

In search of interoceptive profiles: do the heart, lungs, and stomach influence the motor cortex the same way?

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Introduction

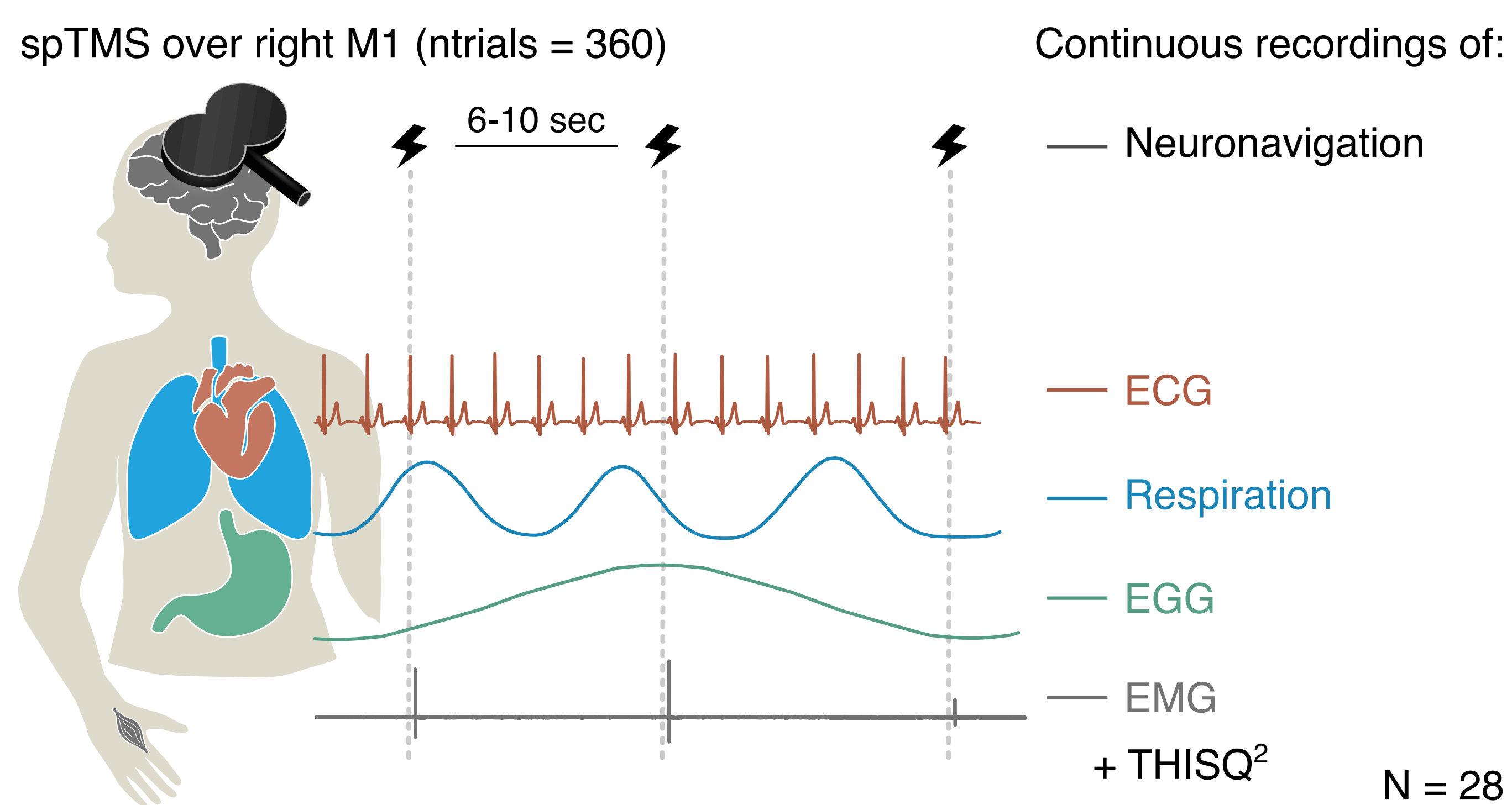
The rhythms of the heart, lungs, and stomach each interact with cognition, exteroception, and action¹. These rhythms each have their respective frequencies (~1Hz, ~0.2Hz, and ~0.05Hz), dedicated afferent pathways, and physiological functions. Yet, many commonalities also exist, such as shared pathways, cortical areas coupled to multiple rhythms, and the general purpose of keeping the organism alive.

To which extent can interoception be defined holistically or should it take organ-specificity into account?

