

# When Autistic Writing is Superior to Neurotypical Writing: the Case of Blogs

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## **Abstract**

*Background:* Studies of autistic children's writing have long focused on weaknesses in structural complexity, organization and taking readers' perspectives. In contrast, awareness is growing that writing is a strength for many autistic adults, as suggested by research on autistic memoirs and autistic college students. Less is known about how well autistic individuals write when they use language for their own purposes, such as writing a blog.

*Method:* We analyzed the word usage patterns of 30 self-identified autistic bloggers and 30 age and gender-matched non-autistic bloggers, assumed to be neurotypical (NT). Blog content was analyzed using qualitative methods.

*Results:* Compared to NT bloggers, autistic bloggers wrote in a more complex manner. Autistic bloggers often wrote about science or other abstract topics rather than discussing daily life events.

*Conclusion:* One subset of autistic individuals, those who write blogs, wrote in a more complex style than did typically developed peers. This may reflect autistic bloggers being an elite subset of autistic individuals, or a cognitive style that includes intellectual interests.

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## When Autistic Writing is Superior to Neurotypical Writing: the Case of Blogs

### Introduction

The neurodiversity movement has called on researchers and clinicians to attend to autistic strengths across the spectrum of abilities (Haney, 2018; Wright et al., 2020). This includes the subgroup of autistic individuals who have normal intellectual ability, estimated to be as many as 59% of all autistic persons (Katusic et al., 2021). One area for new consideration is writing. Writing has advantages over oral language because it avoids the social skills required for face-to-face communication. Written language could thus be a relative strength and/or a special interest of some persons with autism (Boytsova, 2015; Kasirer & Mashal, 2014; Newton et al., 2009). Interestingly, scholars have recently documented that many autistics are highly skilled writers who enjoy writing (Hacking, 2009; Kim & Bottema-Beutel, 2019; Tomlinson & Newman, 2017; Van Goidsenhoven, 2017). Indeed, in two studies of college students, autistic students' stories were rated at a higher reading level than non-autistic students' writing and contained fewer grammatical errors (Gillespie-Lynch et al., 2020; Shevchuk-Hill et al., 2022).'

While discussing writing strengths in autism, Zajic and Brown (2022) reviewed two traditions for studying autistic writing. One investigates foundational writing skills, such as spelling, handwriting, text generation, as well as how these are impacted by underlying language and cognitive skills. An example is classroom studies which have traditionally focused on remediating writing challenges in autistic children (Zajic & Wilson, 2020). The second approach is to study autistic writing with the Writer(s)-with-in-Community (WWC) framework (Graham, 2018). This strength-based approach "...considers the social and historical components (i.e., the community) alongside the cognitive processes (i.e., internal components) that facilitate written language production across time and context" (Zajic & Wilson, 2020, p. 129).

We have responded to the plea for more study of self-motivated autistic writing by analyzing blogs from a strength-based perspective (Stenning, 2020; Zajic & Wilson, 2020). Here we briefly review the different approaches for studying autistic writing, as well as prior studies of autistic bloggers.

### **The Traditional Approach: Focus on Writing Challenges**

The historic emphasis has been to understand and remediate autistic deficits. This has compelled research on how motor deficits, executive impairments and mentalizing challenges

## WRITTEN LANGUAGE IN AUTISM

impact writing (e.g., Akmanoglu & Batu, 2004; Brown & Klein, 2011; Asaro-Saddler & Coles, 2019). Research with autistic children by Pennington and Delano (2012) revealed decreased legibility, complexity, and number of words compared to students without disabilities. These were explained as likely resulting from perspective-taking limitations, executive function and planning problems, and pragmatic language impairments. Pennington and Delano (2012) urged the development of writing instruction tailored to challenges faced by autistic students. The literature they reviewed on interventions consisted of studies with 4 or fewer autistic participants. Targeted skills ranged from spelling to story constructions. All studies reported that interventions were successful. Computer aided instruction (CAI) was present in most of the interventions. Advantages of CAI include minimizing demands of face-to-face interaction and the inherent rewards of multimedia presentations. Many of the interventions employed modeling, by demonstrating writing techniques via printed models, videos, and role-play, consistent with reports of prior researchers (e.g., Akmanoglu & Batu, 2004).

The authors did note a key drawback of the studies they reviewed: most of the studies were in clinical settings or special education classrooms, not in the general education classroom which are increasingly the setting for larger numbers of autistic students.

Brown and Klein (2011) compared neurotypical (NT) adults and autistic persons who had no intellectual impairment on how strongly narrative and expository writing depended on mentalizing ability. Participants viewed video clips of interpersonal conflict, and then produced two writing samples, one about a personal experience with conflict, and one about conflicts between people. Autistic adults produced shorter texts, used fewer mental state terms, and attributed mental state terms to fewer characters in each of the scenes. Compared to NT adults, the autistic adults wrote in a more literal and less cohesive manner and were less likely to consider the mental state of readers. In contrast, NT writers used more cognition and affect terms than did the autistic writers, and more extensively described motivations of the actors in their stories.

Interestingly, different findings were obtained when autistic youth were asked to write a persuasive essay about why their parents should not limit their computer time (Brown et al., 2014). Here there was no evidence of reduced mentalizing among autistic participants aged 8 to

17. This suggests that writing motivation may be an overlooked variable in studies of autistic writing, which is relevant to the recent call for more studies of naturalistic autistic writing.

Asaro-Saddler and Coles (2019) also discussed executive function deficits, but additionally noted that self-regulation and sensory impairments can make writing challenging. These authors described successful writing outcomes when using computers and software programs. They noted, "...one of the greatest barriers to writing for students with ASD [autism spectrum disorder] is that their teachers do not believe they are capable of becoming writers" (Asaro-Saddler & Coles, 2019, p. 64).

### **Strength-based Approaches**

An increasing number of students with autism-spectrum disorders attend college (Bakker et al., 2019; Palmer, 2006). These students typically have normal intellectual abilities, although they have a mix of cognitive and social strengths and weaknesses (Bakker et al., 2019; Gillespie-Lynch et al., 2020; Shevchuk-Hill et al., 2022). Greenbaum (2010) noted that autistic adults in professional writing programs face challenges related to the demands of the classroom environment, such as participating in group projects, meeting deadlines, and complying with educational etiquette. Greenbaum described a specific autistic college student who frequently caused distractions in the classroom (e.g., excessive movements, speaking out of turn), yet the student's written work was always outstanding. The student was a sufficiently accomplished writer that she wrote for her college newspaper.

In comparing the motivations of autistic and non-autistic college students, Cherian et al. (2021) noted that autistic students were more likely than non-autistic students to mention social communication among potential challenges but writing among potential strengths. Autistic students more often than non-autistic students described writing as an ability that could help them find and maintain employment. Autistic students reported more positive writing affect than non-autistic students (Shevchuk-Hill et al., 2022). Autistic students have also been reported to use more varied language in their writing (Price et al., 2020). This could be viewed as a strength, since lexical variation has been used to measure linguistic proficiency.

Several authors have documented and analyzed the writing style and communicative achievements in the "autie-biographies", referring to published autistic memoirs (Hacking, 2009; Kim & Bottema-Beutel, 2019; Tomlinson & Newman, 2017; Van Goidsenhoven, 2017). These

autie-biographies have been instrumental in establishing an autistic community and conveying authentic experiences with readers who could be non-autistic, or autistic and trying to forge an autistic identity (Hacking, 2009). The autie-biographies demonstrate considerable skills. However, by the requirement of being published, one could infer these are exceptional individuals. It would be useful to explore autistic writing where individuals are writing out of their own agency.

