# Hyperscanning: a valid method to study neural inter-brain underpinnings of social interaction

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## Summary

Social interactions are a crucial part of human life. Understanding the neural underpinnings of social interactions is a challenging task that the hyperscanning method has been trying to tackle over the last two decades. Here, we review the existing literature and evaluate the current state of the hyperscanning method. We review the type of methods (fMRI, M/EEG, and fNIRS) that are used to measure brain activity from more than one participant simultaneously and weigh their pros and cons for hyperscanning. Further, we discuss different types of analyses that are used to estimate brain networks and synchronization. Lastly, we present results of hyperscanning studies in the context of different cognitive functions and their relations to social interactions. All in all, we aim to comprehensively present methods, analyses, and results from the last 20 years of hyperscanning research.

## Type of methods
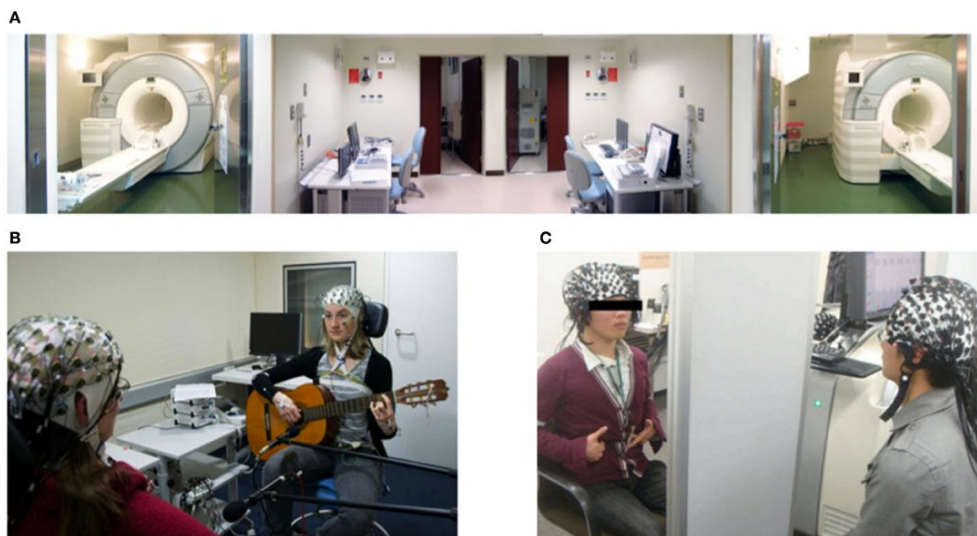


Neuroimaging methods used in Hyperscanning. **(A)** From Koike et al. (2019). View of the dual fMRI facility used to study mutual gaze. **(B)** From Acquadro et al. (2016). EEG measurement of two guitar players. **(C)** From Osaka et al. (2015). fNIRS set up used to study cooperative singing. All parts reproduced/adapted under CC licenses.

## Type of analysis

- Coupling/ Connectivity measures
- Correlation and dependence analysis
- Graph Theory measures
- Information flow
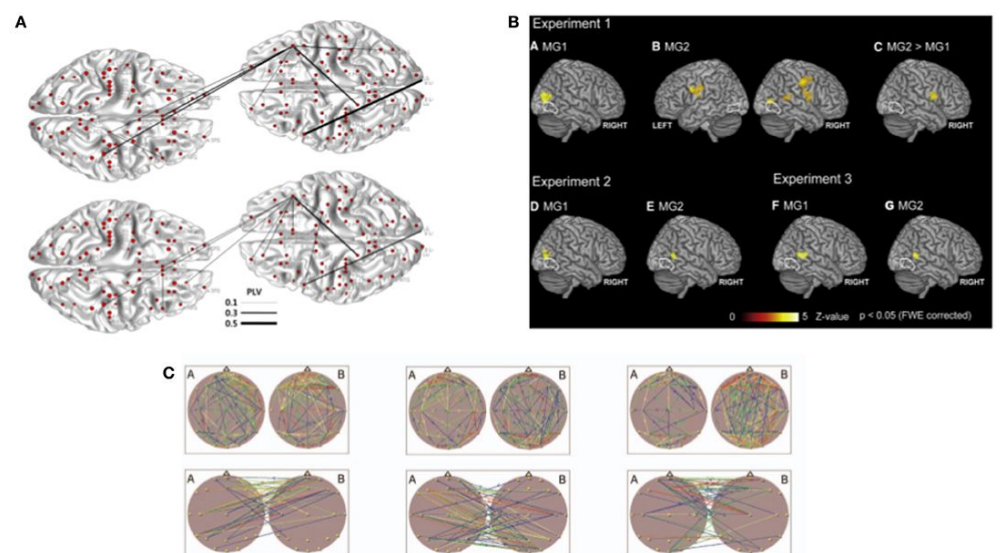


Analysis methods used in hyperscanning to investigate between brain relationships. **(A)** From Yun et al. (2012). Phase synchrony was used as a coupling measure to investigate between-brain connections in implicit coordination task. Topography of the phase synchrony (PLV) between different regions of interest of two participants are presented for theta (4–7.5 Hz) and beta (12–30 Hz) oscillations. **(B)** From Koike et al. (2016). Between-brain synchronization estimated with correlation. **(C)** From Müller et al. (2013). Brain topography maps illustrating significant connection within and between the brains. Example of graph theory measures applied to analyze synchronization during musical improvisation on the guitar. All parts reproduced/adapted under CC licenses.

## Cognitive Functions studied with Hyperscanning

- Speech and Communication
- Games and Decision Making
- Cooperation and Competition
- Action Representation and Joint Action
- Emotion and Affect
- Coordination and Synchronization
- Over Two Heads
- Intervention Methods
- Music

## Acknowledgments