

Writing, Asperger Syndrome and Theory of Mind

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Abstract

This research compared the written compositions of 16 adults with high-functioning autism spectrum disorders and 16 neurotypical control participants, and examined the influence of theory of mind on their writing. Participants ranging in age from 17 years to 42 years, matched on Vocabulary subtest scores from the Wechsler Adult Intelligence Scale (1997), completed the Social Attribution Task and wrote an expository and a narrative text. Texts were assessed on 18 variables representing quality, mechanics, and length. It was found that adults with HFASD wrote lower quality narrative and expository texts, and narratives of shorter length. Theory of mind was positively associated with writing quality and text length across both genres.

Keywords: Asperger syndrome; autism; written communication; writing skills; theory of mind; adults

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Autism spectrum disorder (ASD) is characterized by social deficits, particularly impairments in verbal and non-verbal communication, problems with social reciprocity and failure to develop and maintain peer relationships. It is also characterized by restricted, repetitive patterns of behaviour, interests and activities (American Psychiatric Association, 2010; Gillberg, 1991). Currently, the Diagnostic and Statistical Manual of Mental Disorders-IV-TR (American Psychiatric Association, 2000) distinguishes between autistic disorder and Asperger syndrome (AS). However, the nosological validity of AS has yet to be resolved (Macintosh & Dissanayake, 2004; World Health Organization, 2007). Asperger Syndrome and autistic disorder are differentiated in that individuals with AS do not demonstrate a general delay in language before the age of three years nor do they possess a clinically significant delay in cognitive development (American Psychiatric Association, 2000; World Health Organization, 2007). In contrast, individuals with autistic disorder do experience language delays in that they would not be using full words by age two or meaningful phrases or sentences by age three. Furthermore, individuals with autistic disorder do not necessarily have typical cognitive development (American Psychological Association, 2000). However, in a review of the literature, Macintosh & Dissanayake (2004) reported that “the validity of Asperger’s disorder as a unique syndrome, separate from high-functioning autism has not yet been either conclusively established or refuted” (p. 431). Recent conceptualizations of ASD suggest that the subcategories of autism spectrum disorder represent differing levels of symptom severity on a dimension from low to high functioning (Kamp-Becker, Smidt, Ghahreman, Heinzl-Gutenbrunner, Becker et al., 2010; Macintosh & Dissanayake, 2004). It was beyond the scope of this research to examine differences in writing skills between subtypes of high functioning individuals with ASD. Therefore, in the following, the term high-functioning autism spectrum disorder (HFASD) will

be used to refer to participants who had an autism spectrum disorder and no intellectual impairment.

Writing abilities in autism spectrum

Successful participation in most educational, work and social settings requires solid writing competence (Delano, 2007). Research suggests that this is an area of particular weakness in high-functioning students with autism spectrum disorders (ASD) and that these writing difficulties are out of keeping with their average to above average intelligence. Previously, six studies (Mayes & Calhoun, 2003a, 2003b, 2006, 2007, 2008; Smith-Myles, Huggins, Rome-Lake, Hagiwara, Barnhill, et al., 2003) compared the writing of students with HFASD to age-matched participants without ASD, using intelligence tests and standardized academic achievement tests. In the Mayes & Calhoun series, these authors found that approximately 60% of students with HFASD showed a discrepancy of about one standard deviation between their full-scale IQ scores and their writing achievement scores. Mayes and Calhoun (2003b, 2006, 2007, 2008) summarized their findings by stating that a majority of children with HFASD had a specific learning disability in writing.

To date, only two studies with multiple participants have attempted to describe the specific characteristics of the writing of those with autism. Smith-Myles, et al. (2003) compared students with HFASD with neurotypical (NT) control participants on the Test of Written Language – III (TOWL-III), finding that there were no significant differences between the groups on any of the TOWL-III subtests or composite scores. However, the researchers also quantified nine text variables outside of those normally scored in the TOWL-III and demonstrated that individuals with HFASD produced briefer and less complex texts. Subsequently, Barnes, Lombardo, Wheelwright, and Baron-Cohen (2009) compared the written

narratives of individuals with HFASD to their NT peers. After viewing four scenes from a video containing highly emotional and mentalistic content, participants were asked to write four different narratives describing what they saw. The HFASD group wrote shorter narratives, used fewer mental state terms, and attributed mental state terms to fewer characters in each of the scenes. This research suggests that there may be limited theory of mind content in the writing of individuals with HFASD.