### **Prior Research on Autistic Bloggers**

The current project, on autistic bloggers, fits with the “community of writers” perspective (Zajic & Brown, 2022). Bloggers choose when and what to write, like the writers of autie-biographies, yet bloggers may be more representative of a larger group of motivated adult autistic writers than are published authors.

Blogs have some similarities to controlled writing tasks in that they are frequently topical and encourage the use of standard grammar. They are also self-directed and provide writers with the freedom to choose their own content. Researchers have studied online blogs and forums to address specific research questions (e.g., Caldwell-Harris et al., 2011). Jones et al. (2001) investigated whether blogs written by autistic persons would have reduced emotional content, consistent with theories of that era, that autistic individuals had emotional deficits. The authors instead found extensive emotional expression. The bloggers shared their feelings of alienation, frustration, depression, and pervasive apprehension.

Other researchers have studied online blogs for insight into the lived experience of persons with autism. Boytsova (2015) conducted thematic analysis on ten autistic blogs and asked the bloggers to complete an open-ended questionnaire. Blogging was a significant part of bloggers’ social life and provided a sense of community through exchanges with the larger autism community. Blogging also contributed to a positive off-line identity as an advocate for disability rights. Internet blogging thus provided benefits of self-esteem and leadership skills. Writing excerpts provided by Boytsova (2015) showed good writing ability. Boytsova (2015) additionally shared evidence that not all autistic people who have the skills to blog are necessarily “high-functioning,” as some who blogged were not able to live independently.

Newton et al. (2009) used the text analysis program Linguistic Inquiry and Word Count (LIWC) to calculate the frequencies of diverse linguistic and psychological categories. The

## WRITTEN LANGUAGE IN AUTISM

words people use reflect a variety of individual-differences variables, including gender and occupation (Pennebaker & King, 1999). The LIWC program identifies categories ranging from pronouns and numbers to emotion words, which are reported as a percentage of the text being analyzed.

Newton et al. (2009) compared the posts of self-identified autistic bloggers ( $n = 30$ ) to posts from a large sample of NT bloggers along five dimensions: melancholy (words denoting sadness), socialness (words describing activities, such as school, music, TV), ranting (swear words, words denoting anger), metaphysics (e.g., religious words), and work-relatedness (e.g., work, money). No statistically significant group differences were found among these five categories. However, the autistic bloggers showed more variability in how many social words were used. The authors speculated that autistic persons had larger variability in social experiences than persons without autism, ranging from low to high sociality.

Newton et al. (2009) argued that similarity in word usage between autistic and non-autistic bloggers challenges the "communicational deficit" commonly regarded as a key autistic symptom. They wrote "...we posit that this symptom is an artifact of diagnostic testing that requires proximal communication..." Communication deficits may be reduced "when the playing field is leveled, such that there is time for effortful socio-emotional processing strategies and non-verbal communication behaviors are unnecessary (due to distance)" (Newton et al., 2009. p. 463-464).

In current study, we analyzed the word usage patterns and themes of bloggers with and without autism to better understand how persons with autism employ language in a naturalistic setting. Following Newton et al. (2009), we used the LIWC program. We also rated each blogger's passages for Flesch Reading Ease. Flesch reading ease is a combined measure of the average number of words per sentence and the average number of syllables per word (Flesch, 1948), and thus allows the writing complexity of text to be quantified.

As noted, our theoretical orientation was the strength-based approach of the neurodiversity movement (Gillespie-Lynch, 2020; Zajic & Brown, 2022). We do not make any hypotheses concerning theory of mind deficits, given reduced credibility of this perspective in recent years (see discussion in Brown et al., 2014; Gillespie-Lynch, 2020; Tomlinson & Newman, 2017; Zajic & Wilson, 2022). However, a core characteristic of autism is atypical sociality. Following

the social rewards deficit hypothesis of autism (Chevallier et al., 2012), we anticipated that blog content of the autistic bloggers would be oriented towards discussions of ideas and academic topics and with reduced discussion of social events.

## Method

### Hypotheses

1. *Writing Strengths.* Consistent with Newton et al. (2009) and Gillespie-Lynch et al. (2020), we expected autistic blogs to reveal writing strengths. Specifically, Flesch reading ease and LIWC measures of writing complexity would be similar for autistic and NT bloggers.
2. *Word use would reflect systemizing.* Compared to NT bloggers, autistic bloggers would use more words that refer to the nonsocial world, and to causation, and numbers, reflecting a cognitive style that prioritizes systemizing and objective reasoning (Baron-Cohen, 2020).
3. *Reduced references to people.* Consistent with social rewards deficit theory of autism (Chevallier, 2012), autistic bloggers would make fewer references to other people by having a reduction in 1st person plural (e.g., *we*) and 3rd person pronouns (e.g., *he*, *they*), as well as fewer references to friends and family.
4. *Negative emotion more common than positive for autistic bloggers.* Autistic bloggers would use fewer positive emotion words and more negative emotion words and anxiety-related words (LIWC category inhibition), based on a previous study that found negative emotion to be a dominant theme in the online experiences of several autistic individuals (Jones, Zahl & Huws, 2001).
5. *Blog content would reflect systemizing.* Autistic bloggers would write about topics related to systemizing, consistent with having special interests that relate to systemizing, such as sensory and scientific domains (see Caldwell-Harris & Jordan, 2014; Winter-Messier, 2007).

### Identifying Bloggers

Self-identified autistic bloggers (N = 30) were found on LiveJournal.com, an online blogging site with interest-oriented communities, and Blogger.com, a similar blog hosting site operated by Google. Other researchers have utilized similar numbers of bloggers in their analyses (cf. Clarke



and Van Amerom, 2008). We used the keywords *Asperger* and *Autism* and selected the first 30 bloggers who met criteria below, without regard to gender. Surprisingly, our sample of autistic bloggers contained nearly equal numbers of men (N=14) and women (N=16), despite men being diagnosed with autism at higher rates than women (Loomes, Hull, & Mandy, 2017).

Criteria for inclusion:

- mentioned having an autism spectrum condition in either their profile or blog
- no mention of having any other psychological disorders
- their blogs were written in a journal-style format, meaning separate entries, with at least 5,000 words.

We set the minimum of 5,000 words minimum based on a variety of internet reports that the average blog length is around 800 to 1000 words long. This ensures that bloggers we sampled have made a substantial investment into their blog writing. A minimum of 5,000 words also ensured a large amount of text on which to obtain reliable LIWC categories.

NT bloggers (N = 30) were also selected from LiveJournal and Blogger using the same criteria, minus mention of autism spectrum conditions, and with the proviso that an NT bloggers could be matched to an autistic blogger for gender and approximate age. Table 1 describes the 2 groups.

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*Insert Table 1 here*

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Blog entries were collected starting from the most recent posts and compiled into individual text files for each blogger. Non-prose blog posts such as poems, quizzes, photo captions were omitted for consistency.

## **Procedure**

Three analyses were conducted. LIWC was used to measure word usage; each blog's Flesch reading ease was calculated; and the authors categorized blog content.

