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# Speaking during rhythmic motions of feet vs hands: how do speech and limb movements affect each other?

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## Background

- Body movements impact cognition [1].
- Hand movements and speech can be coordinated [2].
- Body movements and speech each require a specific adaptation of breathing [3,4,5,6].
- **SALAMMBO project : interactions speech, breathing, movement<sup>4</sup>**
- Our aim is to investigate speech-breathing and limb interactions : how do the three systems behave in spontaneous speech tasks ?
- First acoustic results [7] : less pauses and longer speech intervals when moving.

## Question

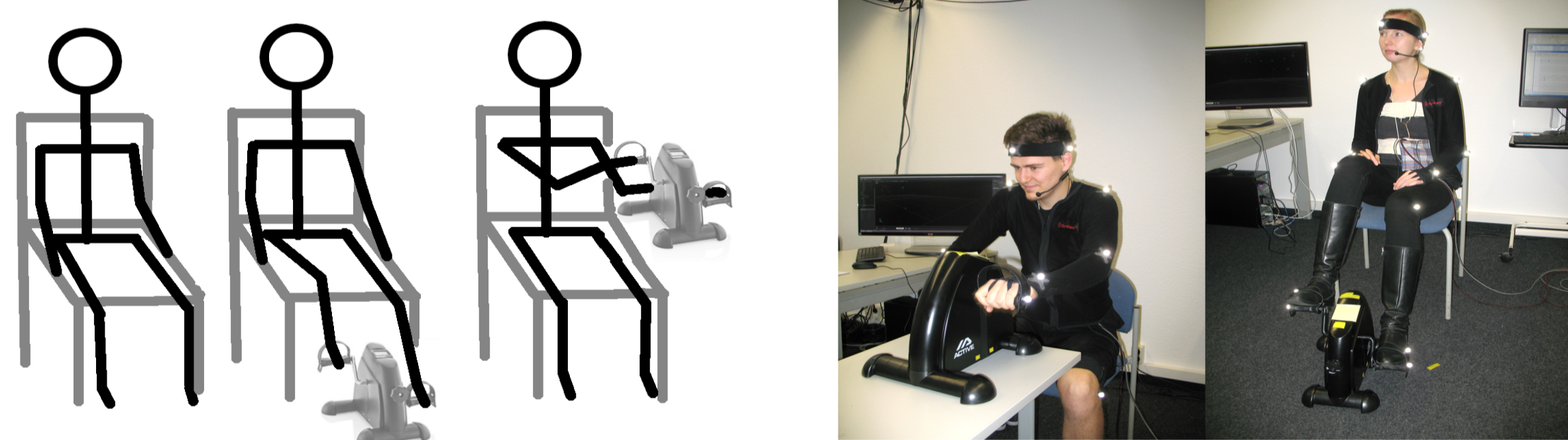
- How does breathing interact with legs vs. arms movements when it is shared with speech ?
- Is the breathing-arms coupling greater while speaking than the breathing-legs one [2] ?

