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Blinded Abstract

Previous studies of students with high-functioning Autism Spectrum Disorder (HFASD) have shown great variability in their writing abilities. Most previous studies of students with HFASD have combined individuals with linguistic impairments (HF-ALI) and individuals without linguistic impairments (HF-ALN) into a single group. The current study was the first to compare the persuasive writing of students with HF-ALN with controls, without confounding the effects of language ability and autism on writing achievement, and while considering possible cognitive underpinnings of their writing skills. Twenty-five students with HF-ALN and 22 typically developing controls completed measures of oral language, nonverbal IQ, social responsiveness, theory of mind, integrative processing and persuasive writing. The persuasive texts were coded on 19 variables across six categories: productivity, grammatical complexity, lexical diversity, cohesiveness, writing conventions, and overall quality. The texts were reliably different between groups across measures of productivity, syntactic complexity, lexical complexity and persuasive quality. Specifically, the texts of students with HF-ALN scored lower on overall quality (*d* = -0.6 SD), contained shorter and simpler sentences (*d* = -1.0), and had less repetition of content words (*d* = -0.8 SD). For the HF-ALN group, integrative processing, language ability and age predicted 77% of the variance in persuasive quality.

Keywords: Autism Spectrum Disorder, written expression, persuasive writing, oral language, Weak Central Coherence, Theory of Mind

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Exploring the Persuasive Writing Skills of Students with High-Functioning Autism Spectrum Disorder

1. Introduction

It has been estimated that, despite having average to above-average intelligence, only 34-47% of adults with high-functioning Autism Spectrum Disorder (HFASD) hold steady jobs and, of those who do, most work in low-level jobs where the pay is generally poor (Howlin, 2003; Howlin, Goode, Hulton & Ruiter, 2004). Furthermore, it has been reported that the annual societal cost due to lost productivity averages $33,000 per adult with HFASD between the ages of 23-32 (Ganz, 2007). This substantial cost could be reduced if students with HFASD had access to appropriate training and resources that enabled them to experience academic success in elementary and secondary school, which in turn gives them the opportunity to attend post-secondary education, receive specialized training, and even develop specialization in a field (Schaefer-Whitby & Richmond-Mancil, 2009). Indeed, Temple Grandin suggests that academic success and specialized skill development are as important as social skills training for individuals with HFASD (Grandin, Duffy & Attwood, 2004).

Before we can implement training and resources to address where students with HFASD need support, we first need to better understand their academic strengths and weaknesses in comparison to their typically developing (TD) peers. Research has demonstrated that academic achievement varies widely in students with HFASD, ranging from severely impaired to exceptional (Jones, Happé, Golden, Marsden, Tregay et al., 2009). How the features of autism may impact academic achievement is, however, relatively unexplored, especially in the area of

written expression. The current study examined the relationships between written language performance and deficits in each of the following three areas: oral language, perspective-taking (or Theory of Mind) and integrative processing, across students with HFASD.

1.1. Oral Language, Theory of Mind and Integrative Processing Skills of Individuals with HFASD

It is well documented that individuals with HFASD struggle to master the pragmatics of language, that is, the conventions or rules governing language use for the purpose of communication (Groen, Zwiers, van der Gaag, & Buitelaar, 2008; Helland, Biringer, Helland, & Heimann, 2012; Tager-Flusberg, 1999; Tager-Flusberg, 2006). For example, children and adolescents with HFASD tend to: (a) lecture about their own interests; (b) introduce irrelevant comments into conversation; and (c) have difficulty initiating, elaborating and expanding conversational topics (Burke, 2005; Church, Alisanski, & Amanullah, 2000; Groen et al., 2008; Tager-Flusberg, 1996; Tager-Flusberg, 1999). Although pragmatic deficits are pervasive in the population of individuals with HFASD, a subgroup of these individuals also have difficulties with the building blocks of language (i.e., deficits in phonology, morphology, grammar and vocabulary; Bennett et al., 2008; Groen et al., 2008; Kjelgaard & Tager-Flusberg, 2001; Lindgren, Folstein, Tomblin & Tager-Flusberg, 2009). Studies have demonstrated that individuals with HFASD and core oral language impairments, hereto termed High-Functioning Autism with Language Impairment (HF-ALI), tend to have difficulties with the production and comprehension of syntactic elements of language, often produce more tense errors, and use less complex sentences (Bennett et al., 2008; Norbury & Bishop, 2003; Szatmari et al., 2009). By contrast, a second subgroup of individuals with HFASD (i.e., High-Functioning Autism Language Normal; HF-ALN) have grammatical, phonological and vocabulary skills in the normal to above

normal range (Kjelgaard & Tager-Flusberg, 2001; Lindgren et al., 2009; Loucas, Charman, Pickles, Simonoff, Chandler et al., 2008).

A second domain that is thought to be critically impaired in all individuals with HFASD is social cognition. More specifically, it has been demonstrated that most individuals with HFASD struggle to understand mental states (such as beliefs, desires, intentions) as applied both to themselves and to others, a phenomenon often referred to as poor Theory of Mind (ToM; Baron-Cohen, Leslie & Frith, 1985; Tager-Flusberg, 2007). One of the major consequences of a limited ToM is believed to be difficulty envisioning the perspective of others (Colle, Baron-Cohen, Wheelwright, & van der Lely, 2008). The original research using false belief tasks showed that lower-functioning participants with ASD had great difficulty distinguishing between the real world and another person's false representation of the world (Baron-Cohen et al., 1985). Similarly, on more advanced experimental tasks designed to tap ToM, such as the Social Attribution Task or the Strange Stories Test, higher-functioning individuals with ASD tended to perform more poorly than their TD peers (Brown & Klein, 2011; Happé, 1994; Klin, 2000).

A third area of weakness observed in individuals with HFASD is a tendency for impaired global processing skills. As a result, they may experience a relative failure to extract the gist or see the big picture in many situations. This concept formed the basis of Frith's (1989) original theory that individuals with HFASD have Weak Central Coherence (WCC). The present study focused on one aspect of WCC, specifically, integrative processing, which is the ability to combine disparate parts into a unified whole. Research has shown that individuals with HFASD tended to be less accurate than their non-disabled peers at integrating words and sentences

into meaningful wholes, and that they had the most difficulty with items that placed the greatest demands on integration to achieve higher order meaning (Jolliffe & Baron-Cohen, 1999; 2000).

1.2. How Might these Features of Autism Impact Persuasive Writing in HFASD?

In persuasive writing, the writer adopts a particular point of view and tries to convince the reader to accept his position (Nippold, Ward-Lonergan, & Fanning, 2005). To be successful, the writer must state his position, support it with emotional and/or logical appeals, anticipate counterarguments and reply to opposing points of view, all without alienating the reader he hopes to persuade (Crowhurst, 1990; Kroll, 1984; Nippold & Ward-Lonergan, 2010; Riley & Reedy, 2005). As such, persuasive writing is a challenging communication task that requires the writer to have sufficient knowledge of the topic, perspective-taking skills, the ability to weigh both sides of an issue, the ability to integrate multiple points of view, and oral language competence (Nippold & Ward-Lonergan, 2010; Riley & Reedy, 2005). Thus, several of the competencies that are necessary to write high-quality persuasive texts are competencies that are believed to be weak in the HFASD population.

Weaknesses in oral language, ToM and/or integrative processing may underlie a wide variety of text characteristics. For example, the written texts of children with oral language impairments (LI) tend to have problems with text microstructure. That is, these texts often contain fewer words, less complex sentences, more spelling errors and less diverse vocabulary as well as demonstrating severe problems with *grammatical acceptability* (i.e., using grammar rules competently; Dockrell, Ricketts, Charman, & Lindsay, 2014; Fey, Catts, Proctor-Williams, Tomblin, & Zhang, 2004; Mackie & Dockrell, 2004; Scott & Windsor, 2000). However, oral

language, ToM and integrative processing weaknesses may also underlie problems in text macrostructure such as overall quality, organization and structure, textual coherence as well as background information and detail. In other words, the underpinnings of these higher-order characteristics of text quality may differ. For example, a given text might have poor organization and structure because the author's weak integrative processing skills hinder his ability must create an integrated framework of ideas. Instead, his ideas are expressed with inadequate development or proof, and details tend not to be placed into larger, integrated frameworks (Flower, 1979). In comparison, a deficit in ToM might suggest that writers with HFASD do not realize the importance of making their writing comprehensible to 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, McEvoy, Tunali,& Kelley, 1990). Alternatively, the author may have weak oral language abilities and as a result, may write short pieces of poorly organized text that inevitably lack detail and that fail to meet the conventions of the genre and needs of the reader (Troia, 2011). In sum, based on these three deficits, it is possible to theorize about the kinds of weaknesses that may characterize the writing of individuals with HFASD. Yet, the question must be asked: Is there any evidence of these types of written expression weaknesses in the texts of individuals with HFASD?

