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Abstract

Whereas typically developing adults tend to show processing differences for ironic versus literal language, recent research has demonstrated that adults with Autism Spectrum Disorder do not show a difference. Building on these findings, the present study examined whether similar effects would emerge in a sample of college students who were assessed on autistic personality traits. Through an eyetracking during reading experiment, participants read sentence contexts in which factors of emotional language, ironic versus literal language, and sentence perspective were manipulated. Results showed that participants who had a low degree of autistic traits somewhat replicated the two-stage processing model of ironic language, meaning that they initially expected ironic criticism to be perceived or intended as hurtful, but then eventually expected this criticism to be amusing instead. Participants who had a high degree of autistic traits did not show the same evidence of two-stage processing for ironic language, suggesting that they may have similar processing patterns as people with Autism Spectrum Disorder. The results provide evidence that differences in the processing of ironic language exist on a continuum that can be at least partially explained by taking into account autistic personality traits.

Autistic Personality Traits and Processing of Ironic Language

In the field of psycholinguistics, research has shown that both the semantic content and the grammatical structure of sentences have implications for the ways in which readers process these sentences (Rayner et al., 1983; Ni et al., 2000). Generally, psycholinguistic studies manipulate one or both of these sentence factors and use on-line, or real time, measures of language processing, such as eyetracking or recording of event-related potential, to determine the ways in which these factors influence processing. In conjunction with these aims, studies of language processing also help researchers understand differences between populations in how processing occurs. One such population that has been studied in the domain of language processing is those with Autism Spectrum Disorder (ASD). It is understood in the fields of both psycholinguistics and autism research that there are differences between those with ASD and the typically developing (TD) population in terms of how language is taken in and understood, both during reading and in social interactions: a key area of difference between the ASD and TD populations is in the processing of emotional language (Lartseva et al., 2015).

Research into the processing of emotional language in the typically developing population has illuminated ways in which emotion words and sentence contexts are processed differently than neutral ones. Using online measures of language processing, studies have shown that, while reading or listening to sentences, participants carefully track the emotions expressed by characters in the sentence context, and display signs of processing difficulties when emotions expressed by these characters are inconsistent with what they have anticipated based on the context (León et al., 2010; Lüdtke & Jacobs, 2015). Additionally, there is evidence that, while all emotion words are considered to be more salient than neutral words in language processing, emotion words with a positive valence are considered more salient and processed more quickly

than those with negative valence, known as a positivity bias (Lüdtke & Jacobs, 2015). This evidence from language processing which supports the significance of emotional language has implications outside of laboratory studies of online reading measures: the focus on emotion words in reading suggests that these same words are salient during social interactions as well. Support for this comes from studies which use sentence contexts depicting social interactions between characters, as language processing of these items gives researchers insight into the processing that takes place during real social interactions. Such studies provide further evidence of processing difficulties resulting from incongruent emotional language; additionally, differences between participants indicate that one's personal experiences with social interactions influence one's ability to conceptualize and integrate socio-emotional information in the sentence contexts (Leuthold et al., 2011). Thus, a person's ability to process and integrate emotional information, as well as their previous experience with doing so, affects their success in social interactions.

While this information is known about emotional language processing among the typically developing population, research into the emotional language processing of those with Autism Spectrum Disorder shows different patterns. In general, studies within the ASD population show notable impairments in the understanding of emotional language, including difficulties with producing and comprehending speech containing emotional language, processing emotional language in both visual (reading) and auditory (listening) modes, remembering emotional content, and inferring the emotional states of others (Uljarevic & Hamilton, 2012; Lartseva et al., 2015). While these difficulties vary within the ASD population depending on an individual's IQ and the complexity of the task, among other factors, it is widely understood that those with ASD do have more difficulty comprehending emotional language as

compared to the TD population. It is important to note that this difficulty arises specifically in emotional language: evidence does not suggest that language processing in general is more difficult for the ASD than the TD population. This is supported by studies illustrating successful processing of other language contexts, including counterfactual, or fictional, contexts, which show an intact ability to distinguish between possible and impossible events in the ASD population (Ferguson et al., 2019). Though there are clear differences between the TD and ASD populations in comprehending and recognizing emotional language, more research is needed in this topic to understand exactly how and why these differences arise, and what implications they have.

In addition to emotional language, another language construct which results in differential processing patterns between ASD and TD groups is non-literal language, specifically irony. Broadly, people with ASD have difficulty understanding the use of non-literal language in both laboratory and pragmatic contexts. One of the major reasons for this difficulty is that correctly interpreting the meaning of non-literal language often requires an individual to understand the intention, beliefs, or mental states of another person, an area in which ASD populations experience significant impairment (Martin & McDonald, 2004; Deliens et al., 2018). As a result, studies of non-literal language processing result in differential patterns between ASD and TD populations, as ASD participants often fail to make an accurate pragmatic inference about the meaning of this language (Deliens et al., 2018).

Previous research investigating the processing patterns of the emotional impact of ironic language among TD participants found evidence to support a two-stage processing model. Filik et al. (2017) manipulated emotion words, literal and non-literal words, and the character perspective of sentences to examine the effects of each of these three factors on reading time

measures. Their items consisted of three sentence contexts, in which one character (the protagonist) criticized the other character (the victim) using either ironic or literal criticism; the following sentence then contained either the victim using a negative emotion to express that they were hurt by the criticism, or the protagonist stating that they had intended for the victim to feel hurt.