## Procedure

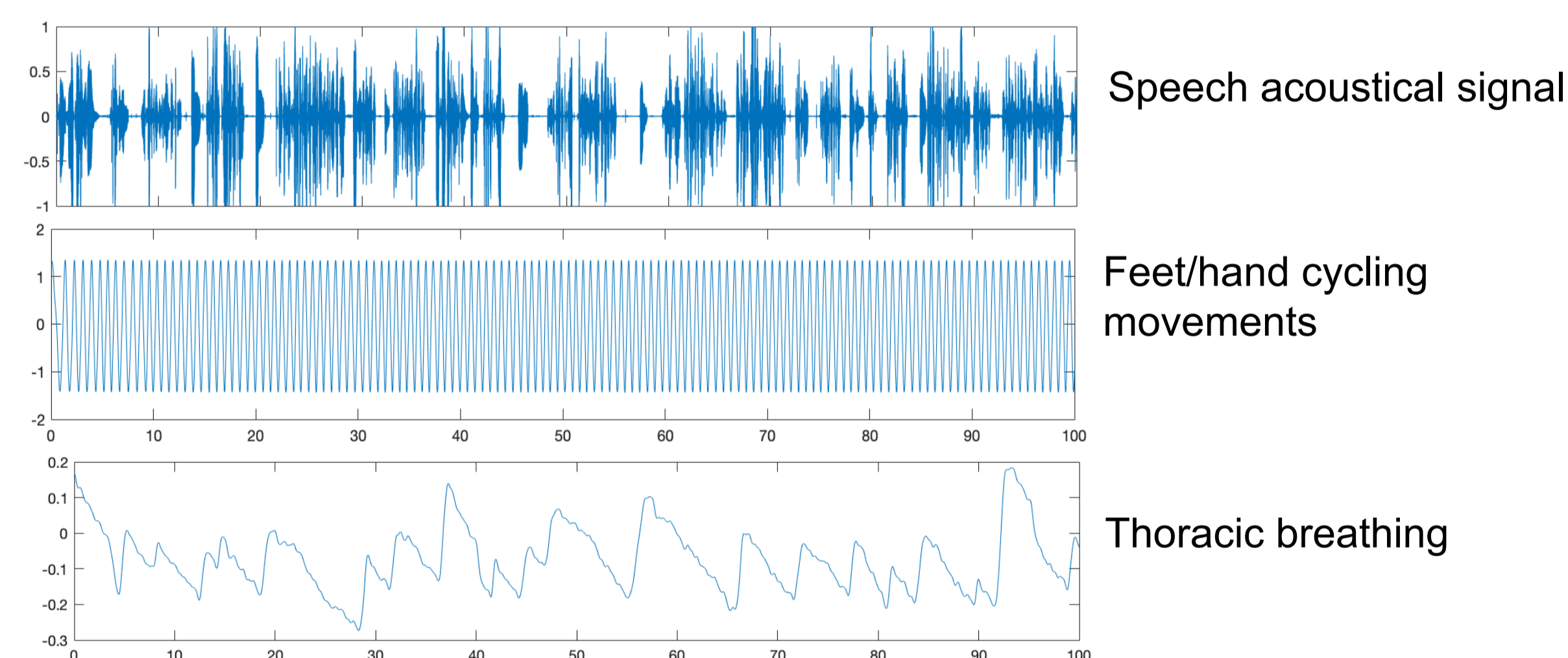
15 German Speakers (8 women, 7 men) between 19 and 40 years old (mean=27, sd=6)

Imagine you have to go to a lonely island and you could bring only five of these ten items. Which ones would you choose? Bring them in order, and motivate your choice. Why wouldn't you take the other five items?

Quiet/Speech only (Q/S)    Quiet/Speech + leg cycling (QL/SL)    Quiet/Speech + arm cycling (QA/SA)



