

THE NEURAL SIGNATURES OF LEADERSHIP: AN INVESTIGATION ON TWO-BRAIN DIRECTED SYNCHRONIZATION DURING EYE CONTACT

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Background: Studies using *hyperscanning* (monitoring two people's brains simultaneously) have shown that when people interact, their brains synchronize; the more in sync, the more successful the interaction. Higher inter-brain synchronization was also observed during eye-contact, suggesting that subtle synchronization processes occur even during non-verbal communication. However, there are many unknowns regarding how and why people's brains synchronize and whether inter-brain synchronization during eye-contact interacts with social relationships.

Aims: We compared hyperbrain synchronization and network characteristics during eye-contact between pairs of friends and strangers and analysed directed connectivity between leaders and followers.

Method: We measured brain-to-brain synchronization (EEG) as pairs of participants engaged in a two-person time reproduction task. Participants were asked to reproduce the duration of an auditory tone that they heard through earphones by making eye-contact for the duration of the tone (monitored using eye-tracking). They were told to break eye-contact once they thought the tone duration had passed. In the control condition, participants completed the same task, but without looking into each other's eyes. We evaluated whether a leader emerged by analysing whether one member of the pair member consistently gazed back first. We measured brain-to-brain synchronization using undirected (ciPLV) and directed (PSI) phase synchronization measures in frequency bands theta, alpha, beta and gamma. We compared the conditions (eye-contact vs. control) using non-parametric cluster permutation. We measured the network characteristics during eye-contact using graph theory.

Results: We observed a stronger gamma band inter-brain synchronization during periods in which the participants made eye-contact. Friends showed significantly stronger inter-brain synchronization and more efficient hyperbrain networks than strangers. The hyperbrain networks displayed rich-club characteristics, with a few nodes showing disproportionately higher number of connections. Furthermore, we found an

increase in theta synchronization from leader to follower. Leaders presented higher access to the entire network compared to followers (i.e. local to global efficiency).

Conclusion: Eye-contact modulates undirected and directed synchronization between brains more than the synchronization within brains, demonstrating that eye-contact is a communicative and social signal.

Keywords: Hyperscanning, EEG, Inter-brain synchronization, Eye-contact, Eye-tracking, Hyperbrain

Publications:

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