### *LIWC analysis*

Conducting between-group significance tests on each of the 80 LIWC categories would result in several type 1 errors. We thus eliminated LIWC categories that were subsets of larger categories, as well as categories generally absent from written prose (e.g., non-fluencies) and

retained 22 LIWC categories that were theoretically relevant based on autistic traits and prior research (see Table 2). Here we review why these 22 LIWC categories were examined.

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*Insert Table 2 here*

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*Writing formality and complexity, relevant to Hypothesis 1:* The LIWC program was used to count frequency of use of colons, semicolons, and quotes. Use of punctuation could reflect a more formal and/or grammatically complex writing style. We included two LIWC measures of vocabulary complexity, long words (words in text with at least 6 letters) and LIWC words. The term "LIWC words" are those in the LIWC dictionary, which are highly common words. Text genres differ greatly in the percentage of LIWC words they contain. Scientific writing averages only 53%, while blogs average about 84%, and conversation reaches 91% (Pennebaker, Francis, & Booth, 2001b). LIWC word usage can thus be regarded as a measure of colloquial language, with higher percentages signifying more colloquial language and lower percentages denoting more specialized language.

*References to the nonsocial world, relevant to Hypothesis 2:* We tested 6 LIWC categories about the nonsocial world (see Table 20, given that autistic individuals are interested in systemizing topics (Baron-Cohen, 2020).

*Reference to people, relevant to Hypothesis 3.* These five categories (see Table 2) were included to test whether autistic bloggers wrote less about people and social activities, consisted with lower social motivation in autistic people, and prior findings on special interests (e.g., Jordan & Caldwell-Harris, 2012).

*Emotional words, relevant to Hypothesis 4.* Emotion words are relevant to longstanding views of emotion processing impairment in autism, including alexithymia (see earlier discussion of hypotheses).

### *Coding blog content*

The 5,000 word blogs excerpts were read without identifying information or demographic codes in text files by the authors who worked independently. Following recommendations for qualitative research (Braun & Clarke, 2006; Nowell, Norris, White, & Moules, 2017), we identified topics, both specific and broad, using our own intuitions to label topics that came to mind during reading.

After topics had been identified, the authors assigned topics to 18 pre-identified categories, listed in Appendix 1, adapted from the method used by Jordan and Caldwell-Harris (2012). The categories include diverse interests, ranging from science to relationships, crafts, facts, food, people, sports, TV/video, nature, history/culture, and psychological disorders. As an example of assigning topics to the 18 categories, one paragraph described "American exceptionalism." American exceptionalism was assigned to the broader topic *History and Culture*. As another example, mentions of *my boyfriend*, *mother*, *husband*, and *friends/relatives* were common. These were coded as belonging to the *People* topic. Many bloggers discussed autism and/or Asperger's syndrome; these were categorized in the 'psychological disorders' category. Categorizing topics according to the pre-identified categories was not difficult. Appendix 1 contains an exhaustive list of all topics identified and the categories to which they were assigned.

## Results

### Flesch Reading Ease and Significant LIWC categories

Relevant to Hypothesis 1, the autistic bloggers used more complex vocabulary than did NT bloggers. This was indicated via lower Flesch reading (FRE) ease scores, ( $t(58) = -3.85$ ,  $p < .001$ ). Table 3 lists average FRE scores for the two groups of bloggers, separated by gender, which did not differ significantly. High FRE scores mean texts that are easier to read; thus text with more rare vocabulary will have lower FRE scores. Our other dependent variables, the LIWC metrics listed in Table 2, were entered into a two-way MANOVA with group and gender as independent variables. The overall MANOVA was significant with main effects for autistic vs. NT group,  $F(29,28) = 1.98$ ,  $p < .05$ , but not for gender. Gender was thus omitted from analyses of LIWC categories.

Table 4 lists the eight measures that were significant in the univariate analyses (conducted following significance in the MANOVA), in order of effect size. The strongest of these was use of long words, with autistic bloggers using more long words, consistent with the FRE result. These results support hypothesis 1, of writing strengths present in autistic blogs, but go beyond it, since autistic bloggers were superior to NT bloggers in terms of using complex vocabulary.

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*Insert Tables 3 and 4 here*

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Not surprisingly, use of long words was inversely correlated with use of common words (measured here as words in the LIWC dictionary, referred to as *LIWC words*). This held across

all bloggers ( $r = -.68, p < .001$ ). Figure 1 shows the relationship between percentage of LIWC words and long words for both groups of bloggers. This graph suggests a continuum between autistic and NT bloggers in their use of specialized vs. common words, with autistic bloggers trending toward more difficulty vocabulary and NT bloggers leaning toward the simpler vocabulary.

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*Insert Figure 1 here*

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Given that the autistic bloggers wrote in a more complex manner, it is worth controlling for writing complexity before examining the remaining LIWC significant categories. We thus repeated the MANOVA described above, but with Flesch reading ease as a covariate. We also omitted percentage of long words from this analysis as it was highly correlated with Flesch reading ease;  $r = -.88, p < .001$ ). The overall analysis remained significant,  $F(7,51) = 3.26, p = .006$ , with the univariate analyses significant for the use of positive emotion words ( $p = .039, \eta^2 = .073$ ), inhibition words ( $p = .005, \eta^2 = .129$ ), and quotation marks ( $p = .039, \eta^2 = .072$ ). These categories are bolded and italicized in Table 4.

Hypothesis 2, greater references to the non-social world was not supported. Although autistic bloggers used more causation words than did NT bloggers, this difference was not statistically reliable when controlling for complex vocabulary (Flesch reading ease). Therefore, using causation words is best understood as a consequence of writing about complex topics such as those involving explanations and causal relations.

Using more words in the categories of time and numbers was also associated with using less complex vocabulary. We found that across all bloggers, time words were positively correlated with motion words, such as *came* and *went* ( $r = .54, p < .001$ ) and the use of past tense verbs ( $r = .54, p < .001$ ). This suggests that time words were used in the context of situated experiences, as occurs when one discusses one's ongoing life experiences. Time words were also negatively correlated with the use of long words ( $r = -.63, p < .001$ ). This suggests that using words about time (e.g., *before, day, today, until, forever*) is part of a colloquial writing style.

Hypothesis 3, that autistic bloggers would make fewer social references, was not borne out. The autistic bloggers were like NT bloggers in their references to friends and family and use of pronouns.

Hypothesis 4 was supported. Autistic bloggers expressed less positive emotion and more inhibition (threat-related words, see examples in Table 2).

### **Gender differences**

Discussion of topics related to systemizing, such as technology, science, and object attachment, were comparable among autistic men and women. However, autistic males discussed sports and games more than did autistic females (Fisher's exact test, males = 6, females = 1;  $p = .031$ ). The only gender difference for NT bloggers was that more NT females discussed food and drink than did NT males (males = 1, female = 6;  $p = .031$ ).

### **Blog content**

Most autistic bloggers mentioned being autistic ( $n=23$  out of 30, or 76%). Their autistic experiences were discussed extensively by 40% of bloggers, including one blogger who wrote about how she enjoyed being autistic. Five bloggers discussed their diagnosis. Only 17% of the autistic bloggers ( $n=5$ ) used their blog as a journal of daily activity, while 40% of NT bloggers ( $n=12$ ) chose to do so. Consistent with the prior blog analysis of Jones et al. (2001), 43% of autistic bloggers discussed the life problems they were facing, while only 7% of the NT bloggers ( $n=2$ ) did so. However, as noted above, autistic bloggers did not use significantly more negative emotion words.

