Background

Attention in autism: Atypical attention and responsiveness to environmental changes are commonly reported among individuals with ASD. 1, 2 and may be related to downstream social communication impairments, repetitive behaviors, and circumscribed interests. 2, 3 Numerous neural investigations of sensory processes subserving novelty detection have yielded mixed results. Neuroimaging studies suggest a reduced ‘alerting’ response (e.g., dlPFC, STS/STG) towards novel stimuli, usually in a sequence of repetitive stimuli. 21, 22, 23, 24 Similarly, studies using Oddball ERP paradigms have found a reduction in the the novelty detection P3a component in ASD. 25, 26, 27, 28 However, findings of increased P3a response to novel stimuli have also been shown. 16, 18, 29 Although discrepant findings may be partially due to methodological differences across studies, atypical neural phenotypes in ASD, genetic and idiopathic etiologies may be linked to divergent neural patterns of attention.

Genetic etiologies of autism: Recurrent disruptive likely gene disrupting (LGD) mutations such as CHD8 and DYRK1A have been implicated as contributing to approximately 10% of ASD. 30, 31 To better describe the known genetic and phenotypic heterogeneity in ASD, recent work has begun to target specific neural phenotypes related to genetic and idiopathic etiologies of ASD. 32. However, it is still unclear how genetic disruptions impact associated aspects of ASD such as atypical attention processes and contribute to phenotypic heterogeneity in ASD.

Methods

- In an Oddball ERP paradigm, children watched a video of a trip to the zoo while passively attending to frequent tones (70%, e.g., 1000 Hz), infrequent tones (15%, e.g., 750 Hz), and novel sounds (15%, e.g., chime, creek).
- Maximum amplitude and peak latency at Cz, Fz, and Pz were extracted for the P3a component (180-350 ms). We focused on difference comparisons for novelty detection (novel vs. frequent).
- Mixed models were estimated for each region with full-factorial comparisons of Group, Condition, and Time in SAS 9.3. We statistically controlled for VIQ, NVIQ, age, and gender; none significantly contributed to models.

![Table of data](image)

### Results

#### P3a component (180-350 ms)

**Topography of P3a**

![Graph of topography](image)

**Waveforms at Fz**

- Only TYP children had faster latencies for Novel sounds relative to Frequent tones at Cz and Fz. Both ASD groups exhibited a larger P3a response than TYP.
- (1) ASD-NON: Slower P3a latencies for Novel at Fz and Pz.
- (2) ASD-LGD: Slower P3a latencies for Novel at Fz and Pz.
- Slower Novel compared to TYP (Pz) and NON (Fz, Pz).

**Correlation with Behaviors**

Pearson correlations indicated larger novel amplitudes correspond with:
- Less repetitive behaviors
- Lower attention
- Lower NVIQ
- Lower communication

**P3a Amplitude**

All groups exhibited increased P3a for Novel sounds relative to Frequent tones at Cz and Fz. Both ASD groups exhibited a larger P3a response than TYP.

- (1) ASD-NON: Larger P3a amplitude (2.26 µV at Cz; 1.93 µV at Fz) than TYP.
- (2) ASD-LGD: Marginally larger P3a amplitude (2.71 µV at Cz) than TYP.

**P3a Latency**

All regions exhibited change of amplitude over time (i.e. trial order).

- (1) ASD-NON: Typical pattern of sensitization at Pz.
- (2) ASD-LGD: Additional habituation at Fz.
- Typical pattern of habituation at Cz.
- Typical pattern of sensitization at Pz.

**P3a Amplitude Dynamics**

For all regions, all groups exhibited change of amplitude over time (i.e. trial order).

**Discussion**

**Increased P3a in ASD**

- Our findings supported prior work indicating an increased P3a novelty detection response. 16, 14, 13, which may suggest a hypersensitivity to change in ASD.
- The ASD-LGD group showed a significantly longer P3a latency suggesting a divergent, and more impaired, pattern of novelty processing for children ASD and an associated de novo LGD mutation.

**Considerations for habituation**

- Importantly, the differences between ASD-NON and ASD-LGD may relate to differences in how attention resources are distributed over the course of the experiment.
- Future work assessing inter- and intra-hemispheric coherence may provide better insight regarding how ongoing processing is related to changes in functional connectivity.

**Individual differences**

- Our behavioral measures suggest that attention reductions may be strongly tied to other cognitive systems.
- Future work should investigate neural patterns of novelty detection among samples with greater recurrence of LGD mutations, and should continue to investigate how individual difference related to cognition and behavior relate to atypical attention processing abnormalities in ASD.

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