## Analysis



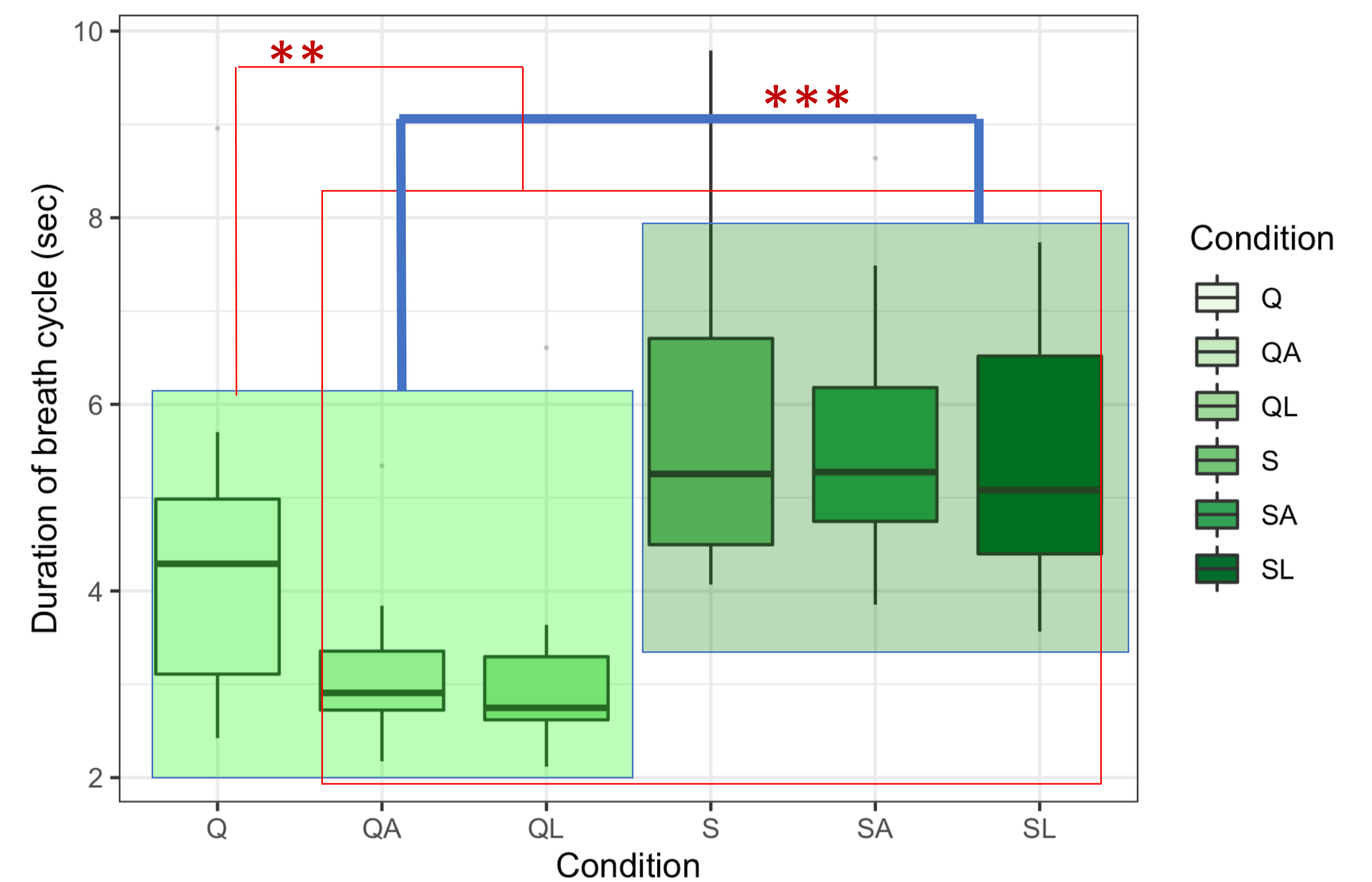
## Conclusion

Movements shorten breathing cycle in case of quiet breathing, this effect is not present when speech occurs.

