

Cooperative and Competitive Related Inter-Brain Synchrony During Gaming

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INTRODUCTION

- ◆ Social interactions are commonly seen in a human's daily life. Furthermore, cooperative and competitive interactions are indispensable parts of social interactions.
- ◆ According to the results of the previous study, a higher inter-brain synchrony in cooperative interactions as compared to competitive interactions [1].
- ◆ This study used hyperscanning to simultaneously record two peoples' brain activity under the circumstances of social interactions.
- ◆ In this study, phase locking value (PLV) [3] is used to estimate the synchronization of signals according to the signal phases. PLV calculates phase differences between two signals in a period of time.
- ◆ This study would like to use the means of computerized card game-slapjack (heart attack) to investigate the inter-brain synchrony between players during gaming.

METHODS

- ◆ 9 pairs of participants aged 22.4 ± 2.0 (5 males and 13 females).
- ◆ Participants have to join three modes in this computerized card game in three modes, single-player, cooperative and competitive modes respectively.
- ◆ In the single-player mode (Fig. 1a), one of the players played the role of a "player", the other played the role of a "bystander". They took turns being the role of "player" or "bystander" after one session ended. In this mode, the player had to press the button correctly to the target (when the visual and auditory stimuli were the same) to get the points. In the cooperative mode (Fig. 1b), two subjects played the game together. To get the points, two players should both respond to the target in time and correctly. In the competitive mode (Fig. 1b), two subjects played together. Two subjects competed with each other, the one that responded to the target faster would get points.
- ◆ Independent component analysis (ICA) was applied to decompose the EEG signals into components and remove artifacts.

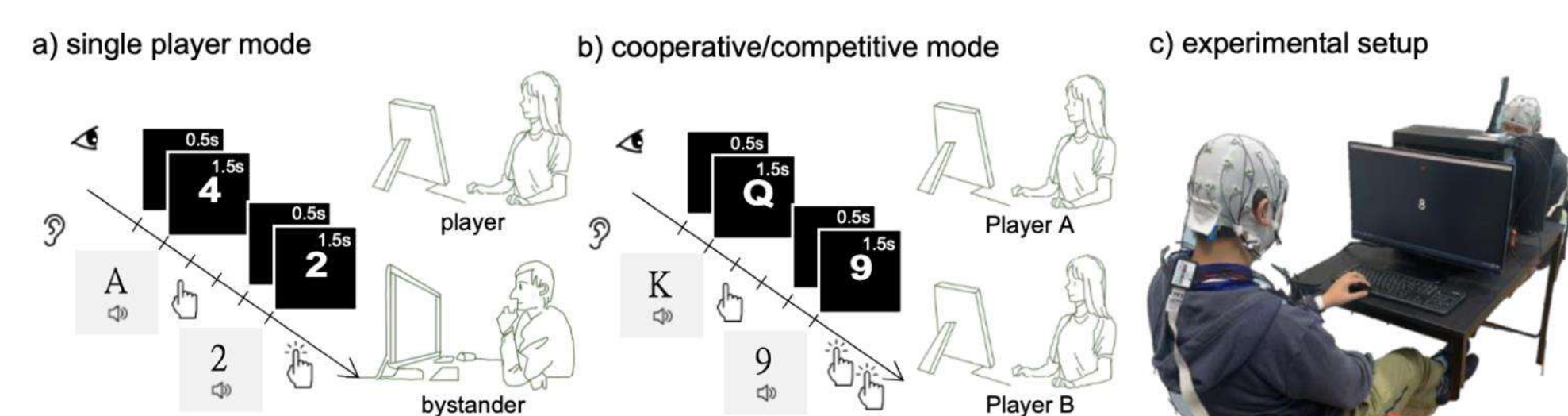


Figure 1. Experimental environment

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ACKNOWLEDGEMENTS

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RESULTS

- ◆ Reaction times in single-player, cooperative and competitive modes were 476.6 ± 87.1 , 445.2 ± 47.5 ms, and 376.7 ± 33.4 ms, respectively. The asterisk indicates significance at $p < 0.05$ (*) and $p < 0.001$ (***) (Fig. 2A).
- ◆ The event-related potential (ERP) of three modes in Fz, Cz, Pz and Oz channels. (Fig. 2B)
- ◆ In five bands, the PLV of the single-player mode was the lowest among three modes. There is no significant difference between cooperative and competitive mode. (Fig. 2C)
- ◆ The t -values of significant event-related PLV changes. The results showed that the alpha PLV of frontal and occipital regions, a stronger coupling in cooperative mode than in competitive mode were observed. (Fig. 2D,E)