1.3. Standardized Assessments of the Writing Skills of Individuals with HFASD

Most research investigating the writing skills of students with HFASD have used standardized writing assessments and reported global writing scores (c.f., Foley-Nicpon, Assouline and Stinson, 2012; Griswold, Barnhill, Smith-Myles, Hagiwara & Simpson, 2002;

Jones, 2007; Mayes & Calhoun 2003; 2008; Smith-Myles, Huggins, Rome-Lake, Hagiwara, Barnhill, et al., 2003; Smith-Myles, Simpson & Becker, 1994). Using meta-analytic technique, Brown (2013) found that the overall mean discrepancy between the written expression scores and nonverbal IQ (NVIQ) scores of students with HFASD was -0.6 SD (Cohen's *d*). This finding was surprising because it suggests that on global measures of academic achievement, students with HFASD were not demonstrating a clinically significant discrepancy between their demonstrated written expression skills and their potential as measured by NVIQ. However, it is important to note that there was great variability in the writing abilities of students with HFASD with scores ranging from *Moderate Impairment* (Standard Score = 65) to *Very Superior* (Standard Score = 162; Foley-Nicpon, Assouline & Stinson, 2012; Mayes & Calhoun, 2003; 2008).

There are two important limitations with this body of research. First, researchers have suggested that global measures of writing achievement may not be capturing the types of problems that students with HFASD are experiencing in writing (Reitzel & Szatmari, 2003). For example, Sivertson (2010) noted that while all three of her young participants with HFASD had both Written Expression scores on the *Woodcock Johnson Tests of Achievement* (*WJ-III*; Woodcock, McGrew, & Mather, 2001) and scores on the *Wechsler Intelligence Scale for Children (4th ed.)* General Ability Index (*WISC-IV*; Wechsler, 2003) in the average range, these students still had "great difficulties with initiating and completing writing tasks in the classroom" (p. 24). Second, this body of research fails to *describe* the writing of individuals with HFASD and how their writing may differ from their TD peers.

1.4. Descriptive Studies of the Writing Skills of Individuals with HFASD

In one of the only descriptive studies of expository writing and autism to date, Brown and Klein (2011) examined the writing skills of adults with HFASD (*n* = 16) and their non-disabled peers (*n* = 16) by asking them to write an essay on the topic of *problems between people*. After evaluating the written texts across 18 text variables, results revealed that the essays of the adults with HFASD were rated lower on overall quality (*d* = -1.0). Further, the primary area of difficulty in their expository texts was that they tended to have difficulty staying on topic (*d* = -0.9) and included abrupt transitions between ideas (*d* = -1.0). In other words, the texts were weak in textual coherence and cohesion. Additionally, there was a tendency for the expository texts of the adults with HFASD to have lower clausal density (*d* = -0.5 SD), contain shorter words (*d* = -0.6 SD) and have more frequent spelling errors (*d* = -0.7 SD), but these modest differences were not significant. Equally important, Brown and Klein (2011) found modest correlations (*r* = .38-.45, *p* < .05) between ToM (as assessed by the Social Attribution Task) and each of expository text quality, coherence, and cohesion. However, this study and, in fact, almost all previous studies on the writing skills of individuals with HFASD, have collapsed participants with HF-ALI and HF-ALN into a single group (cf., Brown & Klein, 2011; Mayes & Calhoun, 2003; 2008). Including individuals with HF-ALI in the HFASD group may have lowered group mean scores in writing skill compared to non-disabled controls due to language ability alone.

In the only study to date to examine the dual impact of language impairments and autism on writing, Dockrell, Ricketts, Charman, and Lindsay (2014) asked children with HFASD and children with LI to write for five minutes about their *best day at school*. The texts were scored on measures of productivity (number of words), grammar (number of correct word

sequences) and a global measure of overall quality. Dockrell et al. (2014) found that there were no significant differences in the written texts between individuals with HF-ALI and individuals with LI across the three writing measures; however, when the entire HFASD group (HF-ALI and HF-ALN combined) was compared to the LI group, the HFASD group outperformed the LI group on productivity and grammar, yet their performance on the writing quality measure was still similar. While it is unfortunate that the authors did not report the writing results for their sample of individuals with HF-ALN alone, this study nonetheless highlights that language ability seems to play a large role in written expression ability of individuals with ASD. However, language ability doesn't necessarily account for all variability in their writing skills, especially with regards to higher order aspects of writing competence.

The aim of the current study was to systematically describe the strengths and weaknesses in the written texts of HF-ALN compared to their TD peers, while carefully controlling for oral language in both the HF-ALN and control groups. Nineteen text variables were examined across the following areas of writing: Productivity, Syntactic Complexity, Lexical Complexity, Cohesiveness, Use of Writing Conventions, and Overall Persuasive Quality. It was hypothesized that a diagnosis of HF-ALN would contribute to written language strengths and weaknesses beyond what would be predicted by oral language skill alone. Specifically, it was predicted that, in comparison to controls, the texts of individuals with HF-ALN would:

(a) be of poorer quality, in terms of:

   i. text organization and structure

   ii. coherence and cohesion

   iii. level of background information

(b) not significantly differ on text variables related to productivity, lexical diversity, syntactic complexity or use of writing conventions, although these variables were also investigated

A second aim of the study was to explore the predictive power of several key variables on persuasive writing quality. As previously described, it was hypothesized that language ability, ToM and integrative processing ability may play a significant role in writing success. Nonverbal IQ and age were also investigated as possible predictors of persuasive writing quality.

2. Methods

2.1. Participants

2.1.1. Inclusion Criteria

This study included 25 students with HF-ALN (3 females) and 22 of their typically developing (TD) peers (8 females) from the Southern Ontario region. There were significantly more males in the HF-ALN group $\chi^2(1, N = 47) = 3.88$, $p = .049$. These same students also completed a narrative writing task, which is described in a separate paper (Brown, Oram Cardy, Smyth & Johnson, 2014). Each participant included in the study:

(a) was 8 to 17 years of age;

(b) had a Performance IQ (PIQ) score greater than or equal to 80 on the *Wechsler Abbreviated Scale of Intelligence* (*WASI*; Wechsler, 1999);

(c) had a Spoken Language Composite score greater than or equal to 80 on the *Test of Language Development: Intermediate 4* (*TOLD-I:4*; Hammill & Newcomer, 2008);

(d) had no additional neurological disorder (e.g., epilepsy, hydrocephalus), sensory impairment (e.g., hearing or vision impairment) or major psychiatric disorder (e.g., schizophrenia, psychosis) ; and

(e) was a native English speaker.

For inclusion in the in the HF-ALN group, participants were required to have a community diagnosis of Autistic Disorder or Asperger's Disorder as well as a *Social Responsiveness Scale* (*SRS*; Constantino, 2005; Constantino & Todd, 2005) *T-score* of greater than or equal to 60. The TD students were required to have no reported disabilities and an SRS *T-score* of less than 60. Table 1 reports participant demographics. (Place Table 1 here). T-tests demonstrated that there were no significant differences between the groups except on social responsiveness.

2.1.2. Recruitment

Several strategies for recruitment were used for this study. Personal contacts were asked to distribute email or paper announcements to parents of students with/without ASD whom they may know. In addition, participants with ASD were invited to participate through announcements placed with local agencies that support individuals with ASD via their websites and through email to their membership. TD children were recruited in two additional ways. First, students who had previously participated in a longitudinal, epidemiological study of school-age children (Archibald, Oram Cardy, Joanisse & Ansari, 2013) received an email invitation. Second, siblings of children with ASD were invited to participate.

