified using their parents'/guardians' response to a CCC-2 item that stated "Child's sex" with two choices the parent could select. However, many autistic individuals have non-conforming gender identities (Dewinter et al., 2017). Future research should utilize a more sensitive technique that captures non-binary gender identity, such as an open-ended question that asks the participant to describe their own gender identity. This also raises interesting questions regarding how to group participants with non-conforming gender identities accurately in studies in which gender is a key variable. Some researchers have described autistic participants as "assigned female at birth" or "assigned male at birth" (e.g., Zajic & Brown, 2022). Further work that centers the perspectives of autistic and non-conforming individuals is needed in this area.

Clinical implications

Given the group differences and individual variability observed in study participants, as well as the challenges many individuals (autism and gender statuses notwithstanding) experience with writing, clinicians should be prepared to support their clients' written language skills. Written language goals and intervention should be strengths-based and centered on each writer's needs for using written language to meet their developmental, academic, social, and employment-related goals. In keeping with recommendations from neurodiversity advocates and autistic self-advocates, specific strategies to support written language include incorporating clients' strong interests in writing activities, providing detailed instructions/rubrics for writing assignments, encouraging and teaching pre-writing and organizing strategies, breaking down the writing assignment into manageable pieces, giving examples of written products, and encouraging and empowering with emotional support (Tomlinson & Newman, 2017; Wood, 2021; Zajic & Brown, 2022). These recommendations align with research-based strategies for writing instruction for a wide variety of learners, including autistic writers (e.g., Accardo et al., 2020; Asaro-Saddler et al., 2021).

Conclusion

Our small sample sizes prevent us from drawing conclusions regarding gender differences in the writing skills of autistic adolescents. However, the data presented here, combined with mounting evidence of gender differences in oral communication for autistic individuals, growing understanding of the interrelatedness of oral and written language, and the long-recognized gender differences in writing performance of the general population, indicate that larger-scale investigation of gender differences in the writing processes and products of autistic individuals is warranted. Data from a larger number of participants, representing a wider age span, and on a broader range of writing product and process variables will help more fully establish the phenotype of autistic females, and thus, be a step toward more fully understanding the unique characteristics of both autistic females and autistic males.

Acknowledgements

We gratefully acknowledge the individuals who participated in this research.

Data availability

The datasets analyzed during this study are available from the corresponding author upon reasonable request.

Declaration of conflicting interests

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

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the American Association of University Women through the American Summer/Short-Term Research Publication Grant awarded to Johanna Price.

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