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Living (and Dying) in the Moment: An Examination of Ongoing Neural Activity During Social Exclusion



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Abstract

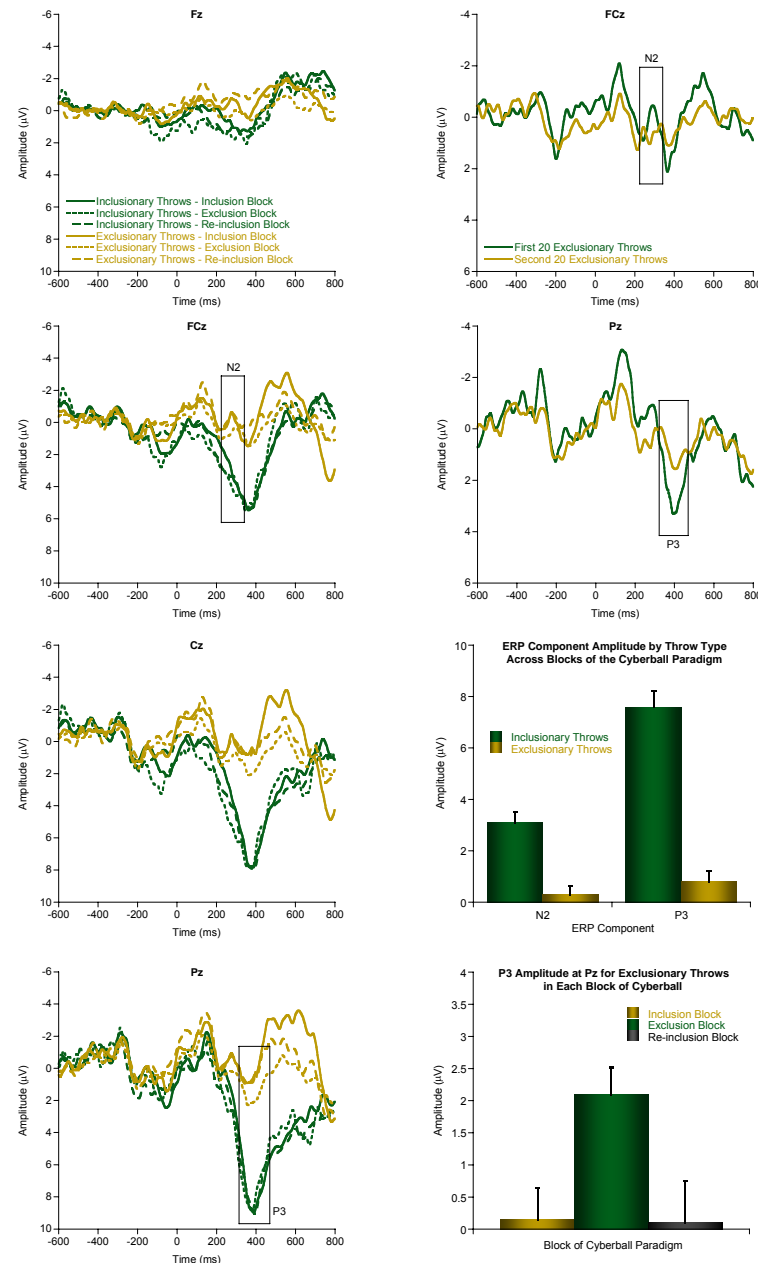
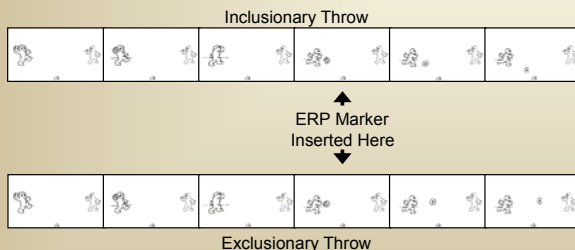
Social exclusion is known to cause alterations in neural alarm activity as well as perceptions of social distress. However, previous research is largely limited to examining neural activation aggregated within blocks of social interactions, which does not allow for the examination of adjustments in neural alarm processes, or additional task-relevant attentional processes, during social interactions. To address these limitations, we examined neural alarm activity and other attention-related neural processes on a trial-by-trial basis during different social interactions that were characterized as largely inclusive or exclusive. Our results show neural alarm activation, evidenced by the N2 component, in response to all exclusionary events, even during inclusionary interactions. Further, we show that the explicit allocation of attention toward an exclusionary experience, indexed by the P3b, is associated with self-reported social distress while the mere activation of the neural alarm is not; implying that neural alarm activation is not specific to prolonged exposure to social exclusion and related social pain. Finally, during the exclusionary interaction, both the N2 and P3 showed larger amplitudes in the earlier stages of exclusion compared to the later stages, suggesting heightened early sensitivity for both components, and P3 amplitude was larger to exclusionary events compared to the two inclusionary interactions, indicating a contextual influence of exclusion.