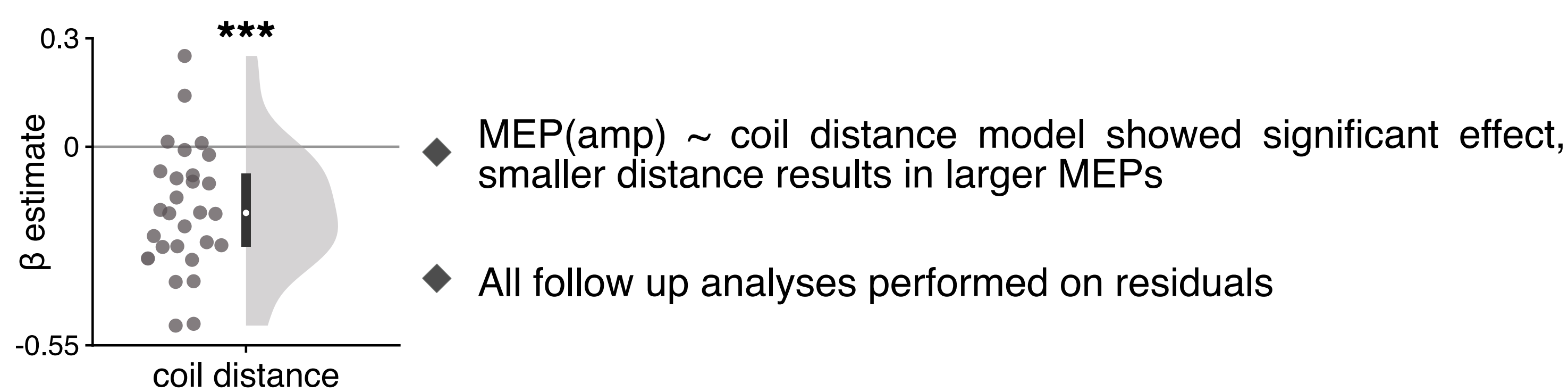
Here we measure coupling between all three visceral rhythms and motor cortex within the same participants to test the following questions:

- Do the phases of the cardiac, respiratory, and gastric rhythm influence motor cortex excitability?
- Does viscera-motor coupling occur in an organ-specific or organ general manner?
- Is viscera-motor coupling linked to the subjective experience of interoception?

Experimental design



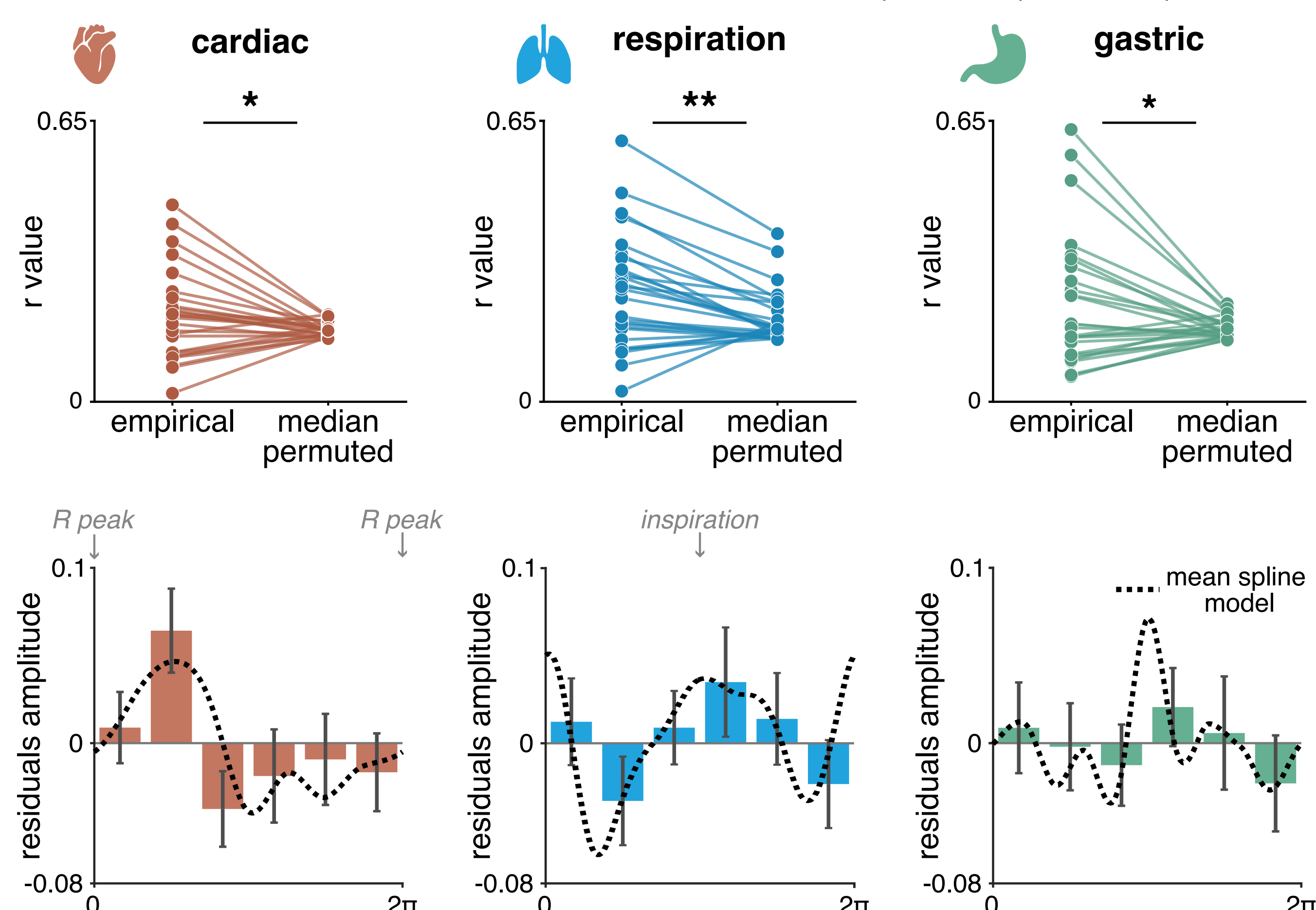
1. Coil distance explains Motor Evoked Potential amplitude