2.1.3. Rationale for including siblings of participants with HF-ALN

Siblings of individuals with HF-ALN were included in the TD group if they had PIQ and language ability scores ≥ 80, below cut-off scores on the SRS, and no reported disabilities of any

kind. Although there is considerable evidence that siblings of children with HF-ALN have a higher incidence of communication difficulties (Yirmiya, Shaked, & Erel, 2001), it has been shown that only a subset of siblings have language impairments. For example, Lindgren et al. (2009) demonstrated that 89% of siblings of children with HF-ALN had language skills in the normal range, while only 11% of the siblings had language impairments. To ensure that the siblings were not significantly different than the non-sibling controls, one-way ANOVAs were conducted on four key variables: Age, PIQ, language ability and social responsiveness, as shown in Table 2. (Place Table 2 about here). The ANOVAs demonstrated that there were no significant differences between the sibling and non-sibling control participants.

2.2. *Measures*

2.2.1. Social responsiveness

The *SRS* (Constantino, 2005; Constantino & Todd, 2005) was used to assess ASD symptomology. The questionnaire asked parents to rate their child on 65 scaled questions in the areas of social reciprocity, social communication, and rigid, repetitive behaviours. The *SRS* generates a *T-score* with higher scores suggestive of greater impairments in social responsiveness. *T-scores* greater than or equal to 60 were used to confirm the presence of a diagnosis of ASD (Constantino et al., 2004; Constantino & Todd, 2005). In the current study, four control participants were excluded because their SRS scores were greater than 60.

2.2.2. Performance IQ

PIQ was assessed using the Block Design and Matrix Reasoning subtests of the *WASI* (Wechsler, 1999). This nonverbal IQ score is primarily a measure of visual-spatial reasoning

abilities. The measure was chosen because it allowed us to obtain an estimate of each participant's PIQ rapidly and efficiently. It is normed for participants aged 6 through 90 years.

2.2.3. Language ability

A comprehensive standardized language assessment, the *TOLD-I:4* (Hammill & Newcomer, 2008), was used to examine oral language skills across groups. It was the most appropriate choice for this study because it used the same six subtests across the entire age range of participants, i.e., 8 to 17 years. The six subtests included: (a) Sentence Combining, (b) Picture Vocabulary, (c) Word Ordering, (d) Relational Vocabulary, (e) Morphological Comprehension, and (f) Multiple Meanings. The six subtests were converted to scaled scores, which were then combined to calculate a standardized Spoken Language Composite score (Hammill & Newcomer, 2008).

2.2.4. Theory of Mind

The *Social Attribution Task* (*SAT*) developed by Klin (2000) was used to assess ToM across groups. The SAT involved watching a sixty second video of two triangles and a circle moving within and around a large rectangle. The participant was then asked to describe what happened in the video. The oral narrative was recorded, transcribed, and scored across six indices: Pertinent Index, ToM Index, Salience Index, Person Index, Animation Index, and the Problem Solving Index as detailed by Klin (2000) in the Social Attribution Task Scoring Manual. Table 3 gives detailed descriptions of these indices. (Place Table 3 about here).

2.2.5. Integrative processing ability

In the Global Integration Test, participants were asked to rearrange sentences according to contextual cues to make a coherent story (Jolliffe & Baron-Cohen, 2000). In total,

participants completed 22 stories. Nine of the stories had only thematic cues, whereas the remaining 13 had both thematic and temporal cues. Each story consisted of five sentences, which were presented to the participant on a computer screen. During the trial story, the participant was shown how to use the mouse to create a coherent story by dragging and dropping the sentences until they were in their proper sequence. When the participant felt that the story was in the proper order, she clicked *Done*. After completing the Global Integration Test, the participant read a short paragraph aloud to the experimenter. The time taken for each participant to read this paragraph aloud was used as a measure of reading speed. Accuracy and response times for each story were recorded by the computer program.

2.2.6. Persuasive writing task

First, the student viewed the following instructions on a computer screen, which were also read aloud to him:

> *Some parents want to limit:*
> - *the type of computer/video games their kids play*
> - *the type of internet and webpages (like Facebook, YouTube, iTunes) their kids are allowed to use*
> - *how long their kids are allowed to be on the computer*
>
> *Do you think your parents should limit what you use the computer for and how much time you spent on it?*

The student was then prompted to click *yes* or *no*. On the subsequent screen, the student would see and be read the following instructions:

> *Pretend that your parents are thinking about limiting what you use the computer for and how much time you spend on it (e.g., games, webpages, screen time). Write an essay to convince your parents to agree with your point of view on limiting your computer use. Make sure you plan your essay, include all elements of an opinion essay, and write as much as you can. My parents SHOULD (or SHOULD NOT) be able to*

limit what I use the computer for and/or how much time I spend on it!
Explain why…

The student would then write his text in a text box that had no spelling or grammar checking available. Students were given unlimited time to complete the writing task, but most completed within half an hour.

2.3. Analysis

We evaluated both lower order (text microstructure) and higher order (text macrostructure) text features. Tables 4 and 5 provide detailed descriptions of these variables. (Place Table 4 about here.) (Place Table 5 about here).

2.3.1. Lower order text variables

In this study, five categories of lower order variables were assessed (Productivity, Syntactic Complexity, Lexical Diversity, Cohesiveness and Writing Conventions) and each category contained the following individual variables: (a) Productivity: number of words, clauses and t-units; (b) Syntactic Complexity: mean length of t-unit (MLTU) and clausal density; (c) Lexical Diversity: Type Token Ratio (TTR), as well as frequency of multi-syllable words, big words and rare words; (d) Cohesiveness: frequency of connectives and use of cohesive reference; and (e) Writing Conventions: frequency of errors in grammar, punctuation, spelling and capitalization.

2.3.2. Higher order text variables

Before assessing the texts on higher-order writing variables, all texts were corrected for spelling, capitalization and punctuation. The goal was to reduce rater bias because such errors have been shown to influence quality ratings (Olinghouse, 2008). Overall persuasive quality was

evaluated using four text variables relating to the ability of the participants to organize ideas into higher order frameworks and to communicate their ideas clearly. As such, overall persuasive quality contained the following variables: rubric scores of structure and organization, coherence, background information, and tone. (The persuasive scoring rubrics are shown in the Appendix A). Further, all higher order scores were adjusted so that the minimum score was 0 and the maximum score was 10. The mean across all the individual variables was taken as the overall composite score (i.e., overall persuasive quality).

2.3.3. ToM and *Integrative processing*

The oral narratives from the SAT were scored by two research assistants, both of whom were naïve to the experimental hypotheses and to the group membership of participants. For the Global Integration Test, the computer program automatically provided accuracy and response time information for each participant after each trial. The response times for all correctly answered trials were averaged to form a response time composite score. The participants' accuracy scores for both the temporal and thematic conditions on the Global Integration Test as well as their scores on each SAT index were converted to a scale from 0 to 10, so that the variables could be compared more easily. Finally, a SAT Composite score was created by averaging across the six indices.

2.3.4. Reliability

Tables 4 and 5 include the inter-rater reliabilities for each variable. The coding of the textual variables was undertaken by the first and third authors and two research assistants. To eliminate rater bias, all coders were blind to the diagnosis of each participant. In addition, the research assistants were intentionally uninformed as to the experimental hypotheses. The first

and third authors independently coded a given variable in its entirety. Then, each variable, for at least 20% of the texts, was scored a second time by a research assistant or the third author. This process allowed us to compute intraclass correlations between the two raters for each variable. In instances where a given variable did not receive an inter-rater reliability score of 0.7 or higher, the coders were retrained and the variable was recoded.

2.3.5. Statistical analysis

With regard to the persuasive texts, multivariate analysis of covariance (MANCOVA) controlling for age was used to assess whether there were differences in the written texts between the two groups across each family of lower order variables. This was done in order to control the experiment-wide risk of false rejections of the null hypothesis due to the large number of textual variables (Hummel & Sligo, 1971). However, the large within group variability in writing scores due to age weakened the power of the multivariate analysis of variance (MANOVA) to detect between group variation. Therefore, age was used as a covariate in all analyses. A one-way analysis of covariance (ANCOVA) also controlling for the effects of age was used to test for differences between groups on the higher order composite score.

Post hoc comparisons on all the individual text variables were run using one-way ANCOVAs. To adjust the significance level of each test relative to the total number of tests in the set, post hoc comparisons were evaluated with a Sidak correction. Further to this, the means, *SD*s, and estimates of standardized mean differences between groups (Cohen's *d*) were reported. These comparisons were completed regardless of the multivariate test results because the information gained by exploring the differences between the groups across all nineteen individual text variables was invaluable. This information was necessary in order to

identify written language strengths and areas for growth of students with HFASD, which turn becomes an essential foundation for developing educational interventions (Foley-Nicpon, Assouline & Stinson, 2012).