Procedure

- Participants completed three blocks of the Cyberball paradigm, throwing the ball with the other players. In each interaction, the human participant was represented by the hand at the bottom of the screen (see below).
 - In the first block (inclusion), participants had an equal probability of receiving the ball as the other players throughout the interaction.
 - In the second block (exclusion), participant had an equal chance of receiving the ball for the first 20 throws, but were then ignored for the remainder of the interaction.
 - In the third block (re-inclusion), participants had an equal probability of receiving the ball throughout the interaction (identical to the first block).

Neural Assessment

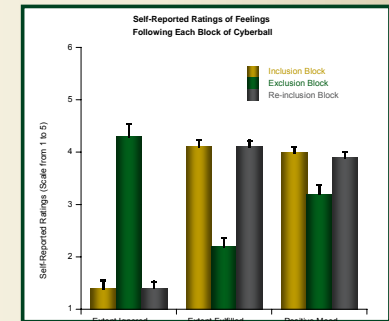
- EEG activity was measured from 64 midline and lateral sites.
- N2 was quantified as the average negative deflecting amplitude between 200-320 ms post-stimulus at the FCz electrode site.
- P3 was quantified as the average positive deflecting amplitude between 320-450 ms post-stimulus at the Pz electrode site.
- The stimulus was defined as the first informational frame in the ball toss that indicated where the ball was being thrown. Throws to the participant were defined as inclusionary throws and throws to the computerized players were defined as exclusionary throws.
- Three participants were excluded from the analyses due to excessive noise and artifacts obtained during EEG collection leaving data from 22 participants in the final analyses.



Results

Social Exclusion Manipulation

- As expected, participants reported feeling less positive mood, having less fulfillment of their social needs, and feeling more ignored in the exclusionary interaction compared to the inclusionary interactions ($F(2, 20) \geq 6.1$, p 's $\leq .008$, partial $\eta^2 \geq .38$).



Neural Measures

- Both N2 and P3 amplitude showed amplitude differences for exclusionary throws compared to inclusionary throws regardless of the overall context of the social interaction, with:
 - larger (more negative) N2 amplitude and smaller (less positive) P3 amplitude for exclusionary throws compared to inclusion throws.
- P3 amplitude to exclusionary throws was larger in the exclusion block of the Cyberball paradigm compared to the two inclusionary blocks (inclusion, re-inclusion).
- Both N2 and P3 were larger for the first 20 exclusionary throws compared to the second 20 exclusionary throws once the complete exclusion began during the exclusion block of the Cyberball paradigm.
- Neither N2 nor P3 amplitude showed a main effect for block. However, because more exclusionary events would be aggregated together in the exclusion block, the aggregated total of N2 activation would be greater in the exclusion block, corroborating Eisenberger et al. (2003, 2007).

Conclusion

This study examined the relation between social exclusion and event-related brain potentials. Results indicated differences in neural activation to specific events within social interactions, regardless of the larger contexts of the interactions. Specifically, we found neural alarm activation, indexed by the N2, to exclusionary throws during inclusionary interactions. This event-related activation did not differ in amplitude to the activation evidenced during social exclusion and was present in the absence of self-reported social distress. Further, differences in the allocation of attention, indexed by the P3, were identified within the larger context of the social interactions, with greater attention paid to exclusionary events when they occurred during exclusion compared to inclusion. Additionally, the modulation of the P3 from inclusion to exclusion was associated with the modulation of self-reported social distress from inclusion to exclusion. Finally, patterns of neural activation changed over the course of the ongoing exclusion experienced during the exclusion block, with heightened neural activity earlier, compared to later, in the exclusion. These findings suggest that discrete events occurring during a social interaction may provide additional insights into social exclusion compared to more global inclusionary or exclusionary classifications of social interactions.