2. Motor cortex is coupled to the cardiac, respiratory, and gastric rhythm

Circular spline GLM³ against permuted chance level (1000 permutations)

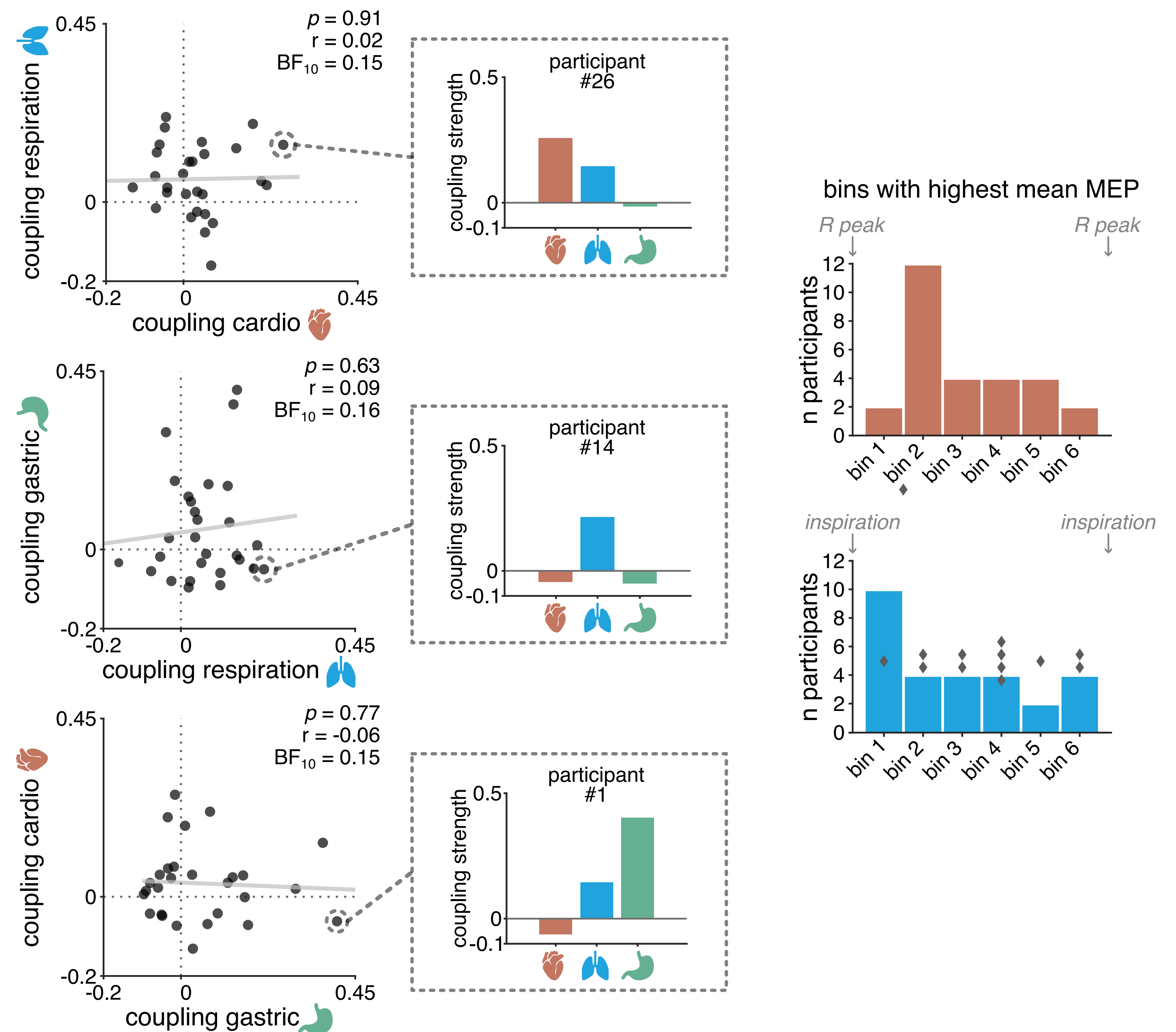
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