Along with the aforementioned studies involving multiple participants, case studies of individual writers with HFASD have been conducted (cf., Chavkin, 2004; Happé, 1991; Jurecic, 2007). These have provided qualitative analysis of their written compositions and highlight a range of deficits. In particular, it has been suggested that writers with HFASD use highly literal language and have difficulty elaborating on their ideas; that their writing is not cohesive and has a distorted sense of audience; and that the social and psychological aspects of their texts are missing or atypical. These problems are theorized to result in part from this population's limited social understanding and their difficulty envisioning the perspective of their readers (Chavkin, 2004; Happé, 1991; Jurecic, 2007).

Exploring Theory of Mind and Writing

Consequently, the question must be asked, why would autism affect writing? Individuals with ASD have been found to have difficulties understanding mental states, an ability termed "theory of mind" (ToM) (Baron-Cohen, 1995; Tager-Flusberg, 2007). The original research into the ToM of individuals with autism involved the use of false belief tasks, which required the participant to distinguish between the real world and another person's false representation of the world (Tager-Flusberg, 2007). Low-functioning children with autism struggle to complete false belief tasks compared to similarly matched participants with other disabilities (cf. Baron-Cohen,

Leslie & Frith, 1985; Baron-Cohen, 1989). High-functioning individuals with autism typically pass false belief tasks; but on more sensitive measures of ToM, such as the Social Attribution Task and the Strange Stories Test, they perform below neurotypical controls (Joliffe & Baron-Cohen, 1999; Klin, 2000).

A ToM deficit could account for several features of the writing of people with HFASD. First, it could affect the ability to write about thoughts and feelings, and it could affect writing in genres such as narrative that foreground these states (Loveland, McEvoy, Kelley, & Turner, 1990). Second, ToM has been found to correlate with the ability to respond to a conversational partner with new, relevant information (Capps et al., 1998; Tager-Flusberg, 1996; 1999), so ToM could affect the ability to generate relevant information while writing as well. Third, ToM deficits may affect the writers' ability to take the perspective of the reader, leading to a lack of background information or context, and a lack of explicit connections that lead the reader through the text (Colle, Baron-Cohen, Wheelwright, & van der Lely, 2008; Loveland, et al., 1990). Finally, in oral language, performance on ToM tasks is correlated with basic aspects of language such as grammar and semantics (Happé, 1995; Tager-Flusberg, 1999; Tager-Flusberg & Joseph, 2005; Tager-Flusberg & Sullivan, 1994), so it may also be related to analogous, "mechanical" skills in writing.

Hypotheses

The aims of this study were to compare the narrative and expository writings of adults without disabilities and those with HFASD, and to examine the relationship between theory of mind and writing. Sixteen text variables were examined within each genre, and combined to form six composites: Narrative Length, Narrative Mechanics and Narrative Quality; and Expository Length, Expository Mechanics, and Expository Quality. Two further variables were

assessed outside of these composites which related to textual evidence of theory of mind. The following hypotheses were tested:

- 1A: Individuals who were NT would score higher than those with HFASD on the Narrative Length Composite and the Narrative Quality Composite.
- 1B: It was not hypothesized that persons with HFASD and the NT controls would demonstrate significant differences on the Expository Length Composite and Expository Quality Composite; or the Narrative and Expository Mechanics Composites, although these variables were also investigated.
- 1C: In narrative texts, individuals who were NT would use more cognition and affect terms and make more references to causes and motivations than their HFASD peers.
- 2: Individuals with HFASD would score lower than their NT peers on the Social Attribution Task
- 3: For both text genres, the Social Attribution Task scores would be associated with the Length, Mechanics and Quality composites and number of mental state terms.

Method

Participants

This study took place in a mid-sized city in Ontario, Canada. Recruitment was carried out in the following ways. Individuals with HFASD were mailed invitations to participate through a community agency or counseling services at the local college and university; as well, local autism associations placed advertisements in newsletters and on websites. Participants without autism were recruited primarily through the local community college. All participants were offered compensation in the form of a \$20 gift certificate.