(1) Charlie was desperately trying to undo the lid of a jar, but was having difficulty with it.

(2a) Ray said to him, ''You're so weak."

(2b) Ray said to him, "You're so strong."

(3a) Charlie felt that this was a very mean thing to say.

(3b) Ray had intended for this to be a very mean thing to say.

Results of this experiment showed that readers initially found it easier to process the negative emotion word in the context of ironic criticism (2b), but eventually, in later reading times, found it easier to process the negative emotion word in the literal context (2a) as they now anticipated the negative emotion following the literal, rather than the ironic, criticism. These results support a two-stage model of processing ironic language, in that readers initial expect that ironic criticism will be more hurtful than literal criticism, but eventually expect the inverse to be true. Filik et al. (2017) then examined another emotional response condition, in which the victim expressed a positive valence emotion following the criticism, or the protagonist expressed that they intended for the victim to experience a positive emotion. Results in this condition showed that readers found it easier to integrate the positive response for ironic criticism than for literal criticism, due to the potentially amusing effect or intention of ironic criticism. Overall, the results of these studies support a two-stage processing model for the emotional impact of ironic

language, which suggests that initially readers expect ironic criticism to be hurtful, but eventually, when they have had more time to fully process the ironic language, come to expect that the ironic criticism is instead amusing.

The work by Filik et al. (2017), which investigated processing of language with literal or non-literal language as well as emotional responses to this language, provides a means to assess the differences in processing between ASD and TD populations in this multi-component context. Following this work, Barzy et al. (2020) created experimental items that combined Experiment 1 (negative valence emotion words) and Experiment 2 (positive valence emotion words) from Filik et al. (2017), which they administered to a group of participants that included both adults with ASD and TD adults. This experiment was conducted to determine whether the ASD participants would show the same two-stage processing that was found in the previous work, or whether the difficulties with processing emotional language and understanding non-literal language in the ASD group would result in a differential pattern of processing for this group (Barzy et al., 2020). After combining the items from the two experiments done by Filik et al. (2017), each of the experimental items in the study by Barzy et al. appeared in eight distinct conditions that were created by manipulating the type of criticism, the sentence perspective, and the valence of the emotion word.

(4) John had been scared by a huge spider in the bathroom sink and immediately ran out shouting.

(5a) Anna said to him, "That was cowardly."

(5b) Anna said to him, "That was brave."

(6a) John thought that this was a very witty remark.

(6b) John thought that this was a very mean remark.

(6c) Anna had meant for this to be a very witty remark.

(6d) Anna had meant for this to be a very mean remark.

Results from this study illustrated that, in the TD group, the two-stage processing model was once again supported: initial reading time measures showed that readers expected the victim to express a negative emotion following ironic (5b), more than literal (5a) criticism, but later reading time measures showed that they eventually expected the victim to express a positive emotion more than a negative emotion following the ironic criticism (5b). However, the ASD group did not show evidence of a similar two-stage model: reading time measures showed that the ASD participants did not differentiate between ironic (5b) and literal (5a) criticism and thus expected the victim's response to be the same for both. This result is important because it sheds light on another major language processing difference between ASD and TD populations which had not previously been studied. Additionally, participants from both groups had greater processing difficulty when the third sentence was from the victim perspective (6a, 6b) as opposed to the protagonist perspective (6c, 6d), attributed to the fact that the victim perspective required the reader to shift perspective three times throughout the discourse, while the protagonist perspective required them to shift two times. This study provides evidence for processing differences between the TD and ASD groups in terms of both emotional and non-literal language.

Importantly, broad conclusions from the results of Barzy et al. (2020) are potentially undermined by several methodological concerns. First, although the authors specify that the target words in both the positive valence and the negative valence condition were equated for length, a careful examination of their items reveals that words in the negative valence condition tended to be higher in frequency than words in the positive valence condition. This is a serious

confound, as it is well-known that reading times tend to be faster for words that are higher versus lower in lexical frequency (e.g., Inhoff & Rayner, 1984; Rayner & Duffy, 1986; see Rayner, 1998, for a review). Additionally, among Barzy et al.'s 56 experimental items, only eight distinct target words were used in each condition, meaning that throughout the course of the experiment, each participant encountered each of these target words multiple times, as they were repeated across different items. This repetition may have led to facilitated processing of the target words with each successive repetition of that word, creating different processing patterns than would be expected the first time a participant read the target word. Finally, one of Barzy et al.'s key regions of analysis was the word immediately after the emotion word (i.e., the post-target region). Unfortunately, however, the post-target region in Barzy et al.'s materials was always the final word of the sentence. This is potentially problematic due to the fact that processing of the final word of a sentence has been shown to differ from processing of internal words within a sentence, due to sentence wrap-up effects (e.g., Just & Carpenter, 1980; Rayner et al., 1989).

Accordingly, one goal of the present study is to address these methodological concerns by generating new target words that reduce the issue of word repetition, balancing the target words across both conditions for length and frequency, and adding additional content to each item following the post-target region so that the post-target region never appears at the end of the sentence.