With regard to the Global Integration Test, a MANCOVA controlling for age was run on the accuracy data. The response time composites were also analyzed using MANCOVA, but these analyses controlled for both age and reading speed. As above, the size of the differences between groups for each variable was quantified using effect sizes. Similarly, the six indices of the SAT task were compared using a repeated measures analysis controlling for age. Additionally, a one-way ANCOVA controlling for age assessed whether the two groups differed on the SAT Composite score.

Finally, Pearson's product-moment correlations were run between overall persuasive quality and the following predictors: age, language ability, social responsiveness, SAT composite score and accuracy on the temporal and thematic conditions of the Global Integration Test. Only those variables that were significantly related to persuasive quality were then used as predictors in a stepwise multiple regression. The regression was conducted to help answer the question of what underlying competencies (language ability, ToM, and/or integrative processing) might be most strongly related to writing strengths and/or weaknesses across both groups.

3. Results

3.1. Lower Order Text Variables

In Table 6, the results of the omnibus MANCOVAs for the lower order text variables are reported. (Place Table 6 here). There were significant differences between the writing of

students with HF-ALN and their TD peers across overall measures of productivity, syntactic complexity and lexical complexity. There were no significant differences between the two groups on cohesiveness and use of writing conventions.

3.1.1. Productivity and syntactic complexity

Whereas the MANCOVA suggested that the length of the persuasive texts of the HF-ALN group tended to be shorter than the persuasive texts of their peers, none of the three individual measures of productivity were reliably different between groups (see Table 7). (Place Table 7 about here). The MANCOVA across all measures of syntactic complexity was also shown to discriminate between the two groups. However, in this case, the two groups differed on the two of the individual syntax variables. Students with HF-ALN tended to write t-units that were shorter (*d* = -1.0 SD) and less complex (*d* = -1.0 SD) than those of their peers. Further, the size of these mean differences suggest that they may be clinically meaningful in that the texts of students with HF-ALN would likely be viewed by educators and speech-language pathologists as having weaknesses in syntactic complexity.

The reported differences between the two groups in terms of productivity and syntactic complexity prompted a closer examination of each group's oral language scores as measured by the *TOLD-I:4*. In addition to an overall language score, the *TOLD-I:4* also provides a grammar composite score based on participants' oral syntactic and morphology skills. As shown in Figure 1, there was no significant difference in grammatical ability between the group with HF-ALN (*M* = 97.76, *SD* = 10.30) and the control group (*M* = 102.00, *SD* = 8.99), $F(1,45) = 2.23$, *d* = -0.4, $p = .142$. (Place Figure 1 about here). An independent samples median test indicated a slight trend for the median of the HF-ALN group (*Mdn* = 96) to be lower than the median of the control

group (*Mdn* = 104), with a modest effect size, χ^2 (2, N = 47) = 3.519, p = .061, η^2 = 0.0765, d = -0.6 SD. These results tentatively suggest that the HF-ALN group had slightly lower oral syntactic ability than the controls.

The tendency for slightly lower oral syntactic ability in the HF-ALN group compared to their TD peers prompted an examination of the Pearson Correlation Coefficients between the *TOLD-I:4* grammar composite and each of: (a) MLTU (r = .258, p = .083); and (b) Clausal density (r = 0.083, p = .584). These correlations demonstrated that there was no relationship between oral grammar ability and syntactic complexity across the two groups.

Although the use of complex syntactical structures in the persuasive writing task was not likely related to oral grammar skills, complex syntax may have been related to the ability of participants to integrate details into higher order frameworks, in this case, hierarchical syntactic structures. Pearson correlation coefficients between the Global Integration Task (Temporal and Thematic accuracy) and MLTU and Clausal Density are reported in Table 8. (Place Table 8 about here). The modest correlations found between integrative processing and syntactic complexity indicate that the syntactic complexity scores may have been partially related to the participants' integrative processing ability.

3.1.2. Lexical complexity and cohesiveness

Overall, lexical complexity differentiated between students with HF-ALN and controls. Examination of the individual means revealed that this disparity was primarily the result of higher mean scores for the HF-ALN group on Type Token Ratio and Frequency of Rare Words (see Table 9). (Insert Table 9 about here.) In particular, students with HF-ALN tended to use a greater number of unique words (d = +0.8 SD) in their persuasive texts along with words that

occur less frequently in the English language (*d* = +0.8 SD) compared to their TD peers. In contrast to the findings for lexical complexity, the texts of students with HF-ALN did not reliably differ across local measures of cohesiveness. Both groups had similar rates of including connectives between clauses (*d* = -0.4 SD) and of referencing each new t-unit to the previous t-unit (*d* = +0.1 SD).

3.1.3. Writing conventions

There were no reliable differences between the two groups on their use of writing conventions (see Table 10). (Insert Table 10 about here.) Both groups had similar rates of grammar, punctuation, spelling and capitalization errors. However, there tended to be more variability in the number of errors in the texts written by students with HF-ALN (with the exception of spelling errors).

3.2. Higher Order Text Variables

Table 11 reports the results of the one-way ANCOVA (controlling for age) on Overall Persuasive Quality as well as the follow-up comparisons between the two groups on the individual text variables. (Insert Table 11 about here.) The texts of individuals with HF-ALN were generally rated more poorly on overall quality (*d* = -0.6 SD); however, these differences in persuasive quality might be perceived as subtle by an educator or clinician. An examination of the four variables within Overall Persuasive Quality showed that the differences were of modest size (*d* = -0.4 to -0.6 SD), yet none were significant after using a Sidak correction for running multiple tests. Although these findings cannot be taken as conclusive, the results indicate that the persuasive texts of the students with HF-ALN tend to be rated more poorly across measures of quality that tap text level of detail, coherence, organization and tone.

3.3. Theory of Mind

As shown in Figure 2, the six SAT variables were entered into a repeated measures analysis. This analysis demonstrated that there were no significant differences between the two groups, Wilks' λ =.892, $F(5, 40) = 0.972$, $p = .446$, $\eta^2 = .108$. (Place Figure 2 about here). Furthermore, a one-way ANCOVA showed that the SAT Composite score did not reliability differ between students with HF-ALN ($M = 5.55$, $SD = 1.27$) and controls ($M = 5.96$, $SD = 1.15$), $F(1,44) = 1.266$, $p = .267$, d = -0.3 SD. Thus, on this measure of ToM, individuals with HF-ALN were performing similarly to their TD peers.

3.4. Integrative Processing

Across the temporal and thematic conditions of the Global Integration Task, the omnibus MANCOVA examining accuracy while controlling for age, Wilks' $\lambda = 0.949$, $F(2,42) = 1.153$, $p = .325$, $\eta^2 = 0.051$, as well as the MANCOVA for reaction time controlling for age and reading speed, Wilks' $\lambda = 0.915$, $F(2,42) = 1.95$, $p = .155$, $\eta^2 = 0.085$, both demonstrated that there were no reliable differences between groups on the Global Integration Task (see Table 12). (Insert Table 12 about here.) Surprisingly, there was a trend for the HF-ALN group to have completed correct trials in the thematic condition slightly faster (d = +0.4 SD, $p = .057$) than their TD peers.

3.5. Predicting Overall Persuasive Quality for Students with HF-ALN and their TD Peers

For the HF-ALN group, there was a fairly substantial correlation (Pearson's r) between overall persuasive quality and each of age, language ability, social responsiveness and accuracy on the thematic and temporal conditions of the Global Integration Test (see Table 13). (Insert Table 13 about here.) In comparison, overall persuasive quality of the TD group was significantly

correlated with each of the above variables and with the SAT composite. However, it is important to note that the correlation between SAT and text quality, $r(47) = .143$, was not significant when the comparison was run across all participants. The significant predictors were then entered into a stepwise multiple regression to further investigate the relationship between these variables and text quality for each of the HF-ALN and TD groups.