- All three visceral rhythms show significant phase-amplitude coupling with MEPs
- Results suggest amplification early in cardiac cycle, with less clearly defined patterns for respiratory and gastric motor coupling

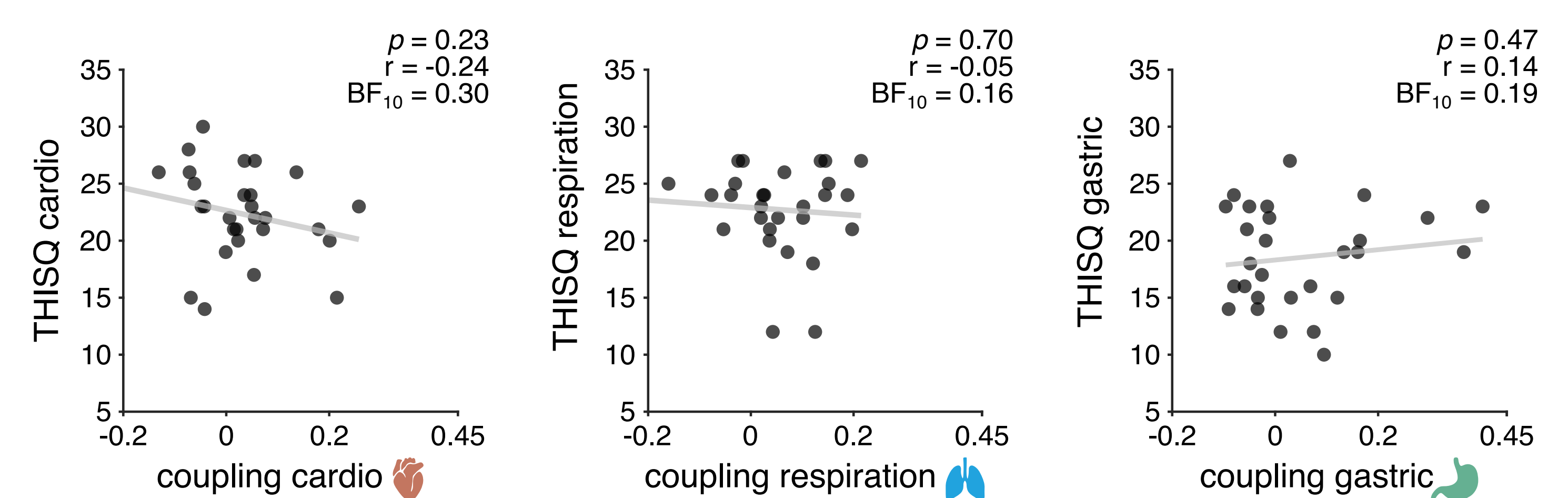
3. Viscera-motor coupling is organ-specific

Coupling strength = empirical - median permuted r value



- No correlations between coupling strengths of different organs, suggesting they are coupled to motor cortex in an independent manner (left)
- Participants show unique combinations of interoceptive profiles (middle)
- Participants with increased MEPs early in the cardiac phase do not show increased MEPs early in the respiratory phase (right)

4. No correlation with self-reported interoception



- No relationship between how strongly participants felt they were coupled to a specific organ, and the coupling with motor cortex for that organ

Conclusions

MEP amplitude is coupled to the phase of the cardiac, respiratory, and gastric rhythm. However:

- no relationship between viscera-motor coupling strength of the different organs
- no relationship between viscera-motor coupling strength and subjective experience of interoception

These results suggest there might be multiple interoceptions, and adds empirical evidence to ongoing discussions on refining the definition of interoception^{4,5}

References

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