Sixteen high functioning individuals with autistic spectrum disorders, including fourteen with Asperger syndrome (AS) and two with autistic disorder, participated in the study, as well as sixteen individuals without disabilities. The participants ranged in age from 17 to 42 years. The ratio of men to women in the sample of individuals with HFASD was 3:1, which was matched in the control group. Three independent *t*-tests were run to investigate group differences on potential confounding variables; Table 1 presents group comparisons of age, Vocabulary subtest scores from the Wechsler Adult Intelligence Scale, third edition (WAIS-III) (Wechsler, 1997), and years of schooling. There were no statistically significant differences between the two groups on any of these variables. One final potential confounding variable was tested: correlations were calculated between the Social Attribution Task and the Vocabulary subtest of the WAIS-III (Wechsler, 1997) to investigate the degree to which ToM was associated with estimated verbal IQ.

[place Table 1 about here]

Materials

General. Inter-rater reliabilities are reported in Tables 2 through 5. The textual analysis along with the coding of the Social Attribution Task involved the principal investigator, and two research assistants naïve to the diagnosis of the participants and to the experimental hypotheses. The texts were scored independently by each rater and then inter-rater reliability was calculated. The Pearson correlation coefficient was used because most variables were either counts or scores on multi-point scales. Differences in the raters' scores were reconciled by discussion to a consensus.

Vocabulary. To test for the potential confound of general verbal cognitive ability, the Vocabulary subtest of the WAIS-III (Wechsler, 1997) was given to all participants. This scale

correlates 0.9 with full scale verbal IQ (Wechsler, 1997), so it provides an efficient estimate of general verbal intelligence.

Social Attribution Task. The Social Attribution Task, a measure of ToM skill, assessed the participants' ability to spontaneously attribute social meaning to ambiguous visual stimuli (Heider and Simmel; adapted by Klin, 2000). It has been shown to discriminate between theory of mind of high functioning adolescents and adults with ASD, versus age-matched individuals without disabilities (Klin, 2000; Klin & Jones, 2006).

The Social Attribution Task involved watching a fifty second video of two triangles and a circle moving within and around a large rectangle. After the participant watched the video twice, he/she was asked to describe what happened in the video. The participant then watched the video again, but it was stopped six times. After each segment, the participant was asked to explain "What happened here?" The participant was then explicitly told to pretend that the shapes were people (if he/she had not done so spontaneously). The participant was then asked: "What kind of person is Big triangle/ Small Triangle/ Small circle?" Finally, the participant watched the video again in four segments and was asked to explicitly name objects, events and interactions as if they were people interacting with each other (Klin, 2000). The Social Attribution Task was recorded and transcribed. Each index was converted to a percentage score and averaged to create the total Social Attribution Task Score ($\alpha = .80$); see Table 2.

Procedure

The assessments were carried out in a quiet room at a location convenient for the participant. The tasks were divided into two one hour sessions. During the first session, participants completed the Vocabulary subtest and Social Attribution Task; in the second session, participants completed the expository and narrative writing tasks. The procedure for the

writing tasks was consistent with the study in which they were developed (Berman & Nir-Sagiv, 2007; Berman & Verhoeven, 2002). First, participants viewed a short video montage to help define the topic of the writing tasks: “problems between people”. The three minute film depicted eleven different situations, representing three types of conflict: moral conflict (e.g., whether to return lost money); social conflict (e.g., how to treat a new boy in class); and physical conflict (e.g., fighting on the playground). All of the actors were teens and each vignette took place in a school setting. The film was shown only once (Berman & Nir-Sagiv, 2007).

Following the video, the participants were required to write two texts. In the narrative condition, the following instructions were given:

This video showed you different kinds of problems, conflicts, and predicaments. I am collecting stories about problems between people. So, I’d like you to write a story about a time when you had encountered a problem with someone. Don’t tell me what you saw in the video, but write me a personal story about something that happened to you, something you experienced. You can take some time to think, and then start writing. Any questions?