For the HF-ALN group, the resultant model predicted 77% of the variance in persuasive writing quality $F(3,21) = 28.16$, *Adj.* $R^2 = 0.772$, $p < .001$, and three variables were included: accuracy in the thematic condition of the Global Integration Test ($\beta = .415$); language ability ($\beta = .403$); and age ($\beta = .413$) (see Table 14). (Insert Table 14 about here.) In other words, integrative processing ability accounted for the most variance in persuasive quality beyond both language ability and the participant's age. For the TD group, the regression model accounted for 74% of the variance in persuasive writing quality, $F(3,18) = 21.33$, *Adj.* $R^2 = .744$, $p < .001$ (see Table 15). (Insert Table 15 about here.) The significant predictors for the TD group were: age ($\beta = .536$), language ability ($\beta = .307$) and social responsiveness ($\beta = -.301$). Thus, like the HF-ALN group, both age and language ability were strong predictors of persuasive writing quality for the TD group. In contrast, the level of ASD symptomology (SRS) in the TD group, but not in the HF-ALN group, also predicted unique variance in persuasive quality.

4. Discussion

This was the first study to conduct a detailed investigation of the persuasive writing skills of children and adolescents with HF-ALN compared to their TD peers. We found that the persuasive writing of students with HF-ALN was reliably different across overall measures of productivity, syntactic complexity, lexical complexity and persuasive quality. In contrast, there

were no significant differences between the two groups on local measures of cohesiveness and overall use of writing conventions.

It was unexpected that individuals with HF-ALN would write shorter and less syntactically complex persuasive texts compared to their TD peers given that both groups were rigorously matched on oral language ability. Nevertheless, the results suggest that individuals with HF-ALN tended to write fewer words and clauses (d = - 0.4 SD, *n.s.*) and to use shorter and simpler sentences in terms of both shorter t-units (d = -1.0 SD, $p < .001$) and fewer clauses per t-unit (d = -1.0 SD, p = .003). These results are in line with the findings of Brown and Klein's (2011) examination of the expository writing of adults with HF-ALN. These researchers also found modest, albeit non-significant, differences between groups across productivity measures (e.g., t-units, clauses, words) and on one measure of syntactic complexity, clausal density. However, some of the adults with HFASD in the Brown and Klein (2011) study likely had co-morbid core oral language impairments and, as such, the difficulties with syntax found by Brown and Klein (2011) might be expected given that syntactic weaknesses of individuals with language impairments are often characterized by short, simple sentences with limited subordination (Nippold, Mansfield, Billow, & Tomblin, 2008). Nonetheless, these same findings in the current study of individuals with HF-ALN prompted a closer examination of the oral language scores as measured by the *TOLD-I:4* grammar composite score, which provides an estimate of oral syntactic and morphological skills.

Although there was no significant difference in oral grammatical ability between the HF-ALN group and controls, there was a slight trend for the median grammar scores of the HF-ALN group to be lower than the control group (p = 0.061) and this difference was modestly sized (d =

-0.6 SD). Although it may be reasonable to suppose that the lower syntactic complexity scores of the HF-ALN group resulted from weaker oral grammar skills, this prediction was not supported. There was no relationship between the oral grammar composite scores and any measure of syntactic complexity in the persuasive texts.

However, an investigation of the predictive power of integrative processing, as measured by accuracy on the thematic condition of the Global Integration Test, found several interesting findings. First, a modest positive relationship across all participants was found between the two measures of complex syntax and integrative processing. Second, integrative processing predicted overall persuasive quality above and beyond age and language ability for students with HF-ALN. Furthermore, the measure of integrative processing that was related to group differences in both syntax and quality was the task that placed the greatest demands on integration to achieve higher order meaning (Jolliffe & Baron-Cohen, 2000), suggesting that integrative processing may be an important predictor of persuasive writing skill in students with HF-ALN. Finally, integrative processing did not predict persuasive writing quality in the TD group.

In contrast to the findings about integrative processing ability, the SAT did not differentiate between the ToM skills of the two groups. Furthermore, the SAT was not significantly correlated with text quality, when we examined this relationship across all participants, despite the fact that Brown and Klein (2011) found a modest significant relationship between the SAT and text quality previously. These non-significant findings were quite surprising given that: (a) individuals with HFASD have demonstrated poorer performance on this ToM task in previous studies (e.g., Brown & Klein, 2011; Klin, 2000; Klin & Jones, 2006);

and (b) persuasive writing requires perspective-taking skills and the ability to write with the audience in mind (Nippold & Ward-Lonergan, 2010; Riley & Reedy, 2005) and, as such, persuasive writing skill should depend, at least in part, on ToM ability. However, several studies have shown that ToM is related to language ability in both TD populations and individuals with HFASD (Apperly, Samson & Humphreys, 2009; Tager-Flusberg, 2007; Tager-Flusberg & Sullivan, 1995). Thus, it may be that since both groups in the current study had similar language abilities, group differences on the SAT were not apparent.

In light of the findings about the predictors of persuasive writing, the shorter text length, simpler syntax and lower overall quality of the persuasive texts of the HF-ALN group might be best understood through the lens of writer-based prose. Flower's (1979) notion of writer-based prose refers to writing that tends not to meet the needs of its audience. From Flower's (1979) list of characteristics of writer-based prose, we have identified two overarching features of this writing style. The first is *problems with integration of details into higher order concepts*. Such texts may read like a list of data and details, where the information is recorded in the exact form in which it was stored. Ideas are expressed with inadequate development or proof, and details tend not to be placed into larger, integrated frameworks (Flower, 1979). In writer-based prose, it seems as if writers assume their audience will "do the work of abstracting the essential features, building a conceptual hierarchy and transforming the whole discussion into a functional network of ideas" (Flower, 1979, p. 28). The second feature of writer-based prose is that there is a *decreased clarity of expression*. The language in these texts is often unclear or vague. The text may contain ambiguous referents and expressions that convey only a general sense to the reader (Flower, 1979).

The results of the current study do not establish, but do suggest, that individuals with HFASD tend to write using writer-based prose to a greater degree than their TD peers. More specifically, in comparison to their TD peers, the texts of students with HF-ALN tended to include: (a) vague or unclear statements; (b) inadequate development of ideas; (c) decreased coherence; and (d) a tendency for details to not be placed into cohesive, hierarchical structure (see Table 16). (Insert Table 16 about here.) While the current study provides preliminary support for the notion that the persuasive writing of children and adolescents with HFASD may be characterized as writer-based prose, future research should investigate this hypothesis further.

Although this style is not ideal, writer-based prose may be an important step in the writing process for writers with HFASD. Writer-based prose reflects the author's thoughts about the material and it represents a practical strategy for managing large amounts of information (Flower, 1979). Transforming writer-based prose into reader-based prose breaks down the writing process into manageable parts and is a practical way to deal with overload on working memory. In creating writer-based prose, writers are able to create a draft that covers the breadth of their knowledge on the topic and drops the burden of making the writing accessible to the reader. It often represents a rich compilation of thoughts that cohere for the writer, but the writing has not yet fully articulated the connections for the reader (Flower, 1979). Teaching writers with HFASD to recognize their writer-based prose and to view it as a positive first step in the writing process may give the writer with HFASD the confidence to continue onto the revising and editing stage. Further, teaching students about writer-based prose defines writing as a multi-stage process and gives a good rationale for the necessity of editing and reworking

written drafts (Flower, 1979). Thus, transforming writer-based prose into reader-based prose should be explored as a possible teaching strategy when working with students with HFASD.

Furthermore, the lens of writer-based prose suggests some tentative implications for instruction. Teachers might consider: (a) the use of graphic organizers in prewriting activities and requiring students to make outlines; (b) having an instructional focus on teaching students to move from facts and details to defining a line of argument; (c) reminding students to focus on the big picture; (d) emphasizing how persuasive writing should be structured; and (e) encouraging students to seek feedback on their writing from multiple readers. Direct instruction on combining simple sentences into more complex grammar structures may also be beneficial.

Further to this, Self-Regulated Strategy Development (SRSD; Graham & Harris, 1993; 1998) may be another useful framework for improving the writing skills of students with HFASD as several studies, to date, have validated the efficacy of SRSD for students with HFASD (Asaro-Saddler & Bak, 2012; 2013; Asaro & Saddler, 2009; Asaro-Saddler & Saddler, 2010; Delano, 2007a; Delano, 2007b; Mason, Kubina, Valasa, & Cramer, 2005; Pennington & Delano, 2012). SRSD is a writing model that explicitly and systematically teaches students cognitive and self-regulation strategies for accomplishing specific writing tasks (Graham, Harris & Mason, 2005) and as such, this research suggests that self-regulation seems to be a critical element of writing competently. As emphasized by Troia (2011), if you can't regulate your writing process, then you are likely "to produce short pieces of writing bereft of detail and lacking polished organization that fail to adequately attend to genre conventions and reader needs" (p. 42). Future research should investigate the relationship between self-regulation skills of students

with HFASD and written language performance as well as continue to evaluate SRSD for its effectiveness at improving the writing skills of students with HFASD.