We tallied the number of bloggers from each group who discussed a particular category (see Appendix 1 for the list of categories and examples). The ratio of Neurotypical to Autism Spectrum is listed after the category descriptor. This ratio allows sorting the topics from *more characteristic of autism* (low NT/autism) to *more characteristic of NT* (high NT/autism ratio, at end of the list). The categories of Sensory interests, Information and Mechanical Systems, and Numerical Information have a NT/autism ratio of 0.0 because no NT bloggers wrote about these topics. Machines and Technology had a NT/autism ratio of 0.20, because typically developing individuals were only 1/5 as likely to write about machines and technology as were autistic individuals. Under the M,F column header we list the number of male and female bloggers whose blogs are categorized under this descriptor. For example, 2 males and 7 females wrote blogs that discussed sensory issues.

Each category was analyzed separately for group differences using a 2-sided Fisher's exact test. More of the autistic bloggers in our study discussed specific sensory fixations (autistic = 9,

NT = 0;  $p = .002$ ) and scientific topics (autistic = 12, NT = 3;  $p = .015$ ) than the NT bloggers. Sensory fixations among autistic bloggers included the feeling of handshaking and specific sounds. Scientific topics among autistic bloggers included human sexuality, evolution, and the physiology of running. The NT bloggers wrote moderately more about food and drink (autistic = 1, NT = 7;  $p = .052$ ), including one blogger's distaste for lima beans and a recent chili cook off. These results confirm hypothesis 5 and are summarized in Figure 2.

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*Insert Figure 2 here*

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NT bloggers more often wrote about daily events, while autistic bloggers wrote more about unique topics and abstract ideas. Writing about daily events lends itself to adopting a colloquial writing style, which is less complex. To determine if writing about abstract ideas is the cause of a more complex writing style, blogs were categorized according to whether the topic was abstract ideas vs. daily life events. We investigated this after all other analyses had been completed, following a suggestion of a reviewer. Appendix 2 contains our method for categorizing blogs as about daily life events vs. abstract ideas.

The 30 autistic blogs were somewhat equally divided between the categories of daily life events (53%) and abstract ideas (47%). In contrast, 80% of NT blogs concerned daily life events. A two-way ANOVA was conducted with Flesch Reading Ease as the dependent variable, and blogger and blog type as the predictor factors. A main effect was obtained for group,  $F(1,56)=8.8$ ,  $p < .004$ ,  $\eta^2=0.12$ , and for blogger (autistic vs. NT),  $F(1,56)=8.2$ ,  $p < .006$ ,  $\eta^2=0.12$ ; with no interaction,  $p > .8$ . These two main effects are depicted in Figure 3.

## Discussion

### **Autistic bloggers wrote in a more complex manner**

Our strongest finding concerned blog content. Autistic bloggers more often wrote about intellectual and abstract ideas and wrote in a more complex manner than NT bloggers. Writing in a complex manner is surprising given the traditional view that writing is challenging for autistic people (Asaro-Saddler & Coles, 2019; Brown & Klein, 2011; Pennington & Delano, 2012). Three possible explanations for this are described here.

*Intellectual interests.* Autistic bloggers more often wrote about abstract ideas. Non-colloquial topics require longer words and longer sentence length, the two components measured for Flesch reading ease. Choosing to write about writing abstract ideas then engenders a more complex

writing style, not autism *pe se*. To explore this idea, we compared NT and autistic bloggers who chose to write about abstract ideas vs daily events. Blogs describing daily events had greater Flesch Reading Ease (i.e., contained longer sentences and longer words). The writing of daily life events was less complex, consistent with a more colloquial style. However, the factors of blogger and blog type were additive (Figure 3). Autistic bloggers wrote in a more complex style than did NT bloggers regardless of blog type. Autistic bloggers writing about daily life events had a Flesch Reading Ease score that was similar to the score of NT bloggers writing about abstract ideas. We thus conclude that the factor responsible for autistic bloggers' more complex writing was something beyond merely choosing to write about abstract ideas vs. daily events.

*Elite subset.* Autistic people we identified as bloggers could be an elite subset of autistic individuals, due to the recent emergence of the online autism community. It wasn't until the 1990s that autism without intellectual disability was recognized in the form of Asperger's syndrome (Frith, 1991). Lacking role models and other supports, autistic individuals may have needed to have superior writing abilities or a special passion for writing to have the confidence to take up the challenge of writing a blog. Our method was to choose the first 30 blogs we could find. Because of browser search algorithms, these would be longest enduring and most popular blogs. Indeed, two of our autistic bloggers but no NT bloggers mentioned publishing books. We checked the blog type and reading ease score of the two published authors. They both had written about daily life events and had Flesch reading ease score of 74 and 75, similar to NT scores (compare in Figure 3). Although those two published bloggers did not contribute to autistic bloggers' more complex writing style, they do illustrate the idea of autistic bloggers being an elite subset of all autistic individuals, and of different selection pressures for choosing to blog for autistic bloggers vs. NT bloggers (see related ideas about selection bias in neuroscience research on autism, Rozenkrantz et al., 2021).

*Cognitive style.* Autistic persons have a cognitive style that emphasizes logical reasoning, deliberation and systemizing (Baron-Cohen, 2022; Rozenkrantz, et al., 2021; Wright et al., 2020). A topic often discussed in the autism community is autistic people's special interests in science and scholarly topics, and their logical and intellectual approach to daily life topics (Caldwell-Harris et al., 2011, 2022). Rozenkrantz et al. (2021) review the literature on the how autistic individuals are less susceptible to common reasoning biases such as the conjunction fallacy, sunk-cost bias, and framing effect. Those authors' explained enhanced rationality in

autistic individuals as due to in greater attention deliberation and reduced use of intuition (see also Ashwin & Brosnan, 2019). This is consistent with our cognitive style explanation for writing complexity,

The 'elite subset' and 'cognitive style' explanations could also apply to Gillespie-Lynch et al.'s (2021) finding that autistic college students demonstrated more advanced writing skills than nonautistic students. Those authors found that the advanced writing skills could be attributed to higher non-verbal intelligence of the autistic students. This is consistent with the elite subset explanation, i.e., autistic students attending college are a high-achieving subset of the autistic population, as well as the cognitive style explanation. Note, however, that a Dutch study found no difference in average examination grades in students with disabilities (including autism) and those without disabilities. However, autistic students "more often had non-standard pre-education qualifications" (Bakker et al., 2019, p. 1).

### **Blog content and LIWC analyses**

Autistic bloggers more frequently discussed topics related to science, compared to NT bloggers. There was a trend for more references to technology (autistic = 5, NT = 1) and information systems (autistic = 3, NT = 0), but those differences were not significant (see Appendix 1 for details). Our sample size was too small to capture those differences as generally fewer than 10 bloggers discussed topics related to a given category. The differences observed in technology references were thus weaker than the emphasis on technology and information systems noted in forum discussion posts (Caldwell-Harris & Jordan, 2014).