In the expository condition, the instructions were:

Now I’d like you to write a composition. I’d like you to write an essay on the topic of problems between people. Please discuss the topic, and present your ideas. Do not write a story, but an essay. You can take some time to think, and then start writing. Any questions?

Participants used a laptop computer and Microsoft Office Word 2007 to write their texts. The writing tasks were presented in a counter balanced order; participants were given unlimited time, but most completed both tasks within one hour, producing texts of one half to one page in length.

Analysis

[place Table 3 about here]

[place Table 4 about here]

[place Table 5 about here]

The texts were analyzed for 18 features representing all linguistic levels. Detailed descriptions of these variables are found in Tables 2, 3, and 4. The large number of textual variables inflated the experiment-wise risk of false rejections of the null hypothesis, so three composites were created for each text type (narrative, expository) by grouping together variables that were conceptually similar and correlated: the Length Composite, the Mechanics Composite and the Quality Composite. The decision to form these composites was supported by the high inter-item reliabilities of each composite (see Table 6). The Length Composite included four variables: total t-units, words, sentences and clauses. The Mechanics Composite included five variables: mean letters per word, mean clauses per t-unit, percentage of large t-units, spelling score, and percentage of sentences with correct grammar. Finally, the Quality Composite included six variables: structure, context, quality, global coherence, percentage of locally coherent sentences, and balance between the landscape of consciousness and the landscape of action (narrative only). The composite scores were formed by transforming the individual variables into z -scores, and then averaging the z -scores for each composite. Two additional text variables were scored separately from the three text composites: Percentage of sentences with one or more cognition or affect terms and percentage of sentences referring to causes and motivations. These two variables were conceptually unrelated to the three text composites, but were of interest given the theorized ToM deficits in the ASD population.

T-tests were then used to compare the two groups with respect to the text composites, the individual text variables, and the Social Attribution Task. This led to a very large number of statistical tests being carried out (most of which were statistically significant). Although Bonferroni's correction has traditionally been used to adjust alpha levels for multiple statistical tests, it is based on the very conservative assumption that only one test out of given set of tests is

statistically significant. In our data, many of the tests were significant in each composite. Therefore, Sidak's correction was used. Like the more familiar Bonferroni correction, it adjusts the significance level of each test relative to the total number of tests in a set. However, it is based on a more complete equation, of which the Bonferonni is a simplification (Abdi, 2007). Finally, correlations were calculated between the Social Attribution Task and the text composites to investigate the degree to which ToM was associated with the writing scores.

Results

Textual Variables

[place Table 6 about here]

Length measures and composite. Table 6 presents group comparisons for the text composites and individual text variables by group for each genre. Group differences on the Narrative Length Composite were significant with a large effect size [$t(30) = 2.16, p = .02, d = 0.8$]. Writers with HFASD wrote substantially shorter narrative texts, with fewer total words ($p = .02, d = 0.8$) and total sentences ($p = .01, d = 0.8$). Group differences on the Expository Length Composite were not statistically significant [$t(30) = 1.15, p = .26, d = 0.4$].

Mechanics measures and composite. For the narrative texts, overall group differences on Narrative Mechanics were non-significant [$t(30) = 1.10, p = .28, d = 0.4$]. Similarly, the groups did not differ significantly on the Expository Mechanics Composite [$t(30) = 2.11, p = .04, d = 0.8$]. However, the difference between groups on Expository Mechanics approached significance ($p = .04, d = 0.8$, non-significant after the Sidak correction).

Quality measures and composite. There was a significant and large effect of group on the Narrative Quality Composite [$t(30) = 4.96, p = .001, d = 1.8$] such that writers with HFASD produced texts that were lower in quality than their NT peers. This included large effects on most

narrative text quality variables: Structure ($p = .01, d = 0.9$), balance between the landscapes of action and consciousness ($p = .001, d = 1.3$), extent of context provided ($p = .001, d = 1.2$), overall quality ($p = .001, d = 1.2$) and global coherence ($p = .01, d = 0.8$). The Expository Quality Composite also differed significantly between groups [$t(30) = 2.86, p = .004, d = 1.0$], including significant differences between groups in global coherence ($p = .01, d = 0.9$) and local coherence ($p = .001, d = 1.0$).

