Interbrain Synchrony and the Prisoner's Dilemma Game: An Approach to Social Anxiety

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Introduction: Interbrain synchrony (IBS) has been increasingly studied in accordance with the conceptual development of two-person neuroscience, which views neural activities from interacting individuals as a single functional unit [[1]. IBS is usually found to be stronger in collaborative than non-collaborative interactions. However, this approach has not been employed in social anxiety (SA) research. The current study investigated the relationship between IBS and SA using a prisoner's dilemma game [2] with a focus on the frontal lobe.

Materials, Methods & Results: Seven healthy participant pairs (4 males and 10 females; mean age 25.36) who did not know each other prior to the experiment participated 20 rounds of a prisoner's dilemma game with EEG being recorded at 64 locations on each head. The game was defined as *splitting* or *stealing* lottery tickets from the respective other player. After the game, each round was labelled *co-operative* (if both participants split) or *defective* (if one or both participants stole), with the intervals between rounds as a baseline. SA trait scores were taken before and after the game using the Liebowitz Social Anxiety Scale (LSAS) and state scores were taken after each round. EEG data was FIR filtered and Hilbert-transformed for each frequency band (θ: 3-7 Hz, α: 8-12 Hz, β: 13-29 Hz, γ: 30-40 Hz). Phase-locking value (PLV) [[3] was computed for each interbrain channel combination (from 26 frontal channels per head) and statistically assessed with Kruskal-Wallis tests with Bonferroni correction. Higher IBS was found for both co-operative and defective conditions vs. the baseline (> 99% combinations, $p < 4.88e^{-06}$). The co-operative rounds also showed higher IBS than the defective rounds (> 80% combinations, $p < .001$). However, no state or trait SA scores could predict the PLVs (Spearman's correlations: ps > .08).
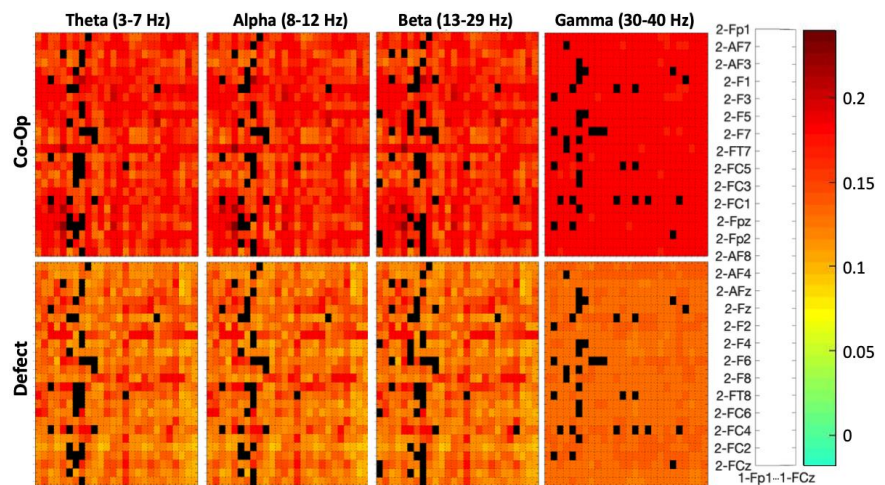
Figure 1. Mean PLV values in the co-operative and defective conditions (statistically assessed against the baseline) across frontal channel combinations. Higher PLVs are observed in the co-operative than the defective conditions. (Black pixels = non-significant PLVs from the baseline.)

Discussion: Co-operation has been associated with the alleviation of SA [4]. In this experiment, significantly greater IBS was present interpersonally over the frontal channels when the participants co-operated than when they defected. Significant interpersonal interaction was also revealed in higher PLVs in both conditions against the baseline. However, no relationship was found between the SA scores (both state and trait) and the IBS. This suggests the lack of power in predicting interbrain connectome with SA scores in the current dataset and demands further research.

Significance: In sight of the very limited research incorporating both SA and IBS, the current study made an early attempt to investigate (interpersonal) SA within the two-person neuroscience framework. Future research will increase statistical power and incorporate channels from other scalp regions.

References

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