We had hypothesized that autistic bloggers would make fewer social references, but this was not found. The autistic bloggers resembled NT bloggers in the LIWC count of social references (such as kin words and use of pronouns). But during content analysis, we observed that autistic bloggers more often used *we* as a generic collective pronoun (impersonal, e.g., *we the people*) compared to NT bloggers. NT bloggers used personal *we* 57% of the time, while the autistic bloggers used personal *we* only 46% of the time (chi-squared,  $\chi^2 = 11.0$ ,  $p = .001$ ). One autistic blogger in particular, whose posts were mainly philosophical, used just one instance of personal *we* compared to 56 instances of impersonal *we*. This is consistent with autistic bloggers having idea-rich writing.



Aside from the differences just discussed, the main conclusion is of overlap in topics between autistic and NT bloggers, as can be seen from numerical counts of topics in Appendix 1. Topics discussed by both groups included media consumption (e.g., watching movies, playing video games), life events (e.g., birthdays), and close relationships. Our findings support the idea that autistic and NT individuals lie on a continuum of cognitive style; others have expressed similar views (Caldwell-Harris & Jordan, 2014; Happé, 1999).

One aspect of writing more complexly was that autistic authors used more colons, semicolons, and quotes. Use of punctuation could reflect a more formal and/or grammatically complex writing style. This is consistent with G-L et al.'s (2022) report that autistic students' wrote stories at a higher reading level than non-autistic students. G-L also found that autistic students' stories contained fewer grammatical errors, which may reflect greater attention to detail, consistent with a detail-oriented cognitive style (Mottron et al., 2003). Because Gillespie-Lynch et al.'s (2022) participants were 92% male, our findings are a useful extension of those authors' result of considerable writing complexity by autistic students. Gillespie-Lynch et al. (2020) did not replicate Brown and colleagues' (2014) finding that autistic students tend to use more rare words. Our findings are thus useful because our autistic bloggers did use more long words and more rare words (Figure 1).

Percentage of text with quotation marks was higher in the autistic group, even when statistically controlling for Flesch reading ease. To understand use of quotation marks, we identified how quotation marks were used in context. Both the autistic and NT bloggers used quotation marks in the following ways:

- to specify names and titles (e.g., we saw “The Avengers”)
- to indicate measurement (e.g., I’m 5’6” tall)
- to imply non-standard readings of words and phrases (e.g., there’s a “traffic jam” in my head; let’s talk about something “fun”).

The autistic bloggers used quotation marks more often in this last category. Use of quotation marks to imply non-standard readings could be a comment on bloggers' awareness of their distinct views and positions as cultural outsiders. For example, the “traffic jam” mention could be alluding to a state of mental chaos that other neurodiverse individuals would understand. The

reference to “fun” could mean something that lacks appeal for the author but is recognized as entertaining in the neurotypical world.

### **Influence of Gender and the question of self-diagnosis**

Our sample of autistic bloggers contained nearly equal numbers of men and women, contrary to reports that autistic men outnumber autistic women, by 2 to 1 or even 3 to 1 (Loomes et al., 2017). This equality was found by prior researchers who analyzed discussion forums (Caldwell-Harris et al., 2011) and blogs (Clarke and Van Amerom, 2008). This could be related to reports that autistic women display more functional social behavior than autistic men (Halladay et. al., 2015).

Do autistic women participate in social media more often than men, because of higher social needs? Consistent with this, one female in our study wrote in her blog that she had a keen interest in others but knew her ability to relate to them was not the norm for autistic women. Another female blogger described caring greatly about others despite not understanding how they feel. These comments are relevant to ongoing debates about how autism manifests differently in women than in men (e.g., Hull & Mandy, 2017; Lai et al, 2011). The gender similarity in blog production could also be explained by women having more interest in journaling.

An additional factor could be that men and women have similar rates of autism, with disparities due to diagnoses that emphasize male-typical symptoms (Hull & Mandy, 2017). However, this explanation requires that more of the female autistic bloggers were self-diagnosed than male bloggers. It is thus worth discussing the question of the diagnostic status of bloggers. Members of the autistic community take diagnosis seriously and are reluctant to claim a status they do not merit (Giles & Newbold, 2011). Giles and Newbold (2011) concluded that formal diagnoses allowed users to present themselves as part of an in-group with special authority to speak about their disorder or disability. Sarrett (2016) noted in a later analysis of *Wrong Planet* posts that many posters accept self-diagnosis, however, posters generally state if they are self-diagnosed. Our impression from comparing similarities and differences between blogs and forum posts is that public blogging is a high-stakes endeavor where honesty is valued. Our bloggers stated they were autistic (or had an Asperger's diagnosis), and none mentioned self-diagnosis. None wondered if they should get diagnosed and none expressed uncertainty about

being autistic, although those are common topics on discussion boards (Caldwell-Harris et al., 2022).

## Limitations

The advantage of analyzing blogs is their ecological validity. Blogs are a naturally occurring writing product, and the content is thus free of educators' or researchers' expectations and hypotheses. A shortcoming is that analyzing public writing products means fewer demographic data than what is possible using a survey. An additional limitation is that content analysis of blogs is difficult and different authors could analyze blogs in a different manner. Computer tools could have been used in sentiment analysis or topics analysis, as reported in several recent studies on autistic online writing (Castro & Lucke, 2016). Future research could use educators or other categories of trained human raters to provide their impression of blog attributes such as writing complexity, rhetorical structure interestingness, or creativity.

## Implications

By analyzing the writing of autistic bloggers, we responded to Greenbaum's (2010, p. 41) call to address a scholarship gap: "If you research autism in education, you will get significant scholarship related to early education, intervention, and mainstreaming, but there is a dearth of research that contributes to the discussion of what happens to these children as they become young adults and move into higher education." Personal blogs hosted on websites such as *Wrong Planet* and LiveJournal allow users to express themselves freely, without the need for face-to-face interactions (Kim & Bottema-Beutel, 2019). Consistent with the framework of The Writer(s)-with-in-Community (WWC) framework (Graham, 2018), these platforms offer a unique opportunity to study how autistic individuals use writing for their own purposes.

Theory-of-mind is no longer a key approach for understanding autism (Gernsbacher & Yergeau, 2019; Gillespie-Lynch et al., 2020). This opens the door to make neurodiversity the theoretical framework. One strength of autistic persons is keen interest in intellectual ideas (e.g., Wright et al., 2020). The current analysis of blog content is consistent with autistic individuals' interest in science, technology, and discussing abstract ideas (Baron-Cohen, 2022; Caldwell-Harris & Jordan, 2014; Wright et al., 2020).

Compared to NT bloggers, autistic bloggers had a more complex writing style, and more often wrote about science or other abstract topics rather than using the blog as a personal journal. This

result adds to the growing literature documenting autistic strengths in writing (Gillespie-Lynch et al., 2020; Greenbaum, 2010; Shevchuk-Hill, et al., 2022; Tomlinson & Newman, 2017; Van Goidsenhoven, 2017). Many educators and writing experts may not be aware that writing can be a strength for autistic students (Asaro-Saddler & Coles, 2019). Altering this view can open more doors for writing to be avenue of personal and career success for autistic students.

The freedom to choose one's own topics and a reduced pressure to conform to readers' needs and interests plausibly allows complex language to flourish. Bloggers, more than non-bloggers, enjoyed writing in general and believed themselves to be good writers (Clark & Dugdale, 2009). Allowing autistic students to write in a manner consistent with their cognitive strengths may enhance academic performance, especially in English or writing classes. Educators could benefit from knowing that individuals with autism may have writing as a special interest (Winter-Messier, 2007), and can write at a more complex level if they can use writing to explore their special interests. Future work can explore how frequently writing prowess coincides with autism, given prior research showing verbal giftedness among people on the autism (Kasirer & Mashal, 2014), along with high intelligence (Crespi, 2016; Wright et al., 2020).

