Multivariate decoding of mutually interacting brains reveals complementary neural mechanisms in leaders and followers

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Neural mechanisms underlying real-time social interaction remain largely unknown, as it has been difficult to implement paradigms in a methodologically feasible and conceptually relevant way. Researchers have increasingly begun to implement two-person paradigms by simultaneously recording brain activity from both people. Most of these studies have investigated symmetrical, and synchronized, neural mechanisms of two-people in a variety of interactive tasks. However, given that people often take on complementary, rather than symmetrical, roles during interaction, there is a real need to develop methods for quantifying complementary two-brain mechanisms. To investigate this, we implemented a multivariate decoding method to reveal complementary patterns of individual, rather than coupled, brain mechanisms in a dyad. We employed a synchronized finger-tapping task while measuring dual-EEG from pairs of participants who either tapped together in a bidirectional interactive task, or followed a computer metronome. Interactive versus non-interactive trials were classified using a multivariate analysis on both brains. This analysis revealed asymmetric patterns of frontal alpha-suppression in each pair, during task anticipation and execution, such that only one member showed the frontal component. Behavioural data analysis showed that this distinction coincided with the leader-follower relationship in 8/9 pairs, with the leaders characterized with a stronger frontal alpha-suppression during the interactive condition. This suggests that leaders invest more resources in planning and control, and shows that leader-follower relationships can be predicted from EEG recordings. Moreover, it provides a novel method for quantifying complementary neural mechanism during real-time social interaction.