An additional goal of the present study is to expand upon the work of Barzy et al. (2020) by investigating whether the language processing differences between the ASD and TD populations exist on a continuum: that is, whether individuals who do not have a clinical diagnosis of ASD but have personality traits that are associated with ASD will replicate results of the ASD group. In order to assess these personality traits, participants in the current study

were administered the Autism-Spectrum Quotient (AQ), a self-report measure that is designed to capture an individual's degree of autistic personality traits in five dimensions: social skills, attention switching, attention to detail, communication, and imagination (Baron-Cohen et al., 2001). The AQ has previously been used to measure autistic personality traits among TD college students and has demonstrated validity and reliability in measuring these traits within this population (Stevenson & Hart, 2017). Generally, TD scores on the AQ are lower than ASD scores; however, there is variability among the scores of each group, as well as overlap between the two. Overall, the AQ has been shown to effectively measure autistic personality traits among TD college students, which makes it an ideal assessment for the present study.

I had three hypotheses. First, I predicted that participants who show a higher degree of autistic personality traits will show less differentiation in the processing of the emotional responses for victims or protagonists following ironic versus literal criticism. Second, I predicted that participants who show a lower degree of autistic personality traits will replicate the two-stage processing model seen in the TD group of Barzy et al. (2020), such that processing will initially be easier for the negative valence response following ironic criticism, but will later be easier for the positive valence response following ironic criticism. Finally, I predicted that across all participants, processing will be easier in the protagonist's perspective than in the victim's. This study is important because it offers an initial opportunity to examine whether the patterns of language processing seen in the ASD population hold true not only among clinically diagnosed groups, but also on a continuum of autistic traits. This study also provides a more nuanced analysis of these processing patterns that have been observed among these distinct groups.

Method

Participants

Forty-nine introduction to psychology students at the University of Richmond participated in exchange for course credit. All participants reported normal or corrected-to-normal vision. Five participants were excluded for being non-native-English-speakers, and ten were removed due to problems calibrating the eyetracker or for consistently failing to read the passages in their entirety. As a result, the final sample size was 34 native-English speaking participants.

Materials and Design

Experimental items were created by adapting the experimental items from Barzy et al. (2020) in several ways: different target words were substituted in many of the items so that each target word was repeated only twice throughout the complete set of items, a phrase was added to the end of the third sentence in each item, and the phrasing in some items was changed slightly so that the items would be easily understood by American participants. As in the items from Barzy et al. (2020), each item had eight potential conditions, created by manipulating the type of criticism, the sentence perspective, and the valence of the emotion word.

(7) Molly, who was a beginner at tennis, kept hitting the ball into the net.

(8a) Charlotte announced, "You are horrible at this."

(8b) Charlotte announced, "You are amazing at this."

(9a) Molly thought that this was a very humorous comment, and they returned to playing tennis.

(9b) Molly thought that this was a very unkind comment, and they returned to playing tennis.

(9c) Charlotte had intended for this to be a very humorous comment, and they returned to playing tennis.

(9d) Charlotte had intended for this to be a very unkind comment, and they returned to

playing tennis.

When a participant encountered an experimental item, they saw either the literal (8a) or ironic

(8b) condition, the victim (9a, 9b) or protagonist (9c, 9d) perspective, and the positive (9a, 9c) or

negative (9b, 9d) valence emotion word. Across all eight of the possible conditions, the pre-

target word and post-target word remain constant, and the post-target word does not appear at the

end of the sentence. Across all items, the positive and negative target words did not differ in

length (mean positive = 7.43, mean negative = 6.89) or log frequency (mean positive = 2.28,

mean negative = 2.81), ts < 1.

Each participant was presented with 56 experimental items and 30 filler items. Eight

counterbalanced lists were constructed so that each participant only saw one version of each

experimental item and each participant saw an equal number of items from each experimental

condition. Samples of the experimental items are listed in Appendix A. To ensure that the

participants were reading the sentences and paying attention, a true/false comprehension question

about the content of the sentences was presented after each item. Half of the questions were

false, while the other half were true. The average comprehension question accuracy was 90%.

After completing the eyetracking experiment, each participant filled out the Autism-

Spectrum Quotient (AQ), a 50-item questionnaire designed to measure an individual's degree of

autistic personality traits from 0-50, with 50 being the highest degree of autistic traits (Baron-

Cohen et al., 2001). Participants filled out this self-administered questionnaire but were not

informed that it was evaluating autistic personality traits. The AQ is presented in Appendix B.

This experiment used a 2 x 2 x 2 x 2 design with three within-subjects factors: type of

criticism (literal vs. ironic); perspective (victim vs. protagonist); and valence (positive vs.

negative emotion); as well as the between-subjects factor of AQ group. Participants were separated into High vs. Low AQ group by a median split of scores on the AQ. The scores ranged from 11-30. Participants who received a score of 11-20 were in the Low AQ group, and participants who scored 21-30 were in the High AQ group.

Procedure

Participants' eye movements were tracked using an Eyelink 1000 as they read the items on a monitor. A forehead rest and chin rest were used to minimize head movements. At the beginning of each trial, participants were told to look at a fixation point that appeared on the left edge of the monitor, marking the location of where the first word of an item would appear. When the gaze was steady, the experimenter presented the sentence. The first two items were always filler items, while the remaining 84 items were presented in a randomized order. After reading each item, the participant pressed a button on a handheld console, at which point a true or false comprehension question appeared and remained on the screen until participants responded by pressing a button on the same handheld console. Following their completion of the eyetracking portion of experiment, participants filled out the AQ and were then debriefed.