[place Table 7 about here]

Causes, motivations, affect and mental states. There were no significant group differences in the percentage of sentences with one or more cognition or affect terms in either the narrative texts [$t(30) = 0.42, p = .34., d = 0.2$] or expository texts [$t(30) = 1.04, p = .15, d = 0.4$]. Similarly, there were no significant group differences in the percentage of sentences referring to causes and motivations in the narrative genre [$t(30) = 1.62, p = .06, d = 0.6$] or the expository genre [$t(30) = 0.62, p = .27, d = 0.2$].

Summary. In sum, the results demonstrated that writers with HFASD had significantly lower text quality across both genres. They also wrote narrative texts shorter in length. Across both genres, mechanics did not differ significantly between the two groups. Finally, there were no significant group differences in the frequency of references to various types of mental states.

Social Attribution Task and Correlations with Text Variables

[place Table 8 about here]

The mean of the HFASD group on the Social Attribution Task was 48.75 ($SD = 9.37$) while the mean of the NT group was 63.62 ($SD = 12.95$). This was a large and significant difference [$t(30) = 3.72, p = .001, d = 1.3$] such that individuals with HFASD scored lower than

their NT peers on this ToM task. It was also found that performance on the Social Attribution Task was positively correlated to performance on the Vocabulary subtest [$r(30) = .34, p = .03$].

In Table 8, correlations between participants' Social Attribution Task scores and the three text composites for each genre are presented. Performance on the Social Attribution Task was positively correlated with the Narrative Quality Composite [$r(30) = .38, p = .02$] and Expository Quality Composite [$r(30) = .43, p = .01$] and many of the component variables of quality. As well, the Social Attribution Task was associated with the Narrative Length Composite [$r(30) = .53, p = .001$] with the Expository Length Composite [$r(30) = .38, p = .02$] and all individual length variables. Third, it was related to performance on the Expository Mechanics Composite [$r(30) = .30, p = .05$]. The correlations between the Social Attribution Task and the Narrative Mechanics Composite [$r(30) = .09, p = .31$] did not reach significance nor was the Social Attribution Task significantly related to frequency of references to internal states in either genre.

Discussion

Previous literature suggests that many students with HFASD struggle to write (e.g., Mayes & Calhoun, 2008), yet this body of research left several unanswered questions. To date, much of the quantitative assessment of the writing of people with HFASD has documented a global writing deficit. New research was necessary that describes the specific characteristics of this writing. Additionally, all previous studies have focused on narrative writing; however, given the psychological and social focus of narrative as a genre, it may represent the worst writing of people with HFASD. This raises the question of how well individuals with HFASD write in other genres. Additionally, informational genres are of interest because beyond elementary school and in the workplace, they are more common than narrative.

The purposes of the present research were to present a systematic description of the writing of adults with HFASD, and to investigate the relationship between ToM and writing. The four main findings were: (a) High functioning people with ASD wrote narrative and expository texts that were significantly lower in quality than people without disabilities; (b) There was a trend for the HFASD group to have some difficulties with the mechanics of writing, but this did not reach statistical significance; (c) High-functioning people with autism wrote shorter narratives than their NT peers; and (d) Theory of mind was positively correlated with text length and quality across both genres, and with expository text mechanics. These relationships will now be discussed further.

Text Quality and Theory of Mind

Individuals with HFASD wrote poorer quality narrative texts than their NT peers with a quite large effect size ($d = 1.8$). This included substantially lower scores on five of the six narrative quality variables. Poorer text structure indicated that people with HFASD had difficulty organizing their narratives, while weaker global coherence suggested that they had difficulty creating stories that fit together into a consistent whole. The inappropriate balance between the landscape of action and the landscape of consciousness in the narratives of the HFASD group was indicative of a simplistic level of complexity and insightfulness of the internal worlds of their characters. Furthermore, their weak context scores implied that they had difficulty providing readers with appropriate background information. The overall result was that the narrative texts of the HFASD group created a less positive impact on the reader. Similarly, in the expository genre, their texts were lower in quality ($d = 1.0$) primarily due to large and significant differences between groups in the global and local coherence of their essays. Thus, adults with

HFASD had difficulty writing expository texts which kept focus on the main topic and included smooth transitions between ideas.