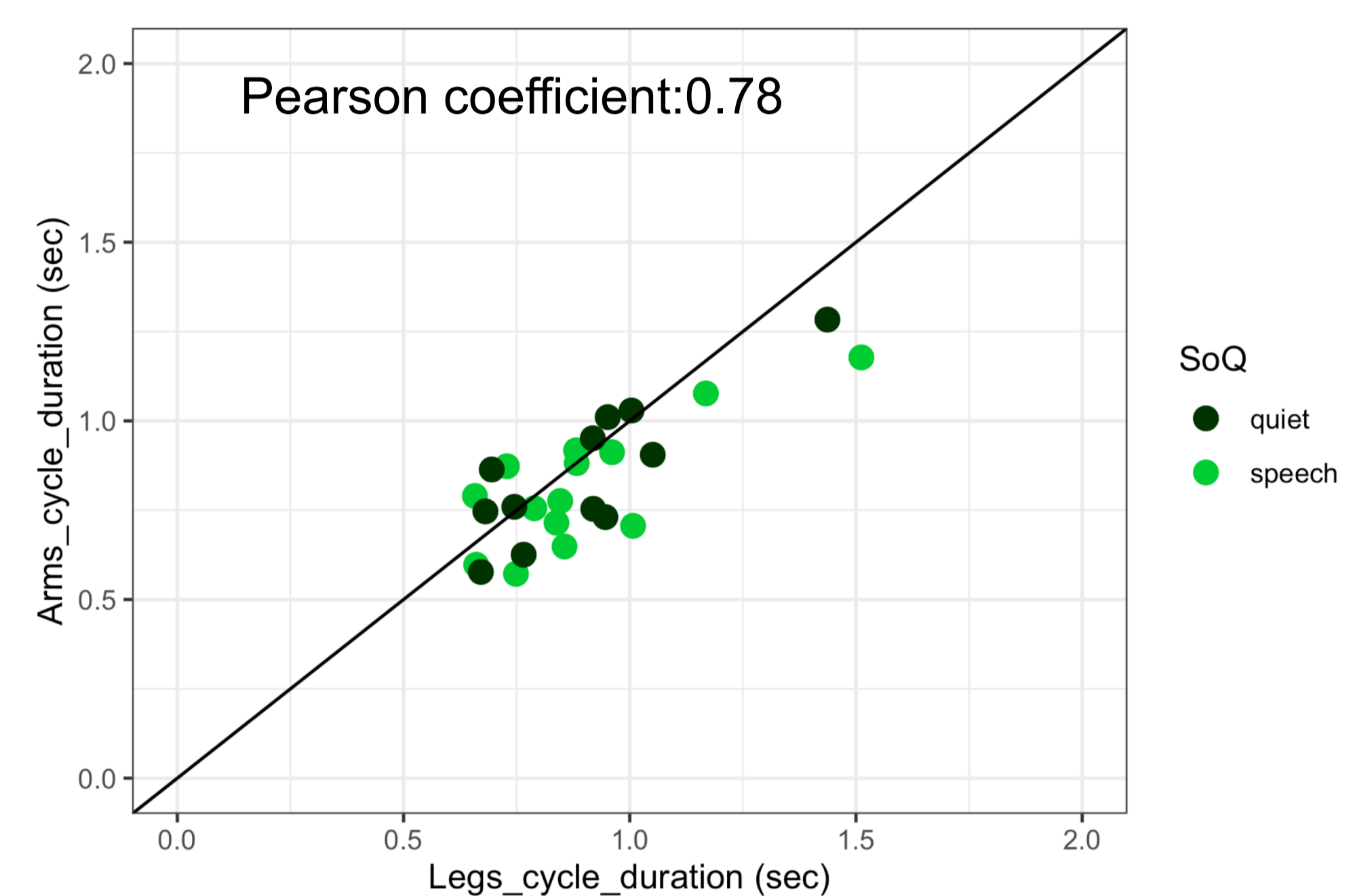
- ➔ When limbs movements are effortless, breathing seems to mainly adapt to speech.
- ➔ What about effortful movements ?

We have unexpected results related to theories of hand-mouth coupling [2]: arms and legs cycles have the same behavior. Is there a Specific coupling?

