

McPartland Lab
Yale Child Study Center, New Haven, CT

Background

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impairments in social interaction and communication.

Pivotal response treatment (PRT) is an empirically validated behavioral treatment for ASD that directly targets social motivation to address deficits in interpersonal interaction and communication.

- A 4-month course of PRT results in measurable changes in pragmatic language, social engagement, and adaptive functioning, with accompanying changes in regional brain activation (Voos et al., 2012).

Treatment outcome in terms of neural efficiency has not yet been studied.

The current study used event-related potentials (ERPs) to examine the temporal dynamics of behavior change associated with positive response to intervention.

We predicted that 1) children would demonstrate improved efficiency in face processing, as indexed by reduced N170 latency, following a 4-month course of PRT, whereas 2) brain activity indexing low-level visual processing would remain unchanged (P100).

Methods

Participants:

- 5 children with ASD between 4-6 years of age.
- Differential Ability Scale - Second Edition (DAS-II), Global Conceptual Ability Score = 114.2 ± 13.3
- Received PRT for 8 hours per week (6 hours with the child and 2 hours with the parent) for 4 months.

Behavioral Measures:

- Administered pre- and post-treatment:
- Autism Diagnostic Observation Schedule (ADOS)
 - Social Responsiveness Scale - Parent Report (SRS)
 - Vineland Adaptive Behavior Scales, 2nd edition (VABS-II)

Experimental Paradigm:

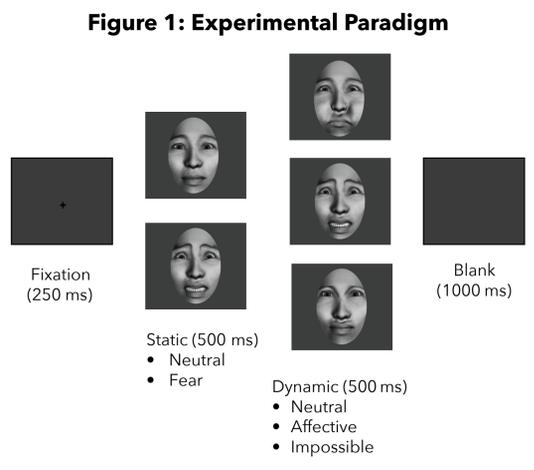
- 73 distinct, dynamic, computer-generated faces that displayed neutral and fearful expressions.

EEG Data Acquisition and Collection:

- Recorded at 500 Hz pre- and post-treatment.
- 128-channel Hydrocel Geodesic Sensor net.

Statistical Analysis:

- Peak amplitude and latency were analyzed using repeated measures ANOVA.
- 2 within-subjects variables:
 - Treatment (Pre/Post)
 - Emotion (Fear/Neutral)



Methods

ERP Analysis:

- P100 and N170 are ERP components associated with early sensory response and face structural encoding, respectively (Rossion et al., 2011).
- P100 and N170 peak amplitude and latency were compared across fear and neutral stimuli, pre- and post-treatment.
- ERPs were segmented to static face stimuli and extracted over the right occipitotemporal region.

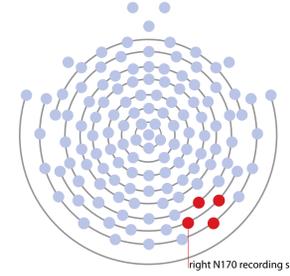


Figure 2: Right N170 and P100 recording sites. Data were averaged across 4 electrodes.

