# Functional integration and segregation of brain-heart networks encode bodily self-mapping

*Keywords: network neuroscience, network physiology, brain-heart interaction, cognitive neuroscience, brain-computer interface*

## Extended Abstract

How do cardiac dynamics interact with brain networks to support fundamental embodied processes, such as distinguishing the self from others or imagining hand movements? The interplay between the brain and cardiac signals is fundamental for maintaining internal balance and orchestrating neural dynamics, shaping both perception and self-awareness. A central function of this interplay is distinguishing the external world, others, and the self—an essential step in constructing bodily self-awareness [1]. To better understand the physiological mechanisms of this bodily self-mapping, we propose a network physiology perspective: shifting focus from localized regions to large-scale neural networks that operate in parallel with and adapt to cardiac activity [2]. By investigating both perceptual and motor domains, this work aims to uncover interoceptive mechanisms through which brain-heart interactions shape perception and imagined action.

In the first part, we examined heartbeat-related modulations during self- and social-touch conditions using functional connectivity analyses coupled with measures of cardiac sympathetic and parasympathetic activity [3]. Results revealed increased coupling between frontoparietal brain networks and parasympathetic activity in the alpha and gamma bands during social touch, while sympathetic-brain coupling decreased as touch interactions progressed (Figure 1) [4].

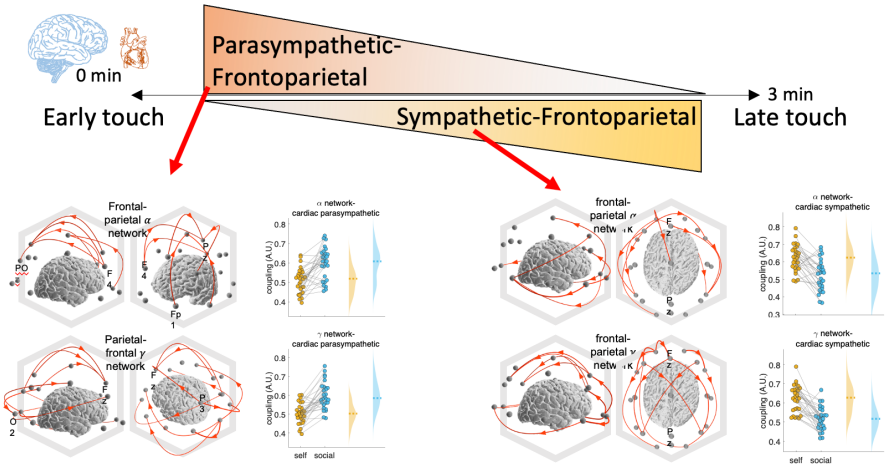


Figure 1. **Brain-heart modulation in self vs social touch**

In the second part, we investigated motor imagery learning over repeated sessions using a right-hand grasping imagery task [5]. We identified a decrease in sympathetic coupling within motor cortical areas during motor imagery. Furthermore, uncoupling between the cerebellum and supplementary motor area in relation to parasympathetic activity significantly correlated with motor imagery learning performance (Figure 2).

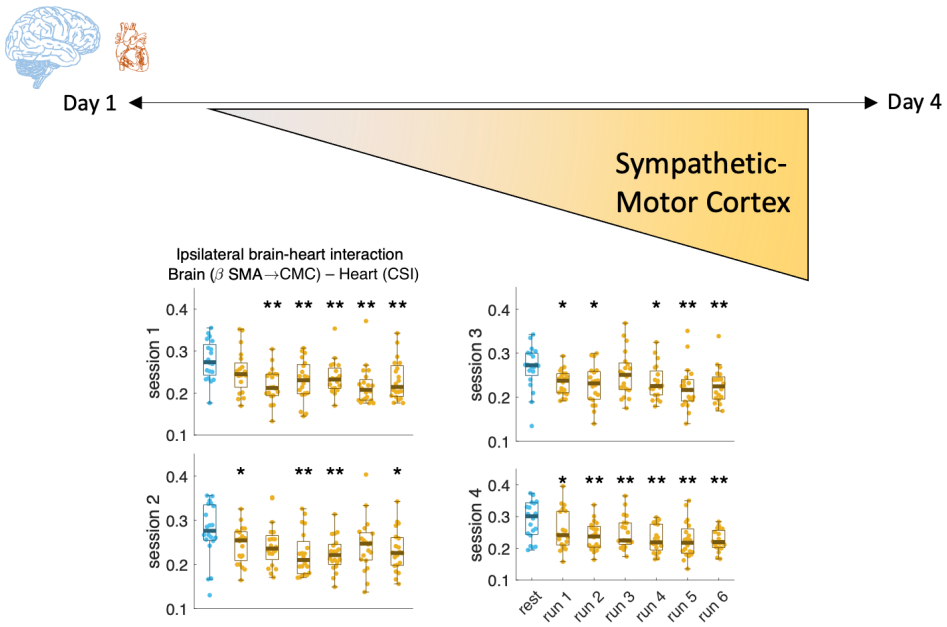


Figure 2. **Brain-heart modulation in right-hand motor imagery**

Across both perceptual and motor domains, our results demonstrate that brain-heart coupling is differentially modulated by context (self vs. social touch, motor imagery task engagement/learning), and that these interactions reflect core mechanisms operating within the brain-heart axis. The findings underscore the role of cardiac autonomic activity co-varying with large-scale brain dynamics, offering new insights into the physiological basis of bodily self-mapping.

# References

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