Analysis

Data analysis focused on four standard eye movement measures. *Gaze duration* is the sum of the duration of all fixations made on a given region during first-pass reading, before the participant moves past this word. *Proportion of regressions* measures the proportion of trials during which the participant made a regressive saccade out of the given region and back to earlier parts of the sentence during first-pass reading. *Regression-path duration* is the sum of all fixations beginning with the initial fixation on a region and ending when gaze is directed away from the region to the right, accounting for time spent looking back to earlier regions in the

sentence before moving on. Finally, *second-pass reading time* measures duration of gaze on a region when readers returned to that region for a second time; second-pass reading time is recorded as zero in cases when a participant does not return to reread a given region for a second time. Following Barzy et al. (2020), eye movement measures are reported for three regions of interest in the third sentence of each item: the pre-target, target, and post-target regions.

Results

The results of the ANOVAs for each dependent variable at each analysis region are reported in Table 1.

Table 1
Eyetracking results

	Pre-Target	Target	Post-Target
Gaze Duration			
Criticism	0.121	0.013	8.233*
Criticism * AQ Group	0.195	0.873	0.044
Perspective	2.306	0.449	0.494
Perspective * AQ Group	0.108	0.083	0.014
Valence	0.312	5.2*	0.474
Valence * AQ Group	0.011	0.11	0.043
Criticsm * Perspective	0.001	0	1.443
Criticsm * Perspective * AQ Group	0.168	8.997*	0.568
Criticim * Valence	1.931	0.554	0.126
Criticism * Valence * AQ Group	1.593	0.003	1.809
Perspective * Valence	0.751	1.021	2.361
Perspective * Valence * AQ Group	0.676	0.182	1.144
Criticism * Perspective * Valence	1.077	0.546	0.035
Criticism * Perspective * Valence * AQ Group	0.082	1.014	0.263
Proportion of Regressions			
Criticism	0.228	0.553	1.396
Criticism * AQ Group	0.621	0.738	0.091
Perspective	0.6	0.765	0.043
Perspective * AQ Group	2.799	1.656	0.103
Valence	0.331	1.691	4.190
Valence * AQ Group	0.036	2.434	3.424
Criticsm * Perspective	0.926	0.879	0.059

Criticsm * Perspective * AQ Group	0.084	0.025	1.448
Criticim * Valence	0.001	1.101	1.043
Criticism * Valence * AQ Group	0	0.039	0.128
Perspective * Valence	4.72*	3.794	0.344
Perspective * Valence * AQ Group	0.027	4.617*	0.125
Criticism * Perspective * Valence	2.125	0.582	0.07
Criticism * Perspective * Valence * AQ Group	0.165	0.045	0.746
Regression Path Duration			
Criticism	1.294	1.505	0.141
Criticism * AQ Group	0.083	1.983	0.078
Perspective	2.318	0.551	0.073
Perspective * AQ Group	2.279	0.139	0.852
Valence	1.688	8.976*	3.768
Valence * AQ Group	0.006	4.473*	7.041*
Criticsm * Perspective	2.35	0.223	0.126
Criticsm * Perspective * AQ Group	0.001	0.696	1.603
Criticim * Valence	1.348	1.301	0.405
Criticism * Valence * AQ Group	0	2.841	1.148
Perspective * Valence	0.993	0.112	0.073
Perspective * Valence * AQ Group	1.5457	1.843	2.774
Criticism * Perspective * Valence	1.237	0.079	0.649
Criticism * Perspective * Valence * AQ Group	0.007	0.139	0.632
Second Pass Reading Time			
Criticism	0.617	0.504	0.704
Criticism * AQ Group	0.037	0.255	0.003
Perspective	0.361	0.342	1.168
Perspective * AQ Group	1.546	5.653*	0.378
Valence	4.915*	1.771	0.589
Valence * AQ Group	0.109	0.568	0.084
Criticsm * Perspective	0.309	0.451	0.134
Criticsm * Perspective * AQ Group	0.688	0.07	0.68
Criticim * Valence	0.023	0.344	0.267
Criticism * Valence * AQ Group	0.35	0.246	0.833
Perspective * Valence	0.656	1.845	0.238
Perspective * Valence * AQ Group	5.251*	8.562*	1.038
Criticism * Perspective * Valence	3.095	0.103	0.535
Criticism * Perspective * Valence * AQ Group	2.48	0.381	0.532