Participants' ToM scores were associated with the quality of both the narrative and expository texts. In the narrative genre, the aspects of quality that were most strongly linked with ToM were balance between landscape of action and landscape of consciousness, structure, and context. These were largely the same variables that showed large differences between the HFASD group and controls. This finding supports the theory that students with HFASD have difficulty in narrative writing because of their difficulties understanding the social world, their pragmatic weaknesses, and their problems with perspective-taking (Loukusa & Moilanen, 2009; Loveland & Tunali, 1994; Tager-Flusberg, 2007). In expository writing, the aspects of quality that were significantly associated with ToM were local and global coherence. Again, these were the same variables that differed between the groups of writers. This is consistent with the finding that expository writing may be difficult for students with HFASD because they have difficulty anticipating the reader's needs (Loveland et al., 1990). Thus, for people with HFASD, their writing difficulties may be partly grounded in their impaired ability to understand the minds of others.

However, it is difficult to determine from this data the directionality of the relationships among ToM, verbal skill and writing ability. It is possible that grammar, semantics and pragmatic language deficits underlie problems in ToM (Apperly, Samson, & Humphreys, 2009) as well as writing. Alternatively, impaired ToM may give rise to these same language deficits. Or it could be that ToM deficits are independent of some oral language skills, such as grammar (Seigal & Varley, 2006), yet nevertheless underlie written language communication difficulties in the ASD population. The modest correlation found between the Social Attribution Task and

estimated VIQ highlights the need to separate the dual effects of ToM and verbal skill on writing ability. Future research is necessary to help clarify the sequence of these factors.

Generativity and Theory of Mind

In this study, adults who were NT wrote narrative texts that were about 66% longer in terms of total words compared to adults with HFASD, confirming previous findings that the narratives of individuals with HFASD (whether oral or written) tend to be shorter than controls (cf., Barnes, et al., 2009; Smith-Myles et al., 2003; Tager-Flusberg, 1995). Previous literature on the oral language skills of individuals with HFASD noted that ToM was related to a greater ability to elaborate and expand on conversational topics (Capps et al., 1998; Tager-Flusberg, 1996; 1999). To this, we have added the finding that generativity in written language is also correlated with theory of mind.

The generativity deficits found in the writing of people with HFASD were significant only in the narrative condition. While expository length and narrative length were not compared statistically, descriptively, there was a trend for the HFASD group to write longer expositories than narratives. It was noted during testing that many participants commented that they used a five paragraph structure for their essay, which is traditional to secondary school writing. One possible interpretation of the differences in length between genres is that the salient structure of the five paragraph essay may have helped the HFASD group produce longer texts. This is in line with the finding that adding structure to tasks can reduce or alter differences between participants with HFASD and neurotypical controls (Capps et al., 1998). However, this interpretation needs to be explored further.

Text Mechanics and Theory of Mind

It has been demonstrated for individuals with HFASD that basic or procedural verbal abilities seem to be intact, while more complex, linguistic functions tend to be atypical (Minshew, Goldstein, & Seigal, 1995). Consistent with this, the HFASD group did not demonstrate significant differences in their aptitude with the mechanics of writing in either genre. However, the trends in the data towards group differences coupled with large effect sizes on some variables suggest that this topic warrants more investigation. The Social Attribution Task scores correlated significantly with Expository Mechanics Composite, and not with the Narrative Mechanics Composite. This somewhat contrasts with previous research in oral narrative, in which ToM correlated with semantic and syntactic knowledge and grammatical skill (Tager-Flusberg, 1999; Tager-Flusberg, 2007; Tager-Flusberg & Joseph, 2005; Tager-Flusberg & Sullivan, 1994). Future, research should continue investigate the HFASD groups' aptitude with the various aspects of text mechanics and its relationship to ToM.