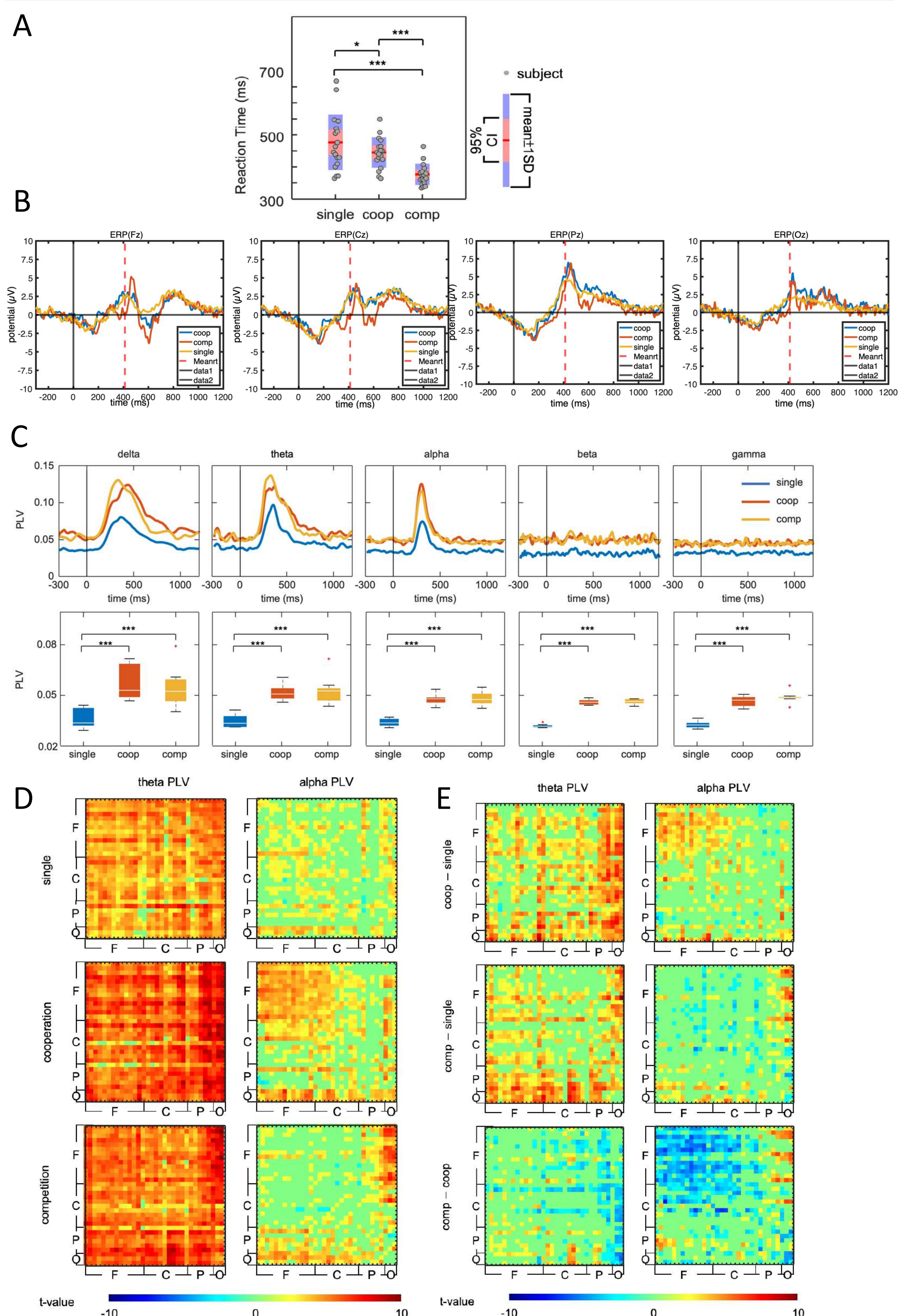


Figure 2. Behavioral performance and EEG activity while gaming.

CONCLUSION

This study used the computerized card game-slapjack in single-player, cooperative and competitive modes to investigate the differences of subjects' inter-brain synchrony in different modes.

The results showed that the reaction times in response to target are faster in cooperative and competitive modes. In addition, the inter-brain synchrony remained stronger in cooperative and competitive modes.