Pre-target region

In the pre-target region, there was a significant perspective by valence interaction in proportion of regressions ($F(1, 26) = 4.72$, $p = .039$) such that the greatest proportion of regressions occurred when the sentence was in the victim perspective and the valence was positive. In second-pass reading time, there was a significant main effect of valence ($F(1, 32) = 4.915$, $p = .034$) indicating that second-pass reading times were significantly longer in the positive valence condition as compared to the negative valence. Additionally, there was a significant three-way interaction of perspective by valence by AQ group in second-pass reading time ($F(1, 32) = 5.251$, $p = .029$) such that, in the Low AQ group, there were longer second-pass reading times when the sentence was in the victim condition and the valence was positive, while for the High AQ group, there were longer second-pass reading times when the sentence was in the protagonist condition and the valence was positive (see Figure 1).
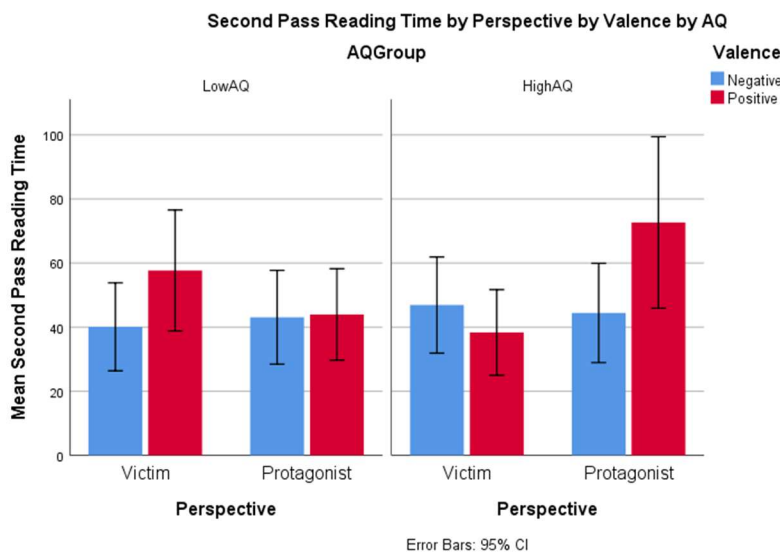

Figure 1

Target region

In the target region, there was a significant main effect of valence in gaze duration ($F(1, 30) = 5.200$, $p = .030$) and in regression path duration ($F(1, 30) = 8.976$, $p = .005$) such that there

were longer gaze durations in the negative valence condition than in the positive valence condition. There was a significant interaction of valence by AQ group in regression path duration ($F(1, 30) = 4.473$, $p = .043$) such that regression path durations were longer in the negative valence condition and for the High AQ group, as well as a significant interaction of perspective by AQ group in second-pass reading time ($F(1, 32) = 5.653$, $p = .024$) such that there were longer reading times for the victim perspective in the Low AQ group. There was a significant three-way interaction of criticism by perspective by AQ group in gaze duration ($F(1, 30) = 8.997$, $p = .005$) such that gaze durations were longer in the victim perspective and the ironic condition for the Low AQ group (see Figure 2). Additionally, there were significant three-way interactions of perspective by valence by AQ group in proportion of regressions ($F(1, 30) = 4.617$, $p = .040$) and second-pass reading time ($F(1, 32) = 8.562$, $p = .006$) such that there were more regressions and longer second-pass reading times in the victim perspective and the positive valence condition for the Low AQ group and longer second-pass reading times for the protagonist perspective and the positive valence condition for the High AQ group (see Figure 3). There were also more regressions- but not longer second-pass reading times- for the victim perspective and negative valence condition for the High AQ group (see Figure 4).
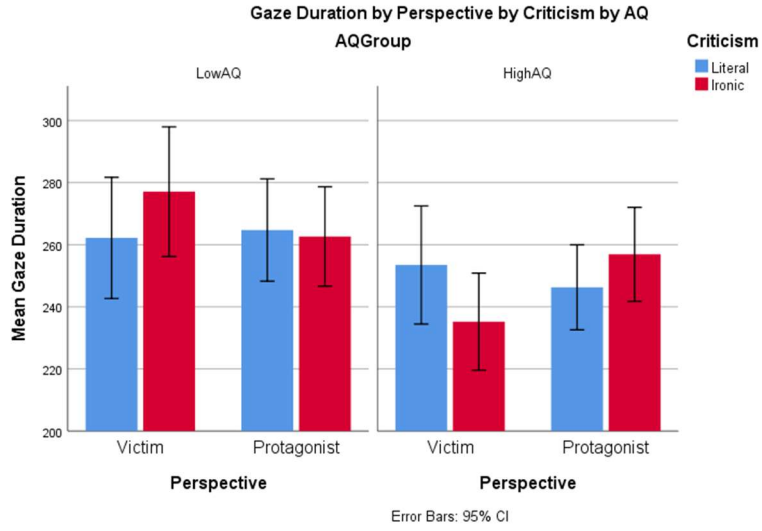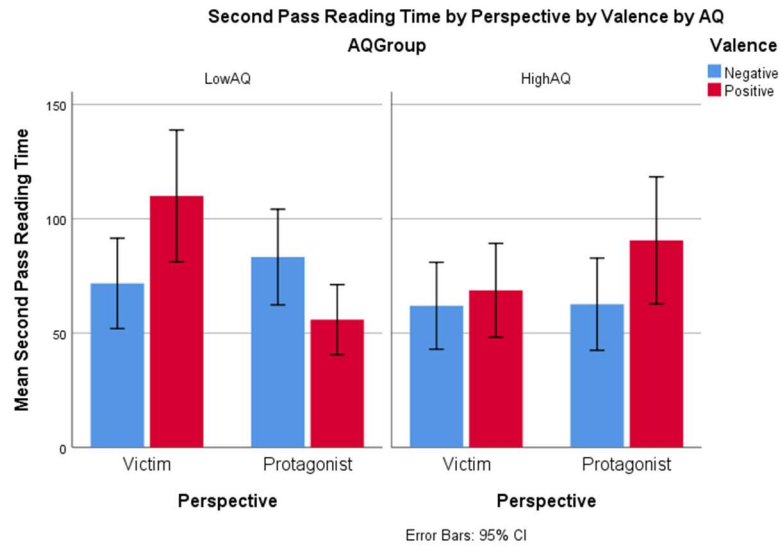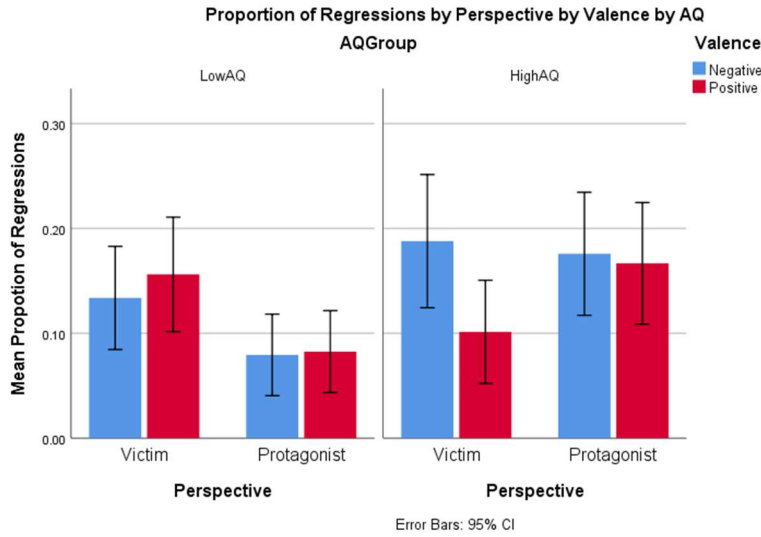
Figure 2

