

# Visual vs. Linguistic Narrative Processing in Individuals with Autism Spectrum Disorders

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## Introduction

Individuals with autism spectrum disorders (ASDs) have been shown to exhibit core deficits in higher-level language processes such as sentence or narrative comprehension [1]. However, semantic processing deficits have *not* been found for non-linguistic stimuli like pictures [2,3].

The prior literature has used linguistic narratives to observe deficits in narrative comprehension in ASD. Given findings that semantic processing of pictures is intact in ASD, would similar deficits be observed if narratives are presented visually?

Visual narratives elicit similar electrophysiological markers of semantic incongruity as language [4,5]. In both linguistic and visual narratives, semantically-incongruent endings elicit a larger N400 ERP component compared to congruent endings [6,7]. The N400 to sentences is reduced in ASD, suggesting impairments in semantic processing of language [8].

We investigated whether semantic processing of visual narratives is impaired in high-functioning individuals with ASD.

- If semantic processing deficits in ASD are restricted to the linguistic domain, we predict a reduced N400 effect compared to normal controls (NCs) for linguistic narratives but not for visual narratives.
- If semantic processing deficits in ASD are more global, we predict a reduced N400 effect compared to NCs for both linguistic and visual narratives.

## Methods

### Participants

- 20 high-functioning individuals with ASD and 19 normal controls. Groups matched on age and sex. The ASD group had slightly lower verbal IQ ( $p = 0.09$ ), non-verbal IQ ( $p = 0.07$ ), and vocabulary scores ( $p < 0.05$ ).

### Stimuli

- Visual narratives adapted from a corpus of *Peanuts* comic strips [4,5]
- Linguistic narratives created by translating *Peanuts* comic strips into short narratives.
- Incongruent conditions created by switching the last word or panel with that of another stimulus

### Procedure

- Visual narrative panels each presented for 1350 ms, 350 ms ISI.
- Initial sentences in the linguistic narrative presented all at once in self-paced reading. Target (last) sentence presented in rapid serial visual presentation (RSVP) format; each word presented for 300 ms, 200 ms ISI.

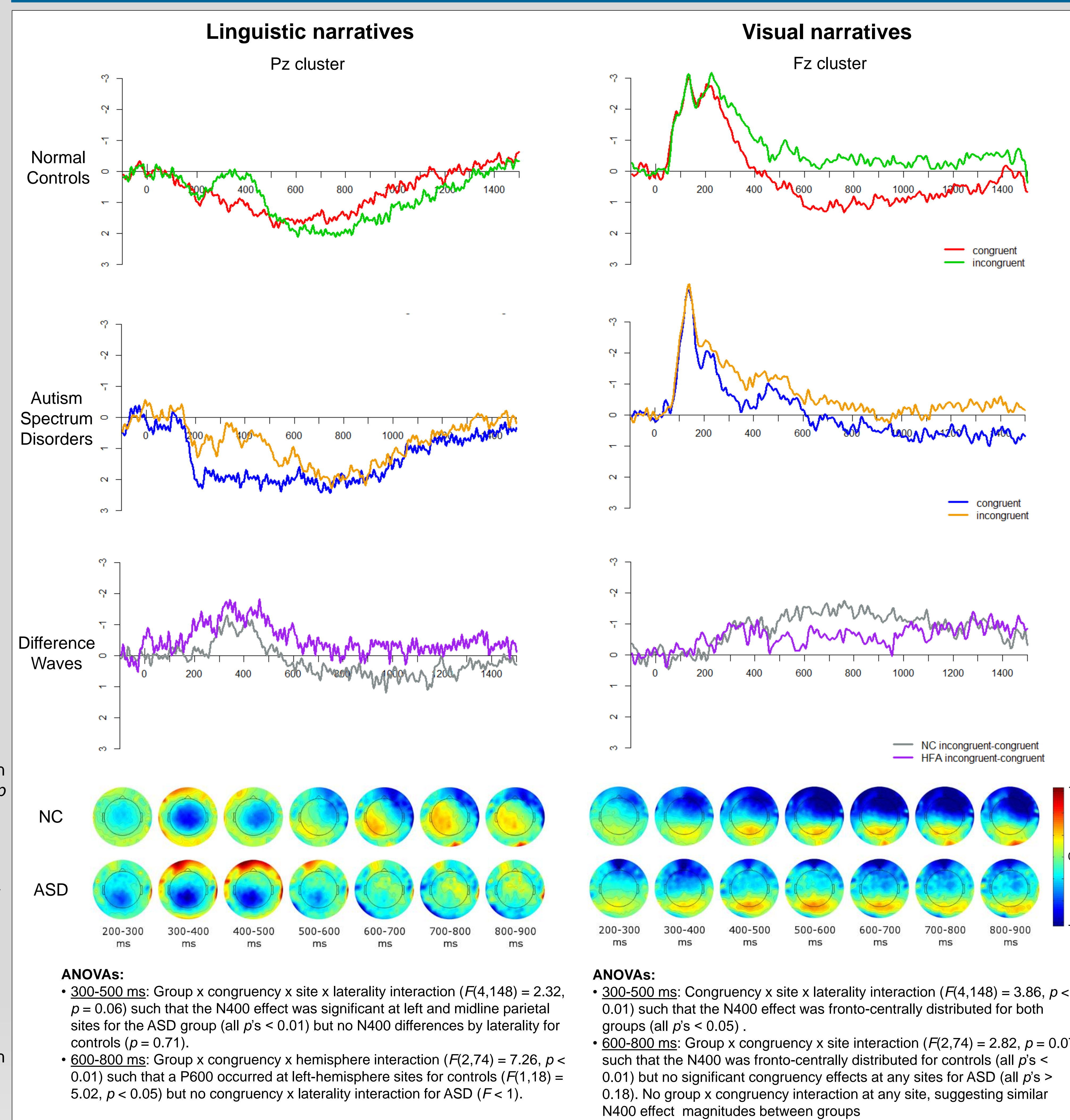
### EEG Data Acquisition and Preprocessing