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## WRITTEN LANGUAGE IN AUTISM

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### Appendix 1: Blog topics by group and category, sorted by strength of group difference

NT=Neurotypical ratio of NT/Autism listed next to category label; 30 NT bloggers; 30 autistic bloggers

M=Male (N=14), F=Female (N=16) in each group of 30 NT and 30 Autistic bloggers

For simplicity, blog topics are not listed separately for male, female bloggers

The ratio of Neurotypical to Autism Spectrum is listed after the category descriptor. Under the M,F column header we list the number of male and female bloggers whose blogs are categorized under this descriptor. For example, 2 male and 7 female autistic bloggers discussed sensory issues, while no NT bloggers discussed sensory issues.

<i>M,F</i>		<i>Sensory Interests, 0.0</i>
Autistic	2, 7	personal sensory issues, body clock and eating, feeling of handshaking, certain sounds, sensory overload, visual thinking
NT	0, 0	-
		<i>Information &amp; Mechanical Systems, 0.0</i>
Autistic	3, 0	manufacturing methods, bus route, archiving/library science, education system, law about driver's licenses, disability laws, inventions
NT	0, 0	-
		<i>Numerical Information, 0.0</i>
Autistic	1, 0	math terms
NT	0, 0	-
		<i>Psychological disorders, 0.13</i>
Autistic	5, 10	specific disorders (Asperger's syndrome, ADHD, personality disorders, Alexithymia, psychopathy, hyperlexia, savantism); topics related to disorders (neurodiversity, anxiety attacks, risk of violence in mentally ill subjects, how autistic brains different, trauma from sexual abuse)
NT	0, 2	cyclothymia or bipolar disorder, Alzheimer's disease
		<i>Machines &amp; Technology, 0.20</i>
Autistic	3, 2	software troubleshooting, coding, tech-based gifts, programming, creating website, Linux, gaming console, types of keyboards
NT	1, 0	computer upgrade (technical)
		<i>Science, 0.25</i>
Autistic	5, 7	mental states, personality traits, disability, evolutionary perspective on bullying, science of running (cardiac muscle), neurotransmitters, endorphins, gender/sexuality, hormones, study on the effect of social media, human territorial behavior, cognitive science, climate change, environmental science

## WRITTEN LANGUAGE IN AUTISM

NT	2, 1	economics, climate change, logic/rhetoric, nature versus nurture
<b><i>Nature, 0.33</i></b>		
Autistic	1, 2	being outdoors, hiking, nature, bouldering
NT	0, 1	the outdoors
<b><i>Animals, 0.33</i></b>		
Autistic	1, 5	pets, farm animals
NT	1, 1	pets, riding horses
<b><i>History &amp; Culture, 0.43</i></b>		
Autistic	5, 2	Ancient Greece, foreign accents, learning languages, history of comedy, authentic cuisine, advent of email, language, middle east, Arabic
NT	2, 1	Japan, other cultures, American exceptionalism
<b><i>Factual Information, 0.60</i></b>		
Autistic	2, 3	specific experiment from the 1950s, Vikings, capital of Denmark, fires in California, general news
NT	2, 1	linguistic facts, marathon scores
<b><i>People, 0.81</i></b>		
Autistic	13,14	<p>friends/relatives (girlfriend, husband, ex-girlfriend, sister, boyfriend, father, mom, ex-husband, wife);</p> <p>groups of people (videogame teammates, sexy people, hot girls, students at college, doctors, relatives, groups that share my interests, psychopaths, people dealing with trauma, we Aspergers, Jewish people, atheists);</p> <p>events with people (friend visiting, children's classroom project, visit from a door-to-door election worker; discussion of movie trailer with online friend)</p> <p>topics relating to people (difficulty relating to people, difficulty with friends, taxonomy of types of people)</p> <p>public people (Frank Miller's political opinions; Stephen Colbert)</p>
NT	11,11	<p>friends/relatives (husband, wife, friends, named friends, daughter, son, brother, sister, father,</p> <p>mother, family, employer, boyfriend, girlfriend, coworker)</p> <p>groups of people (our generation, baby boomers, my readers, types of leaders, musicians, liberals,</p> <p>people who are gay, journalists, Presbyterian girls, Israeli Jews)</p> <p>events with people (parties, going to bars, family vacation, church conference, communicating with people, horse show)</p> <p>topics relating to people (people who are difficult to deal with, speculations about types of</p> <p>people, people who travel)</p> <p>public people (Osama Bin Laden, Cameron Crowe, Matt Damon, Colin Ford, Obama, Michael Jackson, actors in Monty Python )</p>
<b><i>Sports &amp; Games, 0.86</i></b>		

## WRITTEN LANGUAGE IN AUTISM

Autistic	6, 1	online poker, video games, running track & field
NT	4, 2	triathlons, video games, martial arts, NFL, running
<b><i>Creative Arts, 0.90</i></b>		
Autistic	9, 11	writing, book signing, comics, comedy tv shows, movies, acting, writing stand-up comedy, drawing, being fiber artist, pottery, blogging, music, documentaries, photography, anime
NT	9, 9	writing, photography, reading fiction, book review, storyboards, art, anime, art show, music festivals/concerts, movies, slam poetry
<b><i>Vehicles, 1.0</i></b>		
Autistic	1, 0	personal car
NT	1, 0	personal car
<b><i>Item Attachment, 1.22</i></b>		
Autistic	4, 5	new toy, LED lights, specific words, ATMs, an old jingle, bras, old home, website
NT	4, 7	specific words, cigarettes, dead animal, tea, mushrooms, hay, Halloween costume, phone, piercings, camera, wedding charms, website
<b><i>Belief Systems, 2.0</i></b>		
Autistic	4, 1	logic of faith, government, atheists, Judaism, social rules vs religious doctrine, tea party
NT	7, 3	belief in god, Christianity, politics, reform Judaism, feminism, advent, philosophy, Aristotle, bible, values, liberals
<b><i>Crafts, 3.0</i></b>		
Autistic	1, 0	crafting business, building things, making hats
NT	0, 3	quilting, knitting, general crafting, craft shows, scrapbooking
<b><i>Food &amp; Drink, 7.0</i></b>		
Autistic	0, 1	making granola bars
NT	1, 6	cooking, trying specific foods, lima beans, specific meals, chili cook off
Total Topics	Autistic Males: 66 topics      Autistic Females: 71 topics NT Males: 45 topics      NT Females: 48 topics	

## **Appendix 2: Guidelines for categorizing blog type as about daily life events vs. abstract ideas**

All examples are from autistic bloggers.

### **Daily life events**

Daily life events were defined as descriptions of recent events happening today, yesterday, last week, tomorrow. Blogs about daily events needed to contain at least three paragraphs devoted to describing 3 separate, recent life events, while also having minimal (less than one paragraph) description of an intellectual idea. We did not categorize based on time words, since those can be misleading (although autistic bloggers used fewer time words, as shown in Table 4).

Sentences illustrating daily life events included:

- But for now, my living environment is as close to perfect as I can reasonably hope for it to be...
- I'm signing books there again this year... only, this time I'll have copies of Kea's Flight to sign too...
- As a former spelling bee geek (it's been 12 years, believe it or not)...
- I was just trying to register for a forum today, and came across a CAPTCHA that looked like this...