It is nonetheless important to emphasize that the differences in the persuasive texts between groups tended to be subtle (-0.4 SD to -0.6 SD) and not necessarily significant. Further research in this area is needed with a larger cohort of participants in order to increase the power of the analyses to find statistical significance in the modestly-sized differences between the group with HF-ALN and controls. This finding of modest differences between groups across writing measures was likely due to the fact that the two groups were rigorously matched on oral language skill, given that previous research has shown that doing so can reduce or eliminate group differences (c.f., Tager-Flusberg & Sullivan, 1995). This may be especially important in the study of persuasive writing skills of individuals with HFASD given the current study's finding that oral language ability was a strong predictor of overall persuasive quality. Therefore, it is critical that future research examine the persuasive writing of individuals with HF-ALI compared to students with LI. Only by examining the persuasive texts of four different groups: students with HF-ALI, HF-ALN, LI without HFASD and TD controls will we be better able to understand the impact of autism (in the presence and absence of core language impairments) on a student's ability to write persuasively.

Historically, writing has been a central facet of western education (Crowhurst, 1990). In our increasingly digital age, writing has become even more essential in the workplace, the education system and our day-to-day personal lives (Magnifico, 2010). Having a job that requires the individual to regularly produce written reports has become "a marker of high-skill, high-wage, professional work" (College Entrance Examination Board, 2004). Yet, most

individuals with HFASD are unemployed or underemployed despite their average to above average intelligence (Howlin, 2003; Howlin, Goode, Hulton & Ruiter, 2004). This is a huge loss to both the individual with HFASD and to society as a whole. In order for students with HFASD to obtain appropriate employment, students with HFASD need appropriate training and resources to enable them to experience academic success, especially in the area of written expression. This academic success would enable students with HFASD to attend post-secondary education, achieve economic independence and to contribute meaningfully to society.

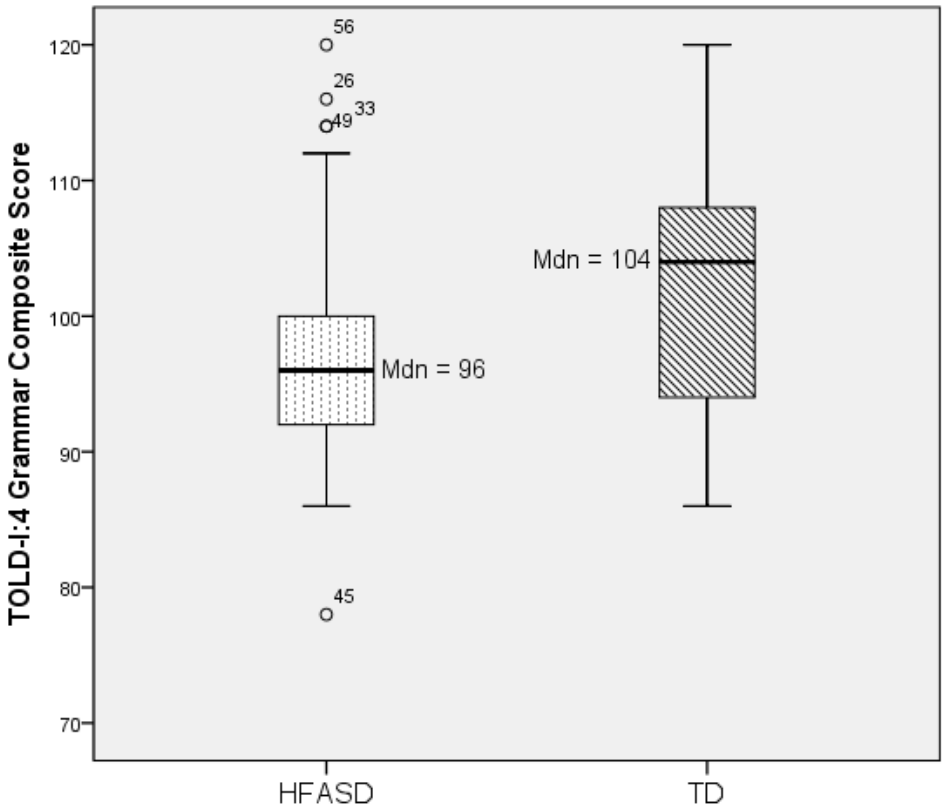
Figure Captions

Figure 1. Grammar composite scores from the *TOLD-I:4.*
Figure 2. A Comparison of Group Scores on the SAT

IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.

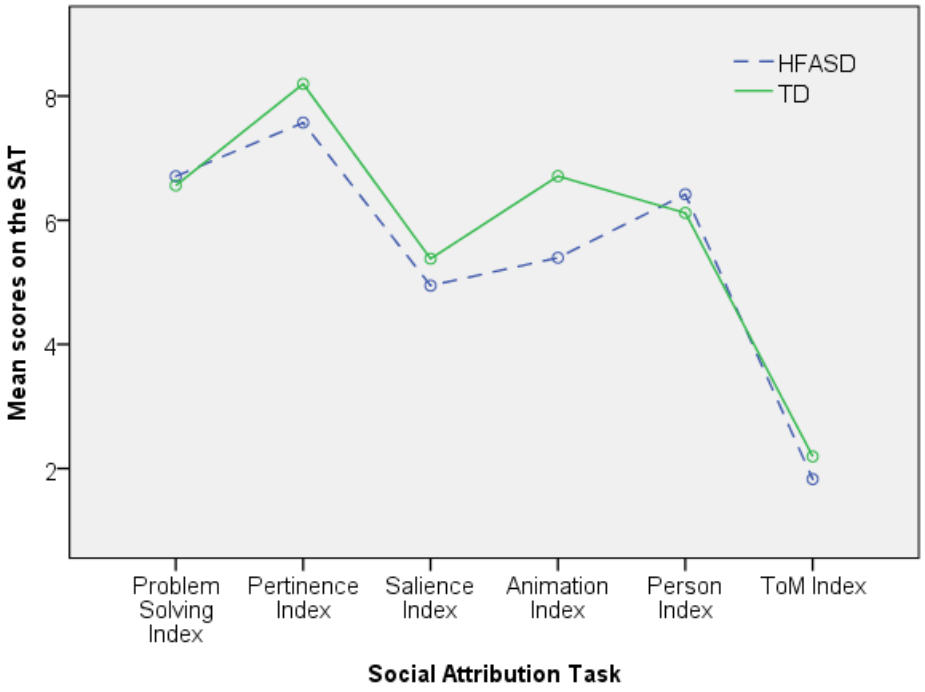
Fig. 1 Grammar composite scores from the *TOLD-I:4.*

[Figure 1 top]



IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.

Fig. 2 A Comparison of Group Scores on the SAT



Tables

Table 1. Participant Demographics

Demographic	HF-ALN (*n* = 25) *M (SD)* Range	TD (*n* = 22) *M (SD)* Range	*t*	*p*	*d*
Age (years)	12.91 (2.15) 8.17-16.83	13.09 (2.50) 8.25-16.83	-0.267	.670	-0.1
Performance IQ (*WASI*)	108.04 (11.61) 84-131	109.59 (10.07) 85-128	0.630	.727	-0.1
Language Ability (*TOLD-I:4*)	98.32 (9.70) 82-123	101.55 (8.12) 83-118	0.227	.232	-0.4
Social Responsiveness (SRS)	85.44 (12.70) 63-113	44.00 (6.66) 35-58	14.242	< .001	+4.3

Table 2. Demographics of the TD group (siblings vs. non-siblings)

Demographic	Siblings (*n*= 8) *M (SD)* Range	Non-siblings (*n* = 14) *M (SD)* Range	*t*	*p*	*d*
Age (years)	13.16 (2.73) 9.75-16.83	13.05 (2.46) 8.25-16.33	0.097	.923	0.0
Performance IQ (*WASI*)	113.00 (9.47) 101-128	107.64 (10.22) 85-123	0.792	.438	+0.5
Language Ability (*TOLD-I:4*)	103.38 (7.63) 94-118	100.50 (8.48) 83-118	1.213	.239	+0.3
Social Responsiveness (SRS)	45.83 (6.30) 38-58	43.07 (6.90) 35-57	0.860	.400	+0.4