- EEG recorded at 250 Hz using an Electrical Geodesics Inc. GES300 EEG System with 256-channel Hydrocel Geodesic Sensor Nets and NetStation version 4.3

### Statistical Analyses

- ANOVAs from 300-500 ms and 600-800 ms: *group* (NC, HFA) x *congruency* (congruent, incongruent) x *site* (frontal, central, parietal) x *laterality* (left, right, midline)

## Results



## Discussion

### Linguistic narratives

In contrast to previous research, in our study individuals with ASD showed an N400 effect that was similar in magnitude to that of controls, suggesting that semantic processing of linguistic narratives was *not* impaired. These adult ASD participants may have developed compensatory strategies for semantic processing of language, which could explain the discrepancy with prior literature.

There were topographic differences in the distribution of the N400 effect between groups, with a more centrally-distributed N400 for controls but a left-lateralized centro-parietal N400 for individuals with ASD. Controls also showed a left-lateralized P600 effect whereas the ASD group did not. These discrepancies may suggest different underlying semantic processing strategies between groups. For example, these adults with ASD may have used a more proactive strategy of semantic processing whereas controls used a more reactive process triggering semantic reanalysis.

### Visual narratives

The magnitude of the N400 effect was reduced in individuals with ASD, although this was a trend which did not reach statistical significance. This could suggest difficulties with semantic processing of visual narratives in ASD.

Higher levels of autistic traits (over both ASD and control participants) were correlated with smaller frontal N400 effects to visual narratives, which further suggests that semantic processing of visual narratives is impaired in ASD.

## Conclusions

These data are preliminary due to possible mismatches between the groups and the relatively small numbers of subjects.

Contrary to prior literature, in this study semantic processing of linguistic narratives was not impaired in the ASD group. However, there were topographic differences in the N400 effect, and an absence of a P600 effect for individuals with ASD, which may suggest group differences in semantic integration strategies.

There was a trend for semantic processing of visual narratives to elicit a smaller frontal N400 effect for the ASD group, although this was not statistically significant. Higher levels of autistic traits were associated with smaller frontal N400 effects. These results suggest subtle impairments in semantic processing of visual narratives in ASD.

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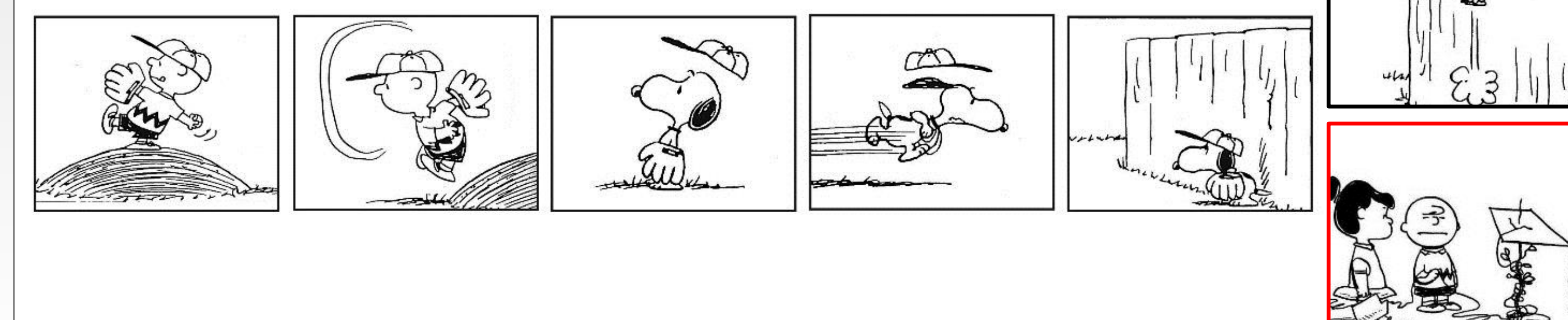
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### Linguistic narrative

Charlie Brown pitched the baseball. The batter hit the ball into the outfield.

Snoopy ran to catch the **BALL**  
**KITE**

### Visual narrative



### Correlations of N400 effect

- We ran correlations of the N400 effect amplitude (incongruent – congruent) with Autism Quotient [9] scores over all participants ( $n = 39$ ) from 300-500 and 600-800.
- Correlations were run at every electrode and  $r$  correlation coefficients were plotted across the scalp. Significant correlations (with an FDR correction at  $p < 0.05$  for multiple comparisons) are marked with black dots
- The frontal N400 effect in visual narratives was positively correlated with AQ scores such that as the level of autistic traits increased, amplitude increased i.e. the N400 effect became *smaller*.
- There were no significant correlations of N400 effect in either modality with IQ or vocabulary scores