Figure 3

Figure 4

Post-target region

In the post-target region, there was a significant main effect of criticism in gaze duration (F(1, 23) = 8.233 p = .009) indicating that there were longer gaze durations in the literal criticism condition than in the ironic condition. There was a significant interaction of valence by AQ group in regression path duration (F(1, 23) = 7.041, p = .014) such that regression path durations were longer for the negative valence condition in the Low AQ group (see Figure 5).
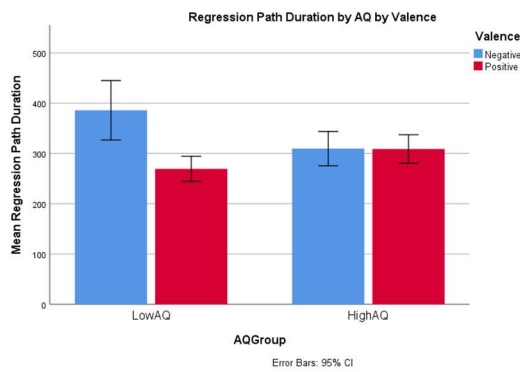

Figure 5

Discussion

Broadly, these results show that the results of the study done by Barzy et al. (2020) involving TD and ASD participants were partially replicated within a college student sample which varied on AQ score, rather than ASD diagnosis. In several areas of the results from the present study, the language processing patterns in the Low AQ group replicate the patterns of the TD group from Barzy et al.'s study, while the High AQ group replicates the results of the ASD group; however, not all of the results were replicated in this study.

Reading time measures within the Low AQ group do provide support for the two-stage processing model of ironic language (Filik et al., 2017; Barzy et al., 2020). Evidence for the two-stage model comes from the three-way interaction of criticism by perspective by AQ group in gaze duration for the target region. This result shows that gaze durations on the target word were longer for the victim perspective, particularly for the Low AQ group in the ironic condition. This interaction indicates that the Low AQ group had initial difficulty integrating the ironic criticism in the victim perspective, which supports the notion that ironic language has greater initial processing costs. Importantly, this result was shown for the Low AQ group, but not for the High AQ group, suggesting that the High AQ group did not encounter this difficulty with the ironic condition. This replicates the result from Barzy et al. (2020), which showed that the ASD group did not differentiate between ironic and literal criticism in the same way that the TD group did.

This pattern of processing is further supported by the three-way interaction of perspective by valence by AQ group in second-pass reading time for the target word. This interaction showed that second-pass reading times were longest among the Low AQ group for the positive valence condition from the victim perspective, illustrating that participants in the Low AQ group expected the victim to feel hurt, not amused, by the criticism and thus had processing difficulty when the victim expressed a positive valence reaction. Once again, this result, which appeared

within the Low AQ group but not the High AQ group, supports the two-stage model of ironic

language processing found among TD participants in Barzy et al. (2020) in that Low AQ

participants anticipated a negative valence reaction in this stage of processing. In the High AQ

group, the longest second-pass reading times on the post-target word were in the positive valence

and the protagonist perspective, indicating that High AQ participants had difficulty integrating

that a character intended a positive meaning with their criticism, which supports the idea that

High AQ participants, like ASD participants, did not access the potential positive, or amusing,

intent of this language. Interestingly, the manipulation of criticism did not interact with these

factors, suggesting that both the Low and High AQ groups did not differ in their processing of

ironic vs. literal criticism at this point. This can be understood in terms of both the two-stage

processing model among the Low AQ group and the fact these participants would expect the

literal criticism to be hurtful, rather than amusing, regardless of the stage of processing since the

literal condition lacks the amusing element that arises later in the processing of the ironic

condition.