Table 3. Social Attribution Task Indices

Index	Description	ICC[a]
Animation Index	Reflected the richness of the social story created by the participant	0.83
Theory of Mind Index	The frequency of cognitive and affective mental state terms used throughout the social story	0.92
Salience Index	Assessed the ease with which the participant gave ambiguous visual stimuli social meaning	0.87
Pertinence Index	Demonstrated the participants' ability to adhere to relevant utterances in accordance with the social framework	0.95
Person Index	Quantified the strength of the participant's ability to ascribe psychological features to shapes	0.83
Problem Solving Index	The extent to which the answers of participants with HF-ALN matched their TD peers once the nature of the task is explicitly stated	0.80

Note. [a] ICC: Intraclass correlation

Table 4. Lower Order Text Variables

Composite	Variable	Definition	ICC[a]
Productivity	Total Words	The number of words in the text	-
	Total T-units	The number of t-units. One t-unit is one independent clause and any clauses dependent upon it	0.99
	Total Clauses	The total number of clauses in the texts (whether dependent, independent or embedded)	0.93
Syntactic Complexity	Mean Length of T-unit (MLTU)	The total number of words in the text divided by the total number of t-units	-
	Clausal Density	The total number of clauses in the text divided by the total number of t-units	-
Lexical Complexity	Type Token Ratio (TTR)[b]	A count of the number of different words in the text divided by the total number of words	-
	Frequency of Multi-Syllable Words[b]	A count of the number of words containing three or more syllables divided by the total number of words	-
	Frequency of Big Words[b]	A count of the number of words with seven or more letters divided by the total number of words	-
	Frequency of Rare Words[b]	A count of the number of words that are considered very rare according to the Corpus of Contemporary American English (COCA), i.e., words that had a frequency rating of greater than 3000 divided by the total number of words	-
Cohesiveness	Frequency of Connectives	The number of clauses that included a connective word divided by total clauses and multiplied by 100.	0.92

	Use of Cohesive Reference	The number of t-units in the text which make reference to the subject or predicate of the t-unit that precedes it divided by total t-units and multiplied by 100	0.77
Writing Conventions[c]	Frequency of Grammar Errors	The total number of t-units containing one or more of the two most common grammar errors (sentence fragments and run-on sentences) divided by the total number of t-units	0.88
	Frequency of Punctuation Errors	A count of the total number of punctuation errors divided by the total number of clauses	0.95
	Frequency of Spelling Errors	A count of the total number of spelling errors divided by the total number of clauses	0.98
	Frequency of Capitalization Errors	A count of the total number of capitalization errors divided by the total number of clauses	0.99

Note. Dashes indicate the variable was scored electronically. [a] ICC: Intraclass correlation [b] This variable was scored using the following online text analyzer: http://www.usingenglish.com/resources/text-statistics.php [c] Rare words were scored using this online text analyzer: http://www.wordandphrase.info/analyzeText.asp

Table 5. Higher Order Text Variables

Composite	Variable	Definition	ICC[a]
Overall Persuasive Quality	Coherence	A holistic judgment of the degree to which: (a) ideas were connected, (b) topic changes were smooth, (c) the student included toff-topic or tangential information, and (d) the text was understandable.	0.89
	Background Information	A holistic judgment of the degree to which the student provided appropriate background information through the inclusion of multiple arguments that were well-developed through supporting reasons	0.92
	Organization and Structure	A holistic measure of the degree to which the narrative: (a) contains the elements of the five paragraph essay structure (i.e., introduction, position statement, three body paragraphs and a conclusion); (b) contains several distinct arguments; and (c) uses paragraphing .	0.85
	Tone	A holistic measure of the degree to which the writer used (a) a respectful and appropriate tone; (b) mature arguments; and (c) softeners (e.g., hedges) to indicate narrator uncertainty and, thus, multiple possible interpretations or perspectives	0.80

Note. [a] ICC: Intraclass correlation

Table 6. Results of the Omnibus MANCOVAs for each Family of Lower Order Text Variables

Lower Order Text Variables	Wilks' λ	*F*	*p*	η^2
Productivity*	0.815	3.171	.034	0.19
Syntactic Complexity*	0.714	8.593	.001	0.29
Lexical Complexity*	0.777	2.949	.031	0.22
Cohesiveness	0.932	1.559	.222	0.07
Writing Conventions	0.901	1.131	.355	0.10

Note. * Significant at $p < .05$

Table 7. Differences between Groups on Measures of Productivity and Syntactic Complexity

Text Variable	HF-ALN	Control	$F(1,44)$	p	d
	M (SD) Range	*M (SD)* Range			
Productivity					
Total number of words	183.48 (178.23) 35 - 722	271.72 (235.10) 60 - 926	2.869	.097	-0.4
Total number of clauses	22.28 (18.79) 5 - 75	31.95 (24.99) 6 - 105	2.791	.102	-0.4
Total number of T-units	12.64 (10.44) 4 – 40	14.95 (11.45) 4 - 42	0.487	.489	-0.2
Syntactic Complexity					
Mean Length of T-unit*	13.62 (3.65) 7.0 - 20.6	17.43 (4.02) 9.1 - 26.9	15.824	< .001	-1.0
Clausal Density*	1.74 (0.421) 1.0 - 2.4	2.13 (0.159) 1.5 - 3.1	10.023	.003	-1.0

Note. *Significant using a Sidak correction of $p < .017$

Table 8. Correlations between Measures of Integrative Processing and Syntactic Complexity

	Thematic Accuracy Score	Temporal Accuracy Score
MLTU	r = .420, p = .003	r = .467, p = .001
Clausal Density	r = .298, p = .042	r = .256, p = .082

Table 9. Differences between Groups on Measures of Lexical Diversity and Cohesiveness

Text Variable	HF-ALN	Control	*F*(1,44)	*p*	*d*
	M (SD) Range	*M (SD)* Range			
Lexical Complexity					
Type Token Ratio*	57.32 (10.70) 40.4-87.0	49.97 (7.02) 35.1-63.9	8.301	.006	+0.8
Frequency of Multi-Syllable Words	2.92 (1.95) 0.0-8.8	2.72 (1.52) 0.0-5.44	0.235	.630	+0.1
Frequency of Big Words	12.67 (5.62) 4.1-25.6	11.24 (3.45) 5.0-16.8	1.148	.290	+0.3
Frequency of Rare Words*	9.42 (4.03) 4.4-17.4	6.51 (3.47) 2.1-13.1	6.770	.013	+0.8
Cohesiveness					
Frequency of Connectives	22.16 (11.33) 0-50	27.62 (14.61) 0-60	2.490	.122	-0.4
Use of Cohesive Reference	83.20 (19.11) 25-100	81.78 (17.21) 33-100	0.078	.781	+0.1

Note. * Significant using a Sidak correction of $p < .013$

Table 10. Differences between Groups on Use of Writing Conventions

Text Variable	HF-ALN	Control	$F(1,44)$	p	d^b
	M (SD)	*M (SD)*			
Writing Conventions[a]					
Frequency of Grammar Errors	16.65 (21.34) 0-75	9.95 (12.28) 0-43	1.640	.207	-0.4
Frequency of Punctuation Errors	47.24 (47.56) 0-171	40.24 (29.90) 0-96	0.276	.602	-0.2
Frequency of Spelling Errors	39.51 (34.07) 0-125	37.11 (34.91) 3-158	0.034	.855	-0.2
Frequency of Capitalization Errors	46.22 (52.05) 0-189	31.96 (35.23) 0-125	1.281	.264	-0.3

Note. [a] Higher scores represent larger error rates. [b] Negative scores indicate that the HF-ALN group made more errors than their TD peers.