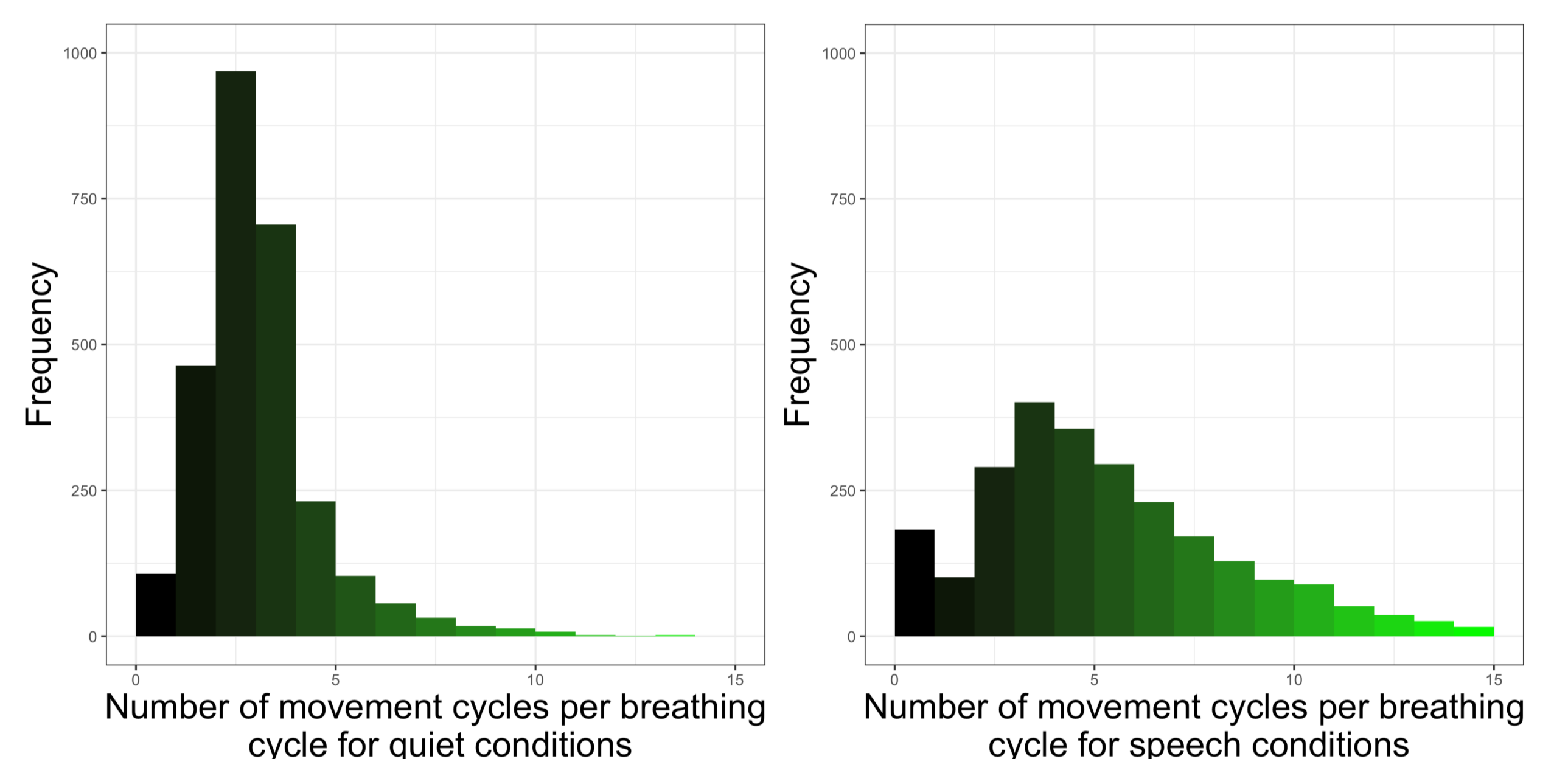
## Duration of breathing cycles according to the condition