 Another notable result is the two-way interaction of valence by AQ group in regression

path duration for the post-target word, which shows that regression path duration was longer for

the negative valence condition in the Low AQ group. This result indicates that, for this later

measure of processing, the Low AQ group had lingering difficulty in the negative valence

condition, such that these participants had longer regressions from the post-target word when the

target word had been a negative valence emotion word. This result partially aligns with the two-

stage processing model in that the Low AQ participants were now, at this later point in

processing, anticipating a positive, rather than negative, reaction, whereas in earlier measures of

processing the inverse had been true. However, the fact that criticism does not interact with these

factors differs from previous findings, as this lingering difficulty after the negative valence target word was found in the both the literal and the ironic conditions. This may be attributable to the positivity bias, the idea that emotion words with a positive valence are processed more rapidly than those with a negative valence (Lüdtke & Jacobs, 2015).

Taken together, these results provide partial support for the findings of Barzy et al. (2020). There was evidence of the two-stage processing model within the Low AQ group, but not the High AQ group, suggesting that these groups mirrored the TD and ASD groups from Barzy et al. However, some key findings from the previous study were not replicated in this study, including the significant four-way interactions that more clearly illustrated the two-stage processing model and the differences in processing between the two groups. The differences between the findings of the present study and the findings from Barzy et al. (2020) may be partially attributed to the differences in samples: the present study used a college student sample, with students split into two groups based on scores on a personality measure, while Barzy et al. used a clinically diagnosed population. Another contributing factor to the differences in findings may be the methodological improvements in the present study, which included balancing target words for length and frequency, varying target words to avoid repetition, and adding additional sentence content to the end of each item to avoid having the post-target region, which was a region of interest, be the last region of the sentence. It is possible that the differences in findings from the previous study to the present may be a result of these improvements to the content of the experimental items.

Despite the methodological improvements in this study, there are limitations that may affect the results. First, the sample size of 34 native English-speaking participants is smaller than ideal, so it is possible that a similar study with a larger sample size might produce different

results with greater power. Another potential limitation is the use of a median split to divide the

AQ score variable into two groups, rather than examining this factor as a continuous variable.

This method of data analysis was necessary in order to analyze the data using a 2 x 2 x 2 x 2

analysis of variance; however, using a linear mixed effects model to include AQ score as a

continuous variable may illuminate different patterns of results than what was seen using this

statistical method. Future research within this laboratory intends to address these potential

limitations by collecting additional data and using a linear mixed effects model to analyze these

findings. Outside of addressing limitations, future research should continue to investigate

language processing patterns relative to personality factors, including additional studies using the

AQ to assess autistic personality traits. Research in this field is still preliminary, and further

work is needed to provide evidence for these patterns of processing and how they affect

individuals in their daily lives, through differences in language processing both during reading

and during verbal interactions.

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Appendix

Appendix A

Sample experimental items

1a. Sandra had misjudged the distance when reversing into the space and bumped into the car behind her. Heather said to her, "That was fantastic parking." Sandra was really amused by this comment about her parking ability.
1b. Sandra had misjudged the distance when reversing into the space and bumped into the car behind her. Heather said to her, "That was horrendous parking." Sandra was really amused by this comment about her parking ability.
1c. Sandra had misjudged the distance when reversing into the space and bumped into the car behind her. Heather said to her, "That was fantastic parking." Heather had intended for Sandra to be really amused by this comment about her parking ability.
1d. Sandra had misjudged the distance when reversing into the space and bumped into the car behind her. Heather said to her, "That was horrendous parking." Heather had intended for Sandra to be really amused this comment about her parking ability.
1e. Sandra had misjudged the distance when reversing into the space and bumped into the car behind her. Heather said to her, "That was fantastic parking." Sandra was really hurt by this comment about her parking ability.
1f. Sandra had misjudged the distance when reversing into the space and bumped into the car behind her. Heather said to her, "That was horrendous parking." Sandra was really hurt by this comment about her parking ability.
1g. Sandra had misjudged the distance when reversing into the space and bumped into the car behind her. Heather said to her, "That was fantastic parking." Heather had intended for Sandra to be really hurt by this comment about her parking ability.
1h. Sandra had misjudged the distance when reversing into the space and bumped into the car behind her. Heather said to her, "That was horrendous parking." Heather had intended for Sandra to be really hurt by this comment about her parking ability.

2a. Alex arrived home and saw the calendar on the table and realized that he had forgotten his wife Jill's birthday. Jill said to him, "You're the most thoughtful husband." Alex thought that this was a very witty thing to say about his error.
2b. Alex arrived home and saw the calendar on the table and realized that he had forgotten his wife Jill's birthday. Jill said to him, "You're the most careless husband." Alex thought that this was a very witty thing to say about his error.
2c. Alex arrived home and saw the calendar on the table and realized that he had forgotten his wife Jill's birthday. Jill said to him, "You're the most thoughtful husband." Jill had intended for this to be a very witty thing to say about his error.
2d. Alex arrived home and saw the calendar on the table and realized that he had forgotten his wife Jill's birthday. Jill said to him, "You're the most careless husband." Jill had intended for this to be a very witty thing to say about his error.
2e. Alex arrived home and saw the calendar on the table and realized that he had forgotten his wife Jill's birthday. Jill said to him, "You're the most thoughtful husband." Alex thought that this was a very cruel thing to say about his error.