Causes, Motivations, Affect, Mental States and Theory of Mind

Losh and Capps (2003) found that children with HFASD made fewer references to causes and motivations in their oral narratives than NT controls. However, in the present study, there were no group differences in the number of cognition and affect terms that adults used in writing, nor in the number of references to causes and motivations. While any absence of significant differences must be interpreted with caution, one possible explanation is that writing facilitated the inclusion of mental state terms, perhaps because it is self-paced and so permits more time for thought. Another explanation is that the mere inclusion of references to the internal worlds of characters is a low level theory of mind skill, perhaps like the ability to pass first order and second order false belief tasks (cf. Baron-Cohen, 1995). In contrast, the balance between landscapes of action and consciousness variable differentiated strongly between the groups,

suggesting that it provides a more high level and sensitive measure of theory of mind in writing. Since the present study involved high functioning adults with ASD, these individuals may have been more successful at the lower-order ToM task of including mental state terms in their narratives, yet struggled with the higher order ToM task of creating complex inner worlds for their characters. Future research must use sensitive measures of textual evidence of ToM when evaluating the writing of this population.

Limitations

One set of limitations in this study involved the sample size, number of dependent variables, and sample heterogeneity. First, there was large variability in the HFASD sample. This heterogeneity was expected as many research studies have reported similar findings (cf., Smith-Myles et. al, 2003); however, it reduced the power of the statistical tests. Secondly, a moderate sample size was obtained due to the difficulty of recruiting participants with HFASD. This also limited the power of the statistical tests, so that only group differences that were large in size attained statistical significance. A third limitation was that the large number of variables and statistical tests increased the likelihood of false rejections of the null hypothesis, while the moderate number of participants meant that some solutions, such as the use of factor analysis to reduce the data, were not practical. Therefore, in order to offset the study-wise probability of false rejections of the null hypothesis, 16 variables were combined to form three composites for each genre. This decision was supported by the very high inter-item reliability of variables within each composite.

One last consideration in this study is the composition of the HFASD group. In this sample, 14 individuals in the HFASD group were diagnosed with AS and only two were diagnosed with autism. While both groups struggle with the pragmatics or, social use, of

language (Tager-Flusberg, 1999), it has been suggested that the primary difference between them is that people with HFA also have delays in all areas of language, while those with AS have only pragmatic difficulties (Bennett, et al., 2008; Seung, 2007). As such, the more pervasive language deficits in individuals with HFA may lead to poorer writing overall compared to their peers with AS. Future research needs to compare the writing of individuals with HFA and AS using comprehensive oral language and written language assessments to help clarify the ways these factors impact each group's ability to write.

Educational Implications

Because this was a causal comparative study, and not an instructional experiment, limited implications can be drawn for instruction. However, based on these findings, we would suggest some tentative implications and directions for instructional research. First, we note that the lower scores of people with HFASD relative to their NT counterparts combined with the importance of strong writing skills at school and at work suggest the importance of investigating writing instruction for these students. Secondly, the fact that the distributions of many variables overlapped between the groups contrasts with most anecdotes from case study research, which tend to be quite negative. These findings provide an encouraging counterbalance, reminding us that the writing of people with HFASD comprises a spectrum of quality; it is not categorically worse than the writing of their NT peers. Thirdly, this study suggests some specific areas for focusing instructional research, including generativity, narrative structure, and textual coherence.

Conclusion

This study explored the written expression of individuals with high-functioning autism spectrum disorders in both the narrative and expository genres. It was found that adults with HFASD wrote narrative texts that were poorer in quality and shorter in length. Their expository

texts were also lower in quality. Finally, theory of mind skill was found to be associated with both length and quality measures. Future research should focus on the oral language abilities of individuals with HFASD along with their writing and cognitive differences to better understand how autism influences a person's ability to write. Understanding the nature of written expression difficulties in students with HFASD may enable educators to develop more individualized, focused and effective interventions for them. This in turn will facilitate the removal of barriers to their successful participation in the workforce and higher education upon graduation.