Table 11. Differences Between Groups on the Higher Order Text Variables

	HF-ALN	Control	*F*(1,44)	*p*	*d*
	M (SD)	*M (SD)*			
Overall Persuasive Quality	**4.15 (2.52)**	**5.57 (2.60)**	**18.813**	**.015**	**-0.6***
Coherence	4.35 (3.21)	5.85 (2.87)	5.928	.046	-0.6
Background Information	3.75 (3.00)	5.40 (3.44)	4.199	.019	-0.5
Organization and Structure	4.65 (3.34)	5.91 (2.94)	3.034	.089	-0.4
Tone	3.85 (2.60)	5.11 (2.86)	2.404	.128	-0.4

Note. * Significant at p < .05

Table 12. Differences between Groups on the Global Integration Test

Variable	HF-ALN *M (SD)* Range	Control *M (SD)* Range	*F*(1,43)	*p*	*d*
Temporal Condition					
Accuracy	6.09 (1.66) 3.1-10.0	6.22 (2.08) 2.3-9.2	0.015	.903	-0.1
Reaction Time	44.33 (16.22) 26.9-97.7	48.96 (20.12) 25.5-101.8	1.80	.187	+0.2
Thematic Condition					
Accuracy	6.40 (1.91) 1.1-8.9	7.12 (1.36) 4.4-8.9	2.36	.132	-0.4
Reaction Time	42.74 (13.01) 22.6-80.4	50.06 (22.17) 21.2-108.0	3.82	.057	+0.4

Table 13. Correlations between Overall Persuasive Quality and Predictor Variables for HF-ALN above the Diagonal and for TD below the Diagonal.

	1	2	3	4	5	6	7	8
1. Persuasive Quality	–	.722*	.241	.499*	-.407*	-.302	.727*	.582*
2. Age	.775*	–	-.134	.111	-.107	-.140	.637*	.544*
3. PIQ	-.343	-.404	–	.342	-.296	-.311	.155	.231
4. TOLD:I-4	.609*	.405	-.100	–	-.194	-.174	.120	.509*
5. SRS	-.592*	-.382	-.080	-.281	–	.047	-.490*	-.082
6. SAT	.594*	.553*	.189	.521*	-.410	–	-.192	-.317
7. GIT Theme Acc	.494*	.361	-.110	.452*	-.346	.127	–	.467*
8. GIT Temporal Acc	.508*	.461*	.071	.494*	-.293	.469*	.147	–

Note. GIT = Global Integration Test; Acc = Accuracy. * $p < .05$, *two-tailed*

Table 14. Regressions predicting persuasive writing quality for the HF-ALN Group

		B	*SE*	*β*	*t*	*p*	R^2	*Adj.* R^2	*F Change*
1	GIT Theme Acc	.959	.189	.727	5.07	< .001	.528	.507	$F(1,23) = 25.72$, $p < .001$
2	GIT Theme Acc	.893	.155	.676	5.75	< .001	.836	.672	$F(1,22) = 12.59$, $p = .002$
	Spoken Language	.108	.031	.417	3.55	.002			
3	GIT Theme Acc	.548	.167	.415	3.28	.004	.895	.772	$F(1,21) = 10.68$, $p = .004$
	Spoken Language	.105	.025	.403	4.11	.001			
	Age	.483	.148	.413	3.27	.004			

Note. GIT Theme Acc = Global Integration Test Thematic Accuracy Score

Table 15. Regressions predicting persuasive writing quality for the TD Group

		B	*SE*	*β*	*t*	*p*	R^2	Adj. R^2	*F Change*
1	Age	.809	.147	.775	5.49	< .001	.601	.581	$F(1,20) = 30.13$, $p < .001$
2	Age	.660	.142	.632	4.64	< .001	.705	.674	$F(1,19) = 6.67$, $p = .018$
	Spoken Language	.113	.044	.353	2.59	.018			
3	Age	.559	.132	.536	4.22	.001	.780	.744	$F(1,18) = 6.20$, $p = .023$
	Spoken Language	.098	.039	.307	2.51	.022			
	Social Responsiveness	-.188	.047	-.301	-2.49	.023			

Table 16. Evidence from the Current Study Supporting the Hypothesis that Individuals with HFASD Tend to Write Using Writing-Based Prose

Characteristics of Writer-Based Prose	Evidence from the current study
Decreased clarity of language use	The texts of the HFASD group were rated more poorly on overall quality, tended to give less background information[b], and tended to use rarer words[a] compared to their peers. All of which may have impacted the clarity of their writing.
Ideas are expressed with inadequate development	Compared to controls, the texts of the HFASD group tended to give less background information[b], and were shorter in length[a]. Further, the texts of the HFASD group tended to have more problems with organization and structure[c]. These findings suggest that the ideas expresses in the texts of students with HFASD may have been inadequately developed compared to their peers.
Decreased coherence	The HFASD group used less repetition of content words[a] and had lower overall coherence scores[b] compared to controls. As such, these findings suggest that the persuasive texts of students with HFASD were less coherent.
Ideas not integrated into overarching frameworks	The syntax used by students with HFASD tended to be less complex[a] and less dense (i.e., fewer t-units tended to contain multiple clauses)[a] compared to their peers. Also, there was slight trend for the HFASD group to struggle with the organization and structure of their persuasive texts[c]. Together, this suggests that the ideas in the texts of the HFASD group as compared to controls were not as well organized into hierarchical frameworks.

Note. [a] Significant difference; [b] Non-significant difference after correcting for multiple tests; [c] Non-significant difference.

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Appendix A

Persuasive Rubrics: Higher Level Text Features

	Persuasive Structure and Organization	**Background Information (Quality and Quantity)**
0	• 5-6 simple sentences (i.e., one t-unit) • No position statement • Arguments are merely listed • No conclusion	• No background information • A list of reasons all or most of which do not answer the question/relate to the topic • No arguments
2	• 5-6 simple sentences (may have some complex sentences) • Position statement present, but is only one sentence long • May use exact position statement that they were given: "My parents SHOULD (NOT) be able to limit what I use the computer for and/or how much time I spend on it!" • Arguments are merely listed • No conclusion	• Inadequate background information • A list of related reasons • No arguments
4	• Text is one paragraph long • A variety of sentence types • Position statement present but may be only one sentence long • The conclusion statement may be a terminating remark not appropriate to the text or is only one sentence long • All the arguments may be clumped together in one paragraph	• Some background information given • at least one argument has been stated • Argument shows limited development through supporting reasons
6	• Text is two paragraphs long • Introduction, position statement and conclusion are present, but each may be only about one sentence long • Beginning to resemble the five paragraph essay structure	• Consistent background information given • One or more arguments have been stated • At least one argument shows good development through supporting reasons

8	• Text is three or more paragraphs long • Each paragraph contains a distinct argument • Introduction and conclusion must be more than one sentence • Text generally follows the five paragraph essay structure	• Excellent background information given • Two or more arguments have been stated • At least two arguments show good development through supporting reasons

	Overall Textual Coherence	**Overall Tone**
0	• Scarce connections between ideas • The text is simply a list of ideas, statements, or thoughts • The text may be very repetitive • There is likely much off topic or tangential information • Text may not make sense	• Tone is rude, angry, harsh, narrow-minded or disrespectful • Didn't take topic seriously • Includes obvious immature arguments • includes black and white statements , generalizations and/or sweeping statements • Uses colloquial language • Does not consider more than one point of view
2	• Rare connections between ideas • There may be much off topic or tangential information • May still have a list-like feel • Text may be only somewhat understandable	• Tone is off-putting, arrogant, whiney, lifeless or mechanical • Commitment to topic may be present but writer needed to take the topic more seriously • Includes many immature arguments • Includes many black and white statements , generalizations and/or sweeping statements • Frequently chooses inappropriate words • Does not consider more than one point of view
4	• Includes some connections between ideas • There may be some off topic or tangential information • Topic changes beginning to be smooth • May read as "choppy" • The text is generally understandable	• Tone is neutral • Writer shows interest and commitment to the topic • Includes some immature arguments • Includes some black and white statements , generalizations and/or sweeping statements but some may be softened by polite forms • Sometimes chooses inappropriate words • Likely does not consider more than one point of view

6	• Regularly connects ideas • May have some off topic or tangential information • Topic changes are often smooth • Reads as a relatively smooth text (not list-like) • The text is understandable	• Tone is respectful and appropriate • Considers the topic seriously • Has mature arguments • Uses generalized statements but are softened by polite forms • Generally chooses appropriate words • May consider the opposite point of view in the argument
8	• Most ideas are connected • Topic changes are generally smooth • Contains many linked ideas • Reads as a smooth text • The text is understandable • Text may be insightful	• Tone is inviting and engaging • Considers the opposite point of view in the argument • Softens tone of argument by "hedges" (indicate narrator uncertainty and, thus, multiple possible interpretations or perspectives) • Exhibits skill in word choice

Based on Berman & Nir-Sagiv, 2007; Brown & Klein, 2011; Midgette, Haria & MacArthur, 2008; Scott, 2009; Westby & Clauser, 1999