Predictive Abilities During Visual Narrative Comprehension in Individuals with Autism

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BACKGROUND

Narrative comprehension in ASD

- Individuals with autism spectrum disorder (ASD) often experience language impairments, particularly in narrative comprehension [1].
- Comprehension difficulties also occur for non-linguistic narratives (e.g. picture sequences or comics) [2], suggesting domain-general impairments in narrative comprehension.

Prediction in narrative comprehension

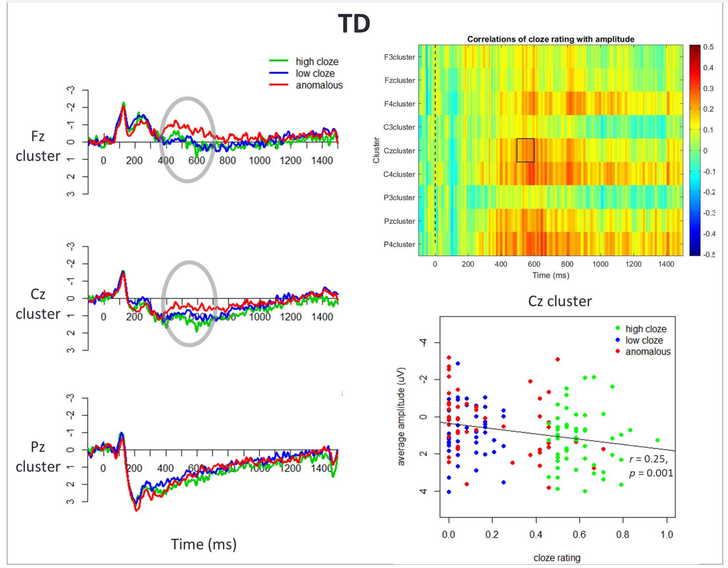
- Successful narrative and discourse processing entails a high degree of prediction to facilitate comprehension [3].
- However, some have proposed that autism is a disorder of prediction [4], such that individuals with ASD are less able to use previous experiences to interpret incoming information. Prediction is examined in language studies by manipulating *cloze probability*, the expectancy of a word given the contextual constraints of a preceding sentence [3]. "High cloze" words are highly predictable; "low cloze" words are less predictable.
- In studies using event-related potentials (ERPs), words in high cloze sentences generate reduced amplitudes at the N400 ERP component compared to words in low cloze sentences. In other words, the more predictable a word, the smaller the N400 amplitude.
- Prediction in visual narrative comprehension can be tested using a similar paradigm, in which a given panel is more or less expected based on the prior narrative context.

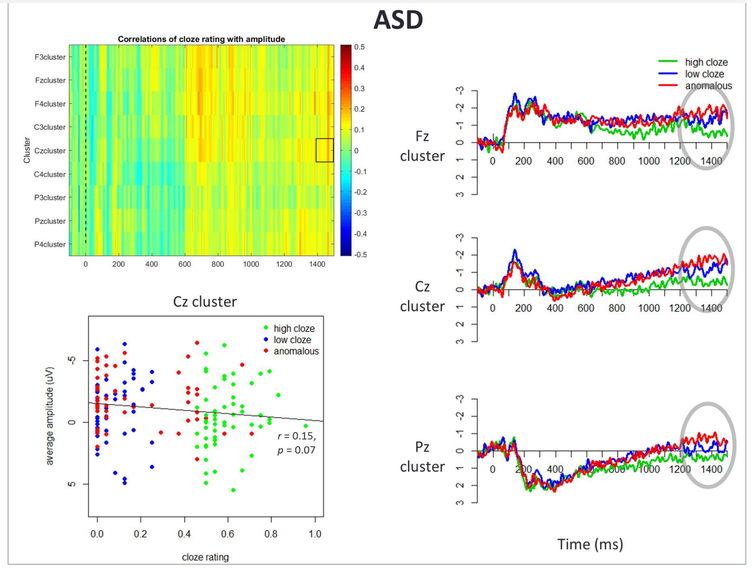
Objective of the current study

- We use a cloze probability manipulation with EEG to determine whether individuals with ASD experience impaired predictive abilities during visual narrative comprehension.

RESULTS

- Repeated-measures ANOVAs in 100 ms time windows from 200-1500 ms with factors of *group* (TD/ASD), *condition* (anomalous/low cloze/high cloze), *site* (frontal/central/parietal), and *laterality* (left/midline/right).
- Trend of group*condition*site interaction from 400-500 ms ($F(4,116)=2.16$, $p=0.08$). TD group shows differences between anomalous and other conditions at frontal sites (all *p*'s<0.05) but no effects of condition in ASD group ($p=0.79$).
- TD group only: anomalous more negative than high and low cloze at fronto-central sites from 400-700 ms; differences between all conditions (anomalous > low cloze > high cloze) at fronto-central sites from 500-600 ms (all *p*'s<0.05).
- ASD group only: differences between all conditions (anomalous > low > high) over all sites from 1300-1400 ms; differences between high cloze and other conditions over all sites from 1400-1500 ms (all *p*'s<0.05).
- Correlations of cloze rating with amplitude: positive associations in the TD group from 400-900 ms (all *p*'s<0.05), especially over midline and right centro-parietal scalp; positive associations in the ASD group from 600-800 ms (all *p*'s<0.05), with a trend from 1400-1500 ms (all *p*'s<0.10), over fronto-central scalp.





METHODS

Participants

- 9 adults with ASD (M = 27 years old), 22 typically-developing (TD) participants (M = 26 years old). Groups matched on age, receptive vocabulary, and verbal/non-verbal IQ (all *p*'s > 0.22).

Stimuli and Procedure

- Participants viewed visual narrative sequences (*Peanuts* comic strips) one panel at a time during concurrent EEG recording.
- ERPs were time-locked to a "target" panel which was either highly predictable ("high cloze") or unpredictable ("low cloze"), as quantified with a pretest.
- In "anomalous" conditions the target panel was incongruent with the preceding narrative. This was expected to elicit the highest N400 amplitudes of all conditions.

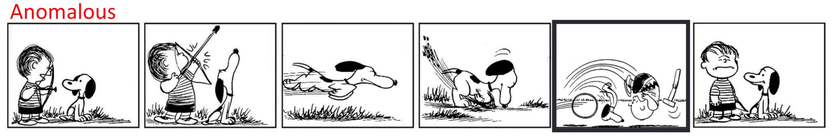
EEG Data Acquisition, Preprocessing, and Analysis

- EEG data recorded at 500 Hz using a 128-channel Geodesics Sensor net and NetStation 5.3.
- Data bandpass filtered from 0.1-50 Hz and segmented into epochs time-locked to the onset of the target panel.

High Cloze

Low Cloze

Anomalous



CONCLUSIONS

- TD adults showed the expected manipulation of ERP amplitude by cloze from 500-600 ms (anomalous > low cloze > high cloze). This is analogous to an N400 effect, although occurs slightly later (perhaps due to more complex visual information).
- The ASD group showed this pattern much later, from 1300-1500 ms.
- Within these windows in each group (500-600 ms in TD; 1400-1500 ms in ASD), amplitude correlated positively with cloze ratings such that less predictable sequences generated larger amplitudes.
- These results suggest that predictive mechanisms are significantly delayed in individuals with ASD, which could underlie domain-general narrative comprehension deficits in this population.

REFERENCES

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