Neural correlates of social exclusion in autism spectrum disorder

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Background: Social impairment is a defining characteristic of autism spectrum disorder (ASD), but recent behavioral research suggests individuals with ASD report typical levels of distress in response to social exclusion. During a virtual ball-tossing game with ostensibly real partners (Cyberball), when children with ASD were excluded from play, self-report of self-esteem, belonging, control, and meaningful existence was impacted similarly to typical controls. Neuroimaging research in typical individuals suggests this social "pain" activates a circuit encompassing anterior cingulate cortex (ACC) and ventral prefrontal cortex (VPFC), regions also theorized to contribute to social dysfunction in ASD. The relationship between neural response and behavioral experience of social exclusion in ASD remains unexplored.

Objectives: To compare electrophysiological and behavioral indices of social exclusion and corresponding distress in children with ASD and typically-developing peers.
Methods: Event-related potentials were recorded using 128-channel Geodesic Sensor Nets while children with ASD and typically developing controls (matched for age, sex, handedness, and cognitive ability) played Cyberball. Participants proceeded through an inclusion phase, in which virtual partners played fairly, and a subsequent exclusion phase, during which virtual partners ceased throwing the ball to the player. ERP responses were compared across three stimulus conditions: inclusion (receiving the ball), omission (another's turn to receive the ball during fair play), and exclusion (virtual players throwing exclusively to one another). Each group's ERPs were contrasted with respect to a mid-latency slow wave (MSW) and a late slow wave (LSW) over medial frontal and posterior scalp regions. Minimum Norm source localization using GeoSource software (EGI) estimated activation in ACC and VPFC. A self-report questionnaire measured ostracism-related distress.

Results: Consistent with previous behavioral research, children with ASD displayed typical levels of ostracism-related distress across domains of social need. However, ERPs revealed distinct temporal processing across groups. Typically developing children differentiated between conditions at both the MSW and the LSW, but children with autism did not exhibit neural differentiation of conditions until the LSW. Source data indicated a pattern of distributed hyper-activation in the ACC-VPFC circuit in children with ASD and diminished sensitivity to inclusion versus exclusion.

Conclusions: This is the first exploration of the temporal dynamics of brain activity associated with social exclusion in ASD, revealing dissociation between behavior and neural response. Children with ASD displayed typical levels of distress in response to social exclusion; however, electrophysiological brain activity revealed distinct temporal dynamics. Compared to typical peers, brain responses did not distinguish between social inclusion and exclusion until late stages of processing. These findings indicate that, in children with ASD, normative overt behavior may be subserved by atypical processing mechanisms. These results are hypothesized to reflect differentially preserved function within ACC regions supporting rule violation and experience of social pain.

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