2f. Alex arrived home and saw the calendar on the table and realized that he had forgotten his wife Jill's birthday. Jill said to him, "You're the most careless husband." Alex thought that this was a very cruel thing to say about his error.

2g. Alex arrived home and saw the calendar on the table and realized that he had forgotten his wife Jill's birthday. Jill said to him, "You're the most thoughtful husband." Jill had intended for this to be a very cruel thing to say about his error.

2h. Alex arrived home and saw the calendar on the table and realized that he had forgotten his wife Jill's birthday. Jill said to him, "You're the most careless husband." Jill had intended for this to be a very cruel thing to say about his error.

3a. Nicole had just made Ellie a cup of tea, but tripped and spilled it all over the living room carpet. Ellie snapped at her, "That was intelligent." Nicole was really entertained by this statement about her mishap.

3b. Nicole had just made Ellie a cup of tea, but tripped and spilled it all over the living room carpet. Ellie snapped at her, "That was stupid." Nicole was really entertained by this statement about her mishap.

3c. Nicole had just made Ellie a cup of tea, but tripped and spilled it all over the living room carpet. Ellie snapped at her, "That was intelligent." Ellie had meant for her to be really entertained by this statement about her mishap.

3d. Nicole had just made Ellie a cup of tea, but tripped and spilled it all over the living room carpet. Ellie snapped at her, "That was stupid." Ellie had meant for her to be really entertained by this statement about her mishap.

3e. Nicole had just made Ellie a cup of tea, but tripped and spilled it all over the living room carpet. Ellie snapped at her, "That was intelligent." Nicole was really offended by this statement about her mishap.

3f. Nicole had just made Ellie a cup of tea, but tripped and spilled it all over the living room carpet. Ellie snapped at her, "That was stupid." Nicole was really offended by this statement about her mishap.

3g. Nicole had just made Ellie a cup of tea, but tripped and spilled it all over the living room carpet. Ellie snapped at her, "That was intelligent." Ellie had meant for her to be really offended by this statement about her mishap.

3h. Nicole had just made Ellie a cup of tea, but tripped and spilled it all over the living room carpet. Ellie snapped at her, "That was stupid." Ellie had meant for her to be really offended by this statement about her mishap.

Appendix B

Autism-Spectrum Quotient

Mark one response that best describes how strongly each item applies to you:

	Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
1. I prefer to do things with others rather than on my own.				
2. I prefer to do things the same way over and over again.				
3. If I try to imagine something, I find it very easy to create a picture in my mind.				
4. I frequently get so strongly absorbed in one thing that I lose sight of other things.				
5. I often notice small sounds when others do not.				
6. I usually notice car number plates or similar strings of information.				
7. Other people frequently tell me that what I've said is impolite, even though I think it is polite.				
8. When I'm reading a story, I can easily imagine what the characters might look like.				
9. I am fascinated by dates.				
10. In a social group, I can easily keep track of several different people's conversations.				
11. I find social situations easy.				
12. I tend to notice details that others do not.				
13. I would rather go to a library than to a party.				
14. I find making up stories easy.				
15. I find myself drawn more strongly to people than to things.				
16. I tend to have very strong interests, which I get upset about if I can't pursue.				
17. I enjoy social chitchat.				
18. When I talk, it isn't always easy for others to get a word in edgewise.				
19. I am fascinated by numbers.				
20. When I'm reading a story, I find it difficult to work out the characters' intentions.				

21. I don't particularly enjoy reading fiction.				
22. I find it hard to make new friends.				
23. I notice patterns in things all the time.				
24. I would rather go to the theater than to a museum.				
25. It does not upset me if my daily routine is disturbed.				
26. I frequently find that I don't know how to keep a conversation going.				
27. I find it easy to "read between the lines" when someone is talking to me.				
28. I usually concentrate more on the whole picture, rather than on the small details.				
29. I am not very good at remembering phone numbers.				
30. I don't usually notice small changes in a situation or a person's appearance.				
31. I know how to tell if someone listening to me is getting bored.				
32. I find it easy to do more than one thing at once.				
33. When I talk on the phone, I'm not sure when it's my turn to speak.				
34. I enjoy doing things spontaneously.				
35. I am often the last to understand the point of a joke.				
36. I find it easy to work out what someone is thinking or feeling just by looking at their face.				
37. If there is an interruption, I can switch back to what I was doing very quickly.				
38. I am good at social chitchat.				
39. People often tell me that I keep going on and on about the same thing.				
40. When I was young, I used to enjoy playing games involving pretending with other children.				
41. I like to collect information about categories of things (e.g., types of cars, birds, trains, plants).				
42. I find it difficult to imagine what it would be like to be someone else.				
43. I like to carefully plan any activities I participate in.				

44. I enjoy social occasions.				
45. I find it difficult to work out people's intentions.				
46. New situations make me anxious.				
47. I enjoy meeting new people.				
48. I am a good diplomat.				
49. I am not very good at remembering people's date of birth.				
50. I find it very easy to play games with children that involve pretending.				