# A systematic review on interbrain synchronization in psychopathological and neurodevelopment disorders

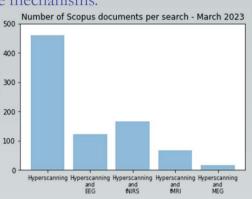
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### INTRODUCTION

Psychopathological conditions and neurodevelopmental disabilities are characterized by impairments in social cognition and interactions, yet the mechanisms underlying these deficits are not well understood.

Hyperscanning allows us to simultaneously measure brain activity in more than one participant and compute interbrain synchrony (IBS) supporting the investigation of these mechanisms.

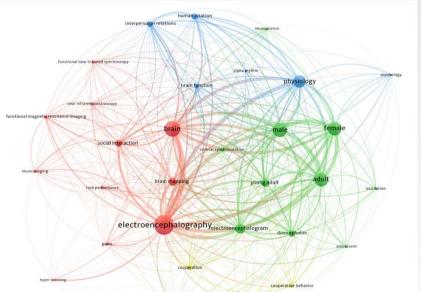
Adopting the suggested literature guidelines (PRISMA and Prospero), this study aimed to conduct a systematic review of EEG hyperscanning research in psychopathological and neurodevelopmental disorders.



**Figure 1.** Number of Scopus documents for different prompts related to the field of neuroscience and hyperscanning.

#### **METHODS**

We searched PubMed, Scopus, and Google Scholar using the prompt: (("hyperscanning" OR "entrainment" OR ("interbrain AND synchrony") OR ("two-person" AND "neuroscience")) AND ("electroencephalography" OR "EEG"). Then, articles were included if they: (1) were original experimental studies (2) were in English (3) employed the hyperscanning technique; (4) included a group of participants with at least one DSM-5 or ICD-10-based diagnosis of a psychopathological and/or neurodevelopmental disorder (5) employed EEG (6) involved a population of adolescents and/or adults.



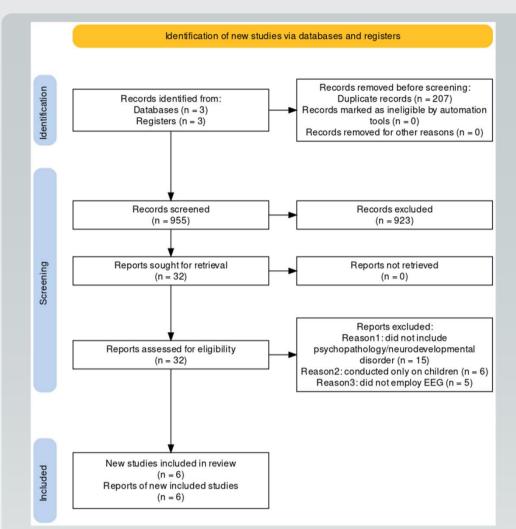


Figure 3. The review flow diagram (PRISMA 2020)

Frontal and prefrontal IBS seems to be recurrently observed in higherfrequency waves (e.g., **beta**, **alpha**), with these power patterns not being uniquely associated with specific disorders.

The detection of IBS seems plausible as these areas support our ability to socially connect with others and are part of the **MENTalizing** system.

Four studies (Kang, 2021; Kang et al., 2022; Rodriguez et al., 2018; Samadani et al., 2021) attempted to support IBS changes as a marker of clinical efficacy with initial, albeit fragile, evidence.

Generally, in the literature, a lack of control for **pseudo-interbrain synchrony** (e.g., motor-induced synchrony, task-induced synchrony, etc.) can be found, underlining the need for higher methodological validity.

#### REFERENCES

• Deng, X et al. (2022). Adolescent social anxiety undermines adolescent-parent interbrain synchrony during emotional processing: a hyperscanning study. International Journal of Clinical

Figure 2. The network visualization of the prompt "hyperscanning and electroencephalography" on SCOPUS (25/03/2023, based on 122 documents and 836 keywords)

We found **1162** potential abstracts that led to **6** inclusions. The overall quality of the included studies was high (evaluated with the NOS score).

## **RESULTS AND CONCLUSIONS**

The included studies indicate that psychopathological conditions are possibly associated with a disruption of IBS, identifying specific loci (frontal, prefrontal, temporoparietal areas) in connection with cerebral palsy, social anxiety, persistent depression, and autism spectrum disorder. and Health Psychology, 22(3).

- Kang K. (2021) Brain Synchronization with Electroencephalography (EEG) for Children/Youth with Disabilities, Their Parents, And Neurologic Music Therapists. ProQuest Dissertation Publishing (2021). University of Toronto (Canada)
- Kang, K. et al. (2022) Does music induce interbrain synchronization between a non-speaking youth with cerebral palsy (CP), a parent, and a neurologic music therapist? A brief report, Developmental Neurorehabilitation, https://doi.org/10.1080/17518423.2022.2051628.
- Key, A. et al. (2022) Greater Social Competence Is Associated With Higher Interpersonal Neural Synchrony in Adolescents With Autism. Front. Human Neuroscience 15:790085. https://doi.org/10.3389/fnhum.2021.790085.
- Rodríguez, E. et al. (2018): Neurodynamics inside therapeutic interaction: a case study with simultaneous EEG. https://doi.org/10.1080/02109395.2017.1407902
- Samadani, A. et al. (2021) Neurophysiological Synchrony Between Children With Severe Physical Disabilities and Their Parents During Music Therapy. Frontiers in Neuroscience, 15:531915. https://doi.org/10.3389/fnins.2021.531915.

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