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Table 1

Group Demographics

Demographic	HFASD M (SD)	NT M (SD)	<i>t</i> (30)	<i>p</i>	<i>d</i>
Age	25.75 (7.9)	26.56 (7.0)	0.31	0.76	0.1
Vocabulary Score	12.56 (3.1)	14.19 (2.7)	1.60	0.12	0.6
Years of Schooling	14.1 (1.7)	15.0 (1.3)	1.78	0.09	0.6

Table 2

Indices of the Social Attribution Task

Index	Definition	Inter-rater reliability
Animation Index	Reflected the richness of the social story created by the participant.	$r = .71$
Theory of Mind Index	The frequency of cognitive and affective mental state terms throughout the oral narratives.	$r = .85$
Salience Index	The number of twenty possible story elements that were included in the participant's narrative.	$r = .90$
Pertinence Index	Demonstrated the participants' ability to adhere to relevant utterances in accordance with the social framework.	$r = .82$
Person Index	Quantified the strength of the participant's ability to ascribe psychological features to shapes	$r = .86$
Problem Solving Index	Measured the extent to which the answers of participants with HFASD matched their NT peers once the nature of the task was explicitly stated.	$r = .89$

Table 3

Length Composite and Variables

Variable	Definition	Inter-rater Reliability
Total words	The number of words in the text.	-
Total sentences	The number of sentences as indicated by punctuation in the text.	-
Total t-units	The number of t-units. One t-unit is one independent clause and any clauses dependent upon it.	Narrative: $r = .99$ Expository: $r = .99$
Total clauses	The total number of clauses in the texts (whether dependent, independent or embedded).	Narrative: $r = .99$ Expository: $r = .99$

Note: Dashes indicate this variable was scored electronically.

Table 4

Mechanics Composite

Variable	Definition
Mean Letters per Word	The total number of letters in the text divided by the total number of words.
Mean Clauses per T-Unit	Measured by dividing ‘total clauses’ by ‘total t-units’.
Percentage of Large T-Units	The number of t-units which had more than one clause divided by total t-units.
Spelling Score	Mean word length multiplied by the ratio of the number of words spelled correctly over the total number of words.
Percentage of Sentences with Grammar Correct	<p>The total number of sentences in the text, which were either a run-on sentence or a sentence fragment. Then the score was subtracted from the ‘total sentences’ to create a total number of sentences with correct grammar. Then this new amount was divided by total sentences to create a percentage.</p> <p>Interrater Reliability: Narrative $r = .97$; Expository $r = .97$</p>

Table 5

Quality Composite

Variable	Definition	Interrater Reliability
Structure	A holistic judgment out of five on the degree to which the essential structural elements existed in the text.	Narrative: $r = .80$ Expository: $r = .79$
Balance between landscapes	For the narratives only, the level of complexity and insightfulness of the internal worlds of their characters.	Narrative: $r = .72$
Context	A holistic score out of five for amount of background information, description and expansion of ideas.	Narrative: $r = .70$ Expository: $r = .75$
Quality	A holistic judgment out of seven on the how the text impacted the reader (e.g., Was it enjoyable to read?)	Narrative: $r = .85$ Expository: $r = .90$
Global coherence score	A holistic rating out of five based on the degree to which the participant's text fit together into a whole on the assigned topic.	Narrative: $r = .70$ Expository: $r = .84$
Percentage of locally coherent sentences	The number of sentences which made reference to the subject or predicate of the previous sentence divided by 'total sentences'.	Narrative: $r = .79$ Expository: $r = .95$

Table 8

Correlations between Narrative and Expository Text Variables and Social Attribution Scores

	Social Attribution Score	
	Narrative Text	Expository Text
Length Composite	.53*	.38*
Total T-Units	.52*	.39*
Total Words	.49*	.34*
Total Sentences	.53*	.35*
Total Clauses	.47*	.40*
Mechanics Composite	.03	.34*
Mean Letters per Word	-.01	.18
Mean Clauses per T-Unit	.14	.26
Percentage of Large T-Units	.28	.31*
Spelling Score	.17	.32*
Percent Correct Grammar	.21	.19
Quality Composite	.38*	.43*
Balance (rubric)	.54*	-
Structure (rubric)	.39*	.21
Context (rubric)	.37*	.28
Quality	.34*	.40*
Global Coherence	.10	.38*
Local Coherence	.19	.45*

Percentage of sentences referring to causes and motivations	.16	.23
Percentage of sentences with one or more cognition or affect terms	.17	.22

Note. Dash means this variable was not scored.

*p<.05, one-tailed.