## Correlation between duration of arms and legs cycles

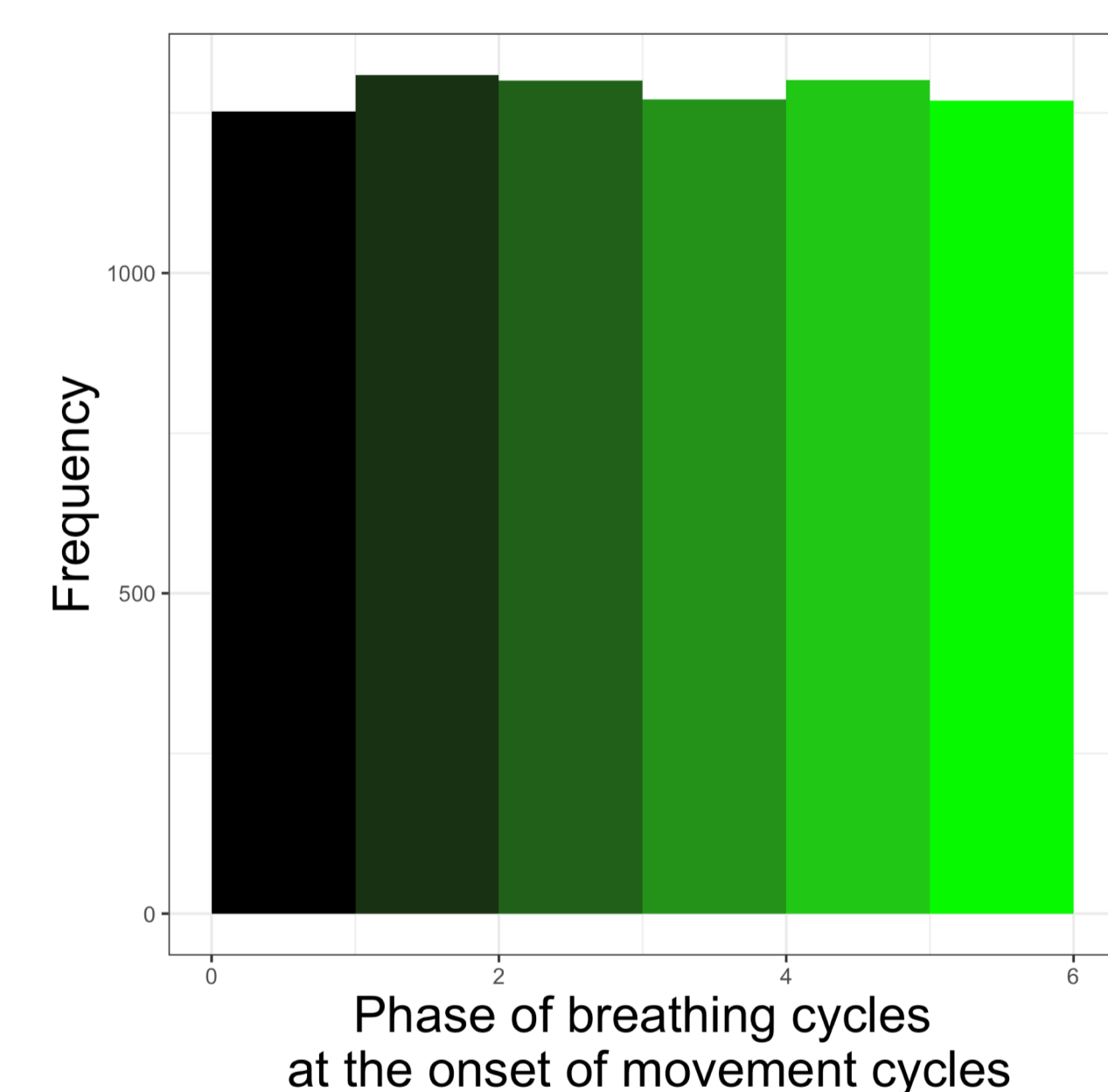


## Breathing cycle duration / movement cycle duration (ratio)



## Breathing and movement coordination

Onset of movement cycles relative to the breathing cycles



Results

- References** [1] Oppezzo, M., & Schwartz, D. L. (2014). Give your ideas some legs: The positive effect of walking on creative thinking. *Journal of experimental psychology: learning, memory, and cognition*, 40(4), 1142. [2] Gentilucci, M., Benuzzi, F., Gangitano, M., & Grimaldi, S. (2001). Grasp with hand and mouth: A kinematic study on healthy subjects. *Journal of Neurophysiology*, 86, 1685–1699. [3] Pouw, W., Harrison, S. J., & Dixon, J. A. (2018). Gesture-Speech Physics: The Biomechanical Basis of Gesture-Speech Synchrony. *Preprint PsyArxiv doi, 10*. [4] Bardy, B. G., Hoffmann, C. P., Moens, B., Leman, M., & Dalla Bella, S. (2015). Sound-induced stabilization of breathing and moving. *Annals of the New York Academy of Sciences*, 1337(1), 94-100. [5] Fuchs, S., Reichel, U. D., & Rochet-Capellan, A. (2015). Changes in speech and breathing rate while speaking and biking. [6] Fuchs, S., Petrone, C., Rochet-Capellan, A., Reichel, U. D., & Koenig, L. L. (2015). Assessing respiratory contributions to f0 declination in German across varying speech tasks and respiratory demands. *Journal of Phonetics*, 52, 35-45. [7] Heather Weston & Susanne Fuchs (2019), Rhythmic limb movements affect speech output differently in individuals.

Notes

4. [Spoken Language in Motions: Learning and Adaptation of speech coMMunication in the context of BOdy motions](#)

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