Results

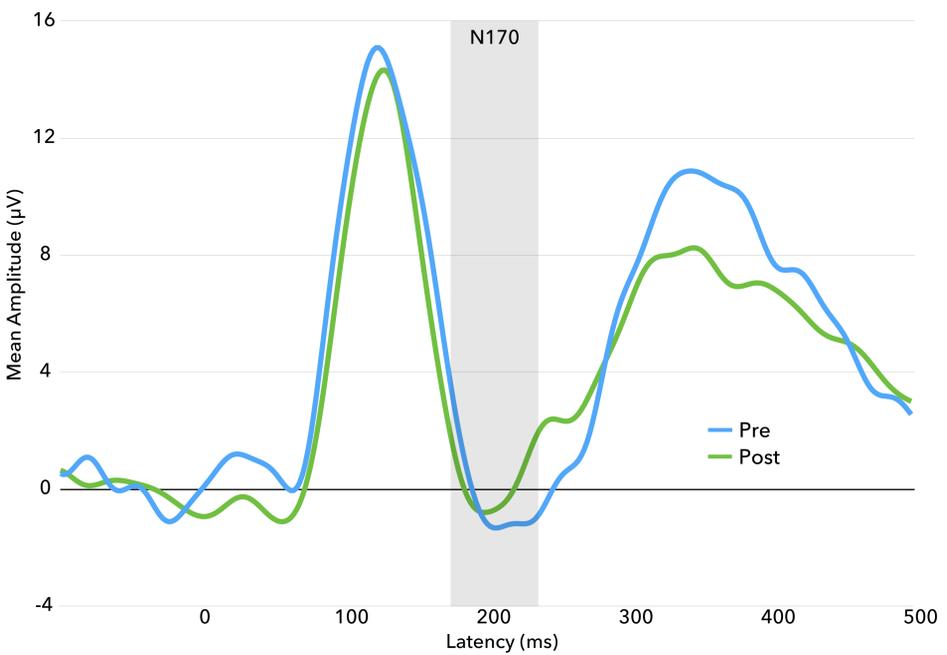


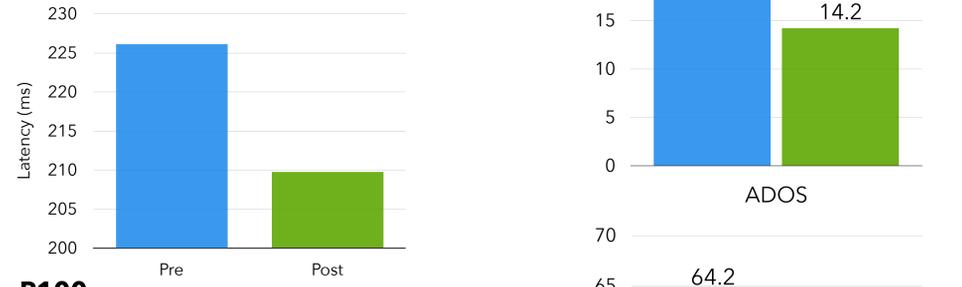
Figure 3: Grand average waveform, depicting the N170 across all participants (N=5) for fear faces, pre- and post-treatment. Waveforms were averaged across 4 electrodes in the right hemisphere.

N170

- A main effect of treatment [$F(1,4) = 6.892, p=.058$] indicated a change in face processing following PRT treatment, as indexed by N170 latency. Post-hoc paired samples t-tests were conducted to explore results of the omnibus test:
 - Following treatment, participants demonstrated significantly reduced N170 latency in response to fearful face stimuli ($p=.020$).
 - There was no significant change in N170 latency in response to neutral face stimuli ($p>.05$).
- There was no significant change in N170 amplitude [$F(1,4) = 2.15, p=.22$].

Results

Figure 4: PRT resulted in reduced N170 latency in response to fearful faces.



P100

- There was no significant change in either P100 latency or amplitude as a function of PRT treatment (All F 's $< 1.26, p$ s $> .32$).

Behavioral

Table 1: Behavioral Measures

	Mean (SD)	Pre	Post
ADOS		18.4 (6.8)	14.2 (4.7)
SRS		64.2 (11.8)	54 (23.3)
Vineland Socialization		89.6 (6.7)	95 (15.4)

Figure 5: PRT resulted in improved social behavior as measured by the ADOS, SRS, and Vineland Socialization Domain.

Conclusions

PRT was associated with improved efficiency of neural indicators of social behavior. Notably, effects of treatment were reflected in markers associated with social perception (N170), rather than low-level sensory processes (P100), suggesting focal treatment effects on social-communicative behavior.

These findings provide the first evidence of alterations in processing efficiency resulting from PRT. Because N170 delays are characteristic of ASD, these results suggest improvement in mechanisms related to core social impairments.

Study results emphasize the import of brain-based outcome measures acquired with temporally-sensitive imaging methods.

References

Rossion, B., & Caharel, S. (2011). ERP evidence for the speed of face categorization in the human brain: Disentangling the contribution of low-level visual cues from face perception. *Vision Research*, 51(12), 1297-1311. doi:10.1016/j.visres.2011.04.003

Voos, A.C., Pelphrey, K.A., Tirrell, J., Bolling, D.Z., Vander Wyk, B. C., Kaiser, M.D., . . . Ventola, P. (2012). Neural Mechanisms of Improvements in Social Motivation After Pivotal Response Treatment: Two Case Studies. *Journal of Autism and Developmental Disorders*, 43(1), 1-10. doi: 10.1007/s10803-012-1683-9

Acknowledgments

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