### **Abstract ideas**

These blogs focused on intellectual ideas. Three-quarters of the paragraphs in blog needed to be concerned with ideas, rather than events. Some of the following examples used time words yet were still clearly about specific topics, such as social disorder, stereotypes or religion (see Appendix 1 for examples of topics).

Sentences illustrating daily life events included:

- The other day, I was reminded why I hesitate to tell people I'm mildly autistic.
- So the other day I blew up about a particularly problematic article over in the atheist/skeptic community...
- In other news, my (significantly less formal) class today was a blast! I teach a drop-in class on Fridays about recycling/practicality-oriented crafts...



Table 1: Description of bloggers

Group	Number of bloggers	Age	
		Mean ( <i>SD</i> )	Range
Autism Spectrum	30	31 (8)	18-48
Male	14	30 (8)	18-48
Female	16	32 (8)	18-46
Neurotypical	30	30 (7)	18-46
Male	14	29 (7)	18-43
Female	16	31 (7)	20-46

Table 2: LIWC categories included in preliminary analysis

LIWC Category	Examples	Prediction about autism bloggers
<u>Writing formality and complexity, N=5 categories, relevant to Hypothesis 1</u>		
LIWC words*	Words contained in the LIWC dictionary, indicating relatively common or colloquial words.	lower
Long words*		higher
Quotation Marks*	also: Colons, Semicolons	unclear
<u>References to the nonsocial world, N=6 categories, relevant to Hypothesis 2</u>		
Time*	<i>annual, before, day, forever, October, spring, today, until</i>	unclear
Causation	<i>affect, consequence, how, influence, reason, since, therefore</i>	higher
Space	<i>above, along, beside, close, east, far, here, inside, middle</i>	higher
Motion	<i>approach, bring, carry, drive, flying, follow, move, run</i>	higher
Numbers	<i>one, second, million</i>	higher
Biological/Physical	<i>ache, allergic, arm, binge, blood, cough, diet, kiss</i>	higher
<u>Reference to people, N=5 categories, relevant to Hypothesis 3</u>		
1 <sup>st</sup> person singular	<i>I, me, my</i>	higher
Pronouns for we, you (interlocutors)	<i>we, us, our, ours, you, your, yours</i>	lower
Pronouns for others	<i>she, he, they, their</i>	lower
Friends	<i>acquaintance, colleague, fiancé, neighbor, partner</i>	lower
Family	<i>cousin, daughter, husband, relatives, stepfather</i>	lower
<u>Emotional response and Theory of Mind, N=4, relevant to Hypothesis 4</u>		
Positive Emotion	<i>agree, awesome, easy, friendly, happy, proud, trust, win</i>	lower
Negative Emotion	<i>anxious, confuse, difficult, helpless, lie, lonely, offend, regret</i>	higher
Inhibition*	<i>avoid, careful, contradict, delay, hesitate, ignore, prevent</i>	higher
Religion	<i>angel, church, choir, God, pray</i>	lower
* Categories that showed a statistically significant difference between autistic and NT bloggers in our exploratory analysis		

Table 3. Flesch reading ease scores, averaged by group and gender; by group and blog type

Autism Spectrum Condition				Neurotypical		
Overall	Male	Female		Overall	Male	Female
68.8 (8.3)	66.0 (9.2)	71.2 (6.7)		<b>76.1 (6.4)</b>	73.3 (6.6)	78.5 (5.4)

Higher numbers indicate less complex vocabulary and thus easier readability.

Table 4: Significant LIWC categories (n=8) in the final analysis, listed in order of effect size

Category	Average Percentage* (SD)		Statistics
	Autistic	Neurotypical	
Long words	17.8 (2.9)	15.2 (2.3)	$p < .001$ ; $\eta_p^2 = .217$
<b><i>Positive emotion</i></b>	2.4 (0.5)	2.8 (0.6)	$p = .001$ ; $\eta_p^2 = .184$
Time	3.8 (0.9)	4.5 (0.9)	$p = .005$ ; $\eta_p^2 = .134$
Causation	1.1 (0.3)	0.9 (0.3)	$p = .008$ ; $\eta_p^2 = .119$
<b><i>Inhibition</i></b>	0.4 (0.2)	0.3 (0.1)	$p = .008$ ; $\eta_p^2 = .118$
<b><i>Quotation marks</i></b>	0.9 (0.8)	0.4 (0.4)	$p = .011$ ; $\eta_p^2 = .109$
Numbers	1.3 (0.5)	1.6 (0.5)	$p = .013$ ; $\eta_p^2 = .105$
LIWC words (common words)	73.0 (3.0)	74.9 (3.7)	$p = .026$ ; $\eta_p^2 = .086$

\*The average percentage is the mean percentage of blog words from the specified category, averaged across all autistic or all NT bloggers. The three bolded/italicized categories remained statistically significant after including Flesch Reading Ease as a covariate in the MANOVA.



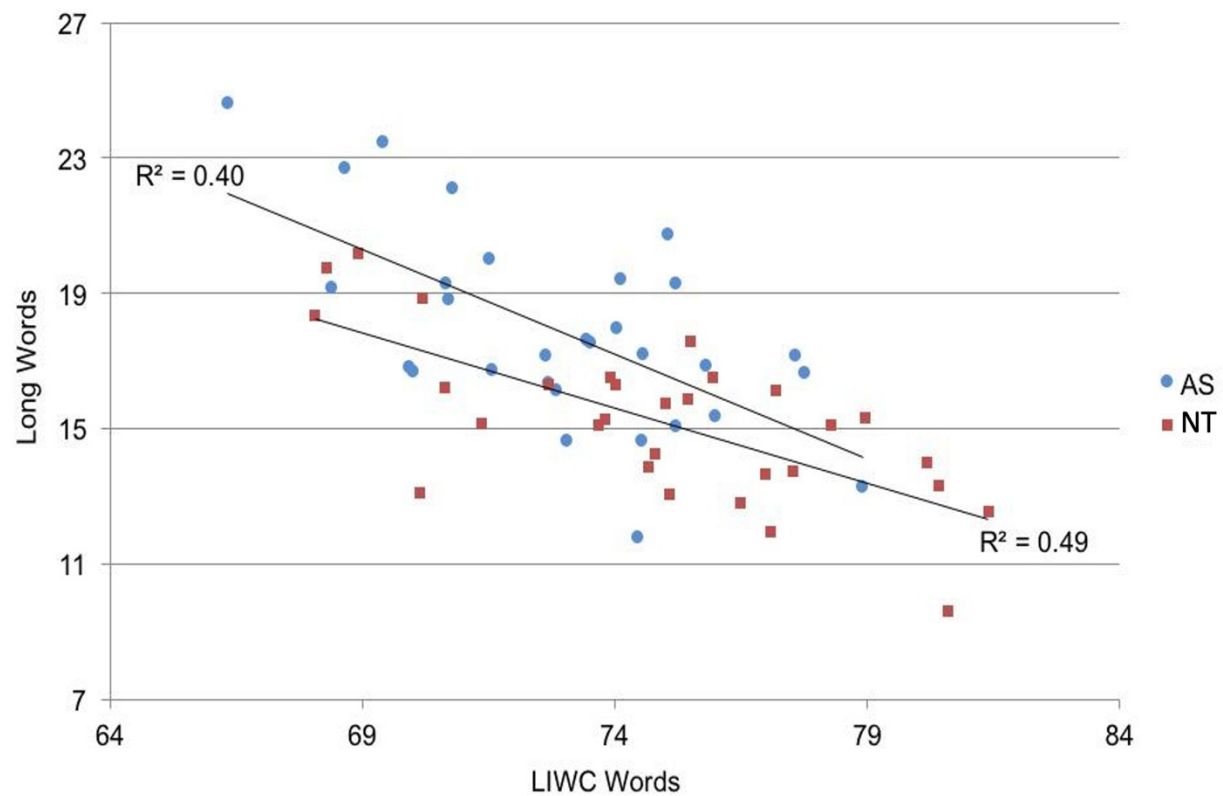


Figure 1. Use of long words compared to LIWC words for individuals on the Autism Spectrum (AS) vs. Neurotypical (NT) bloggers. Values are given as percentages of the total text for each blogger.

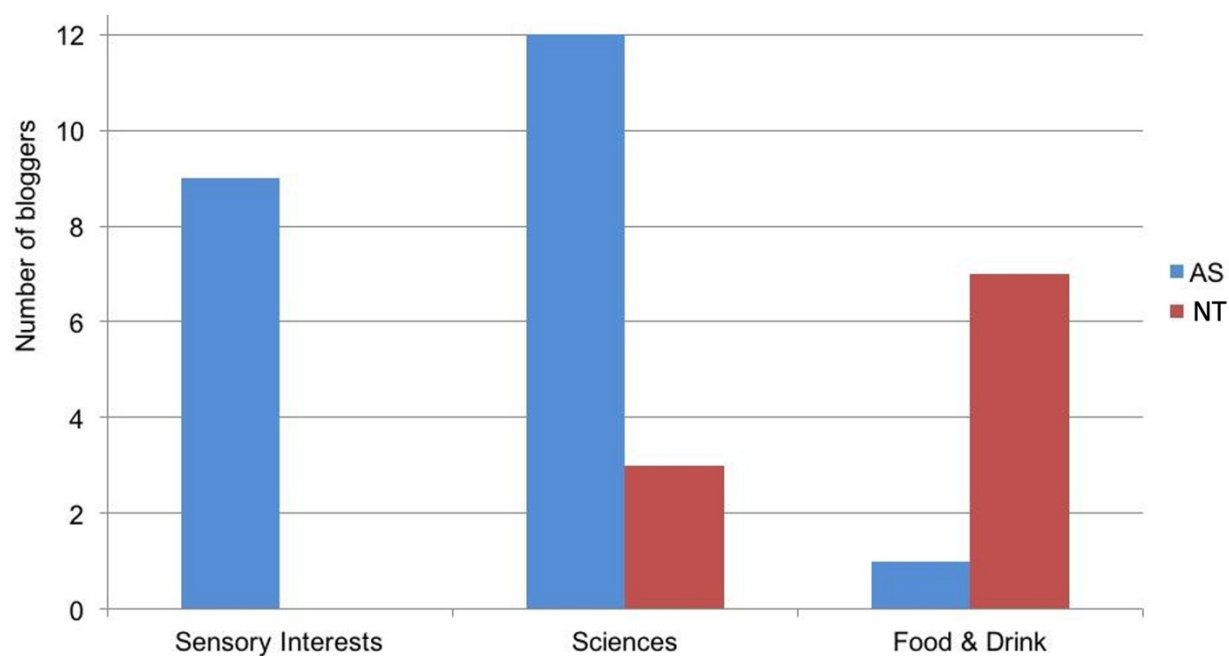


Figure 2. Number of Autism Spectrum (AS) and Neurotypical (NT) bloggers who wrote about three topics were group differences were statistically significant.

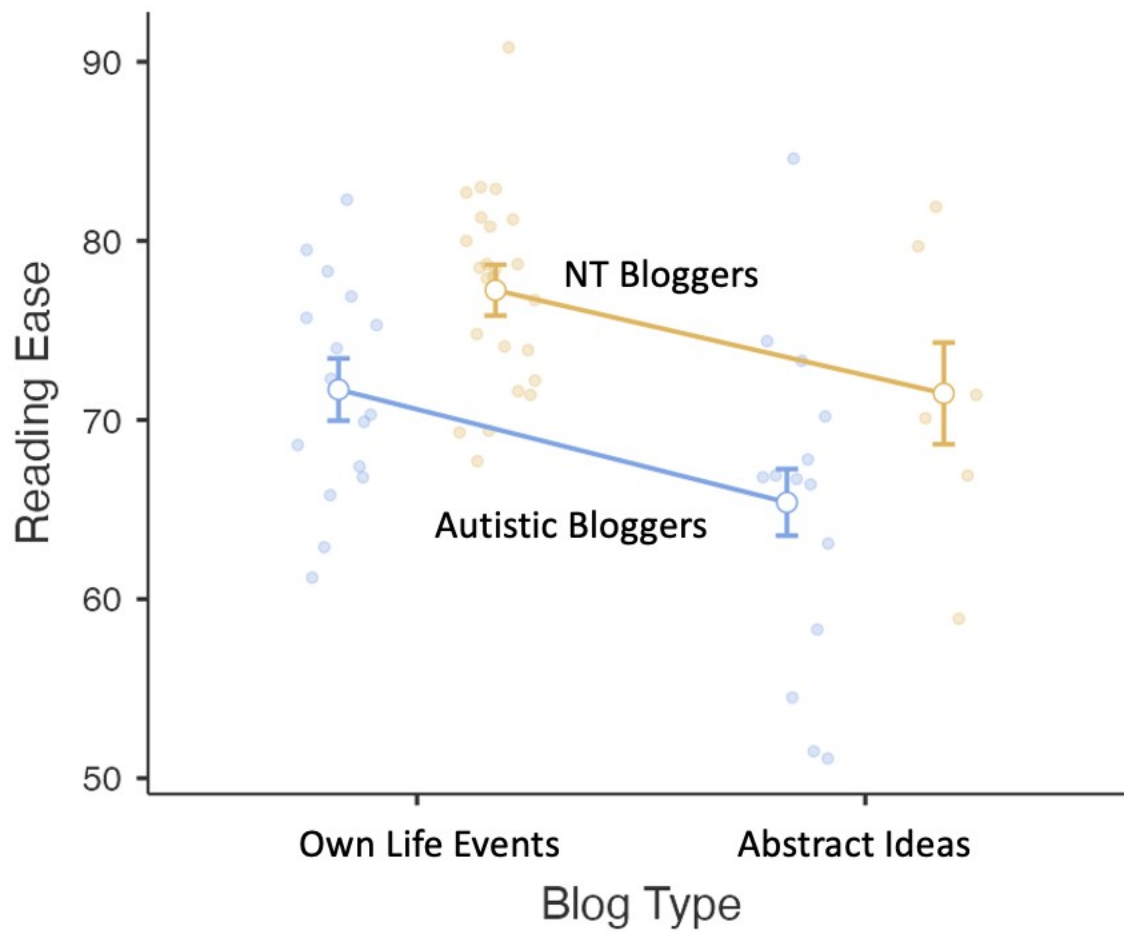


Figure 3. Average Flesch reading ease scores plotted separately according to whether blogs described bloggers' own life events or abstract ideas. Higher scores indicate less complex vocabulary and thus easier readability