Application of breathing techniques influences reaction times

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Introduction

- Respiration is primarily a passive process, but it can be actively shaped, e.g. during physical activity or breathing techniques.
- Respiration regulates physiological functions, including CO_2/O_2 saturation, and heart rate.
- Respiration can influence brain function (Ito et al., 2014; Kluger & Gross, 2021; Liu et al., 2017; Zelano et al., 2016)
- Spontaneous respiration changes unconsciously during cognitive tasks (Huijbers et al., 2014; Johannknecht & Kayser, 2022).
- Breathing techniques are widely applied in psychology and psychotherapy, and their effects on mental states are well-documented (Balban et al., 2023).

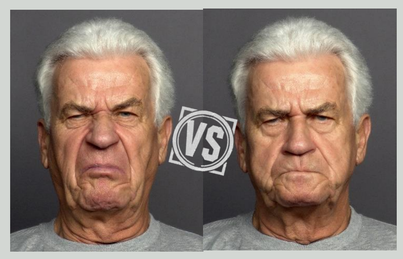
There is a lack of research regarding the impact of breathing techniques on general perception and cognitive function.
Our question:
If we consciously alter how we breathe , can we systematically shape cognitive performance?

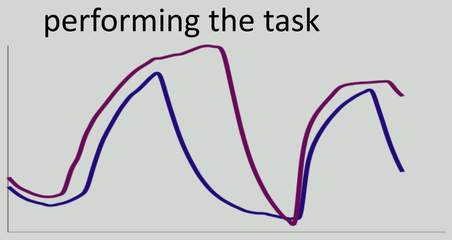
Hypotheses

If we practice breathing techniques for one minute, our behavioural performance in perceptual tasks, performed immediately after the breathing technique, changes.

Methods

- Emotion discrimination task (50 Trials ~ 4min)
- Measurment of:
  - Respiration (Temperature Sensor)
  - Behaviour
- Practicing of different breathing techniques for 1 minute before performing the task





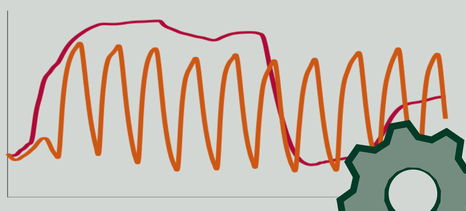


Figure 1: Exemplary respiration traces during the guided practice of breathing techniques: **SILE** (slow inspiration-long expiration), **LISE** (long inspiration–slow expiration), **Slow**, **Fast**

Results

Participants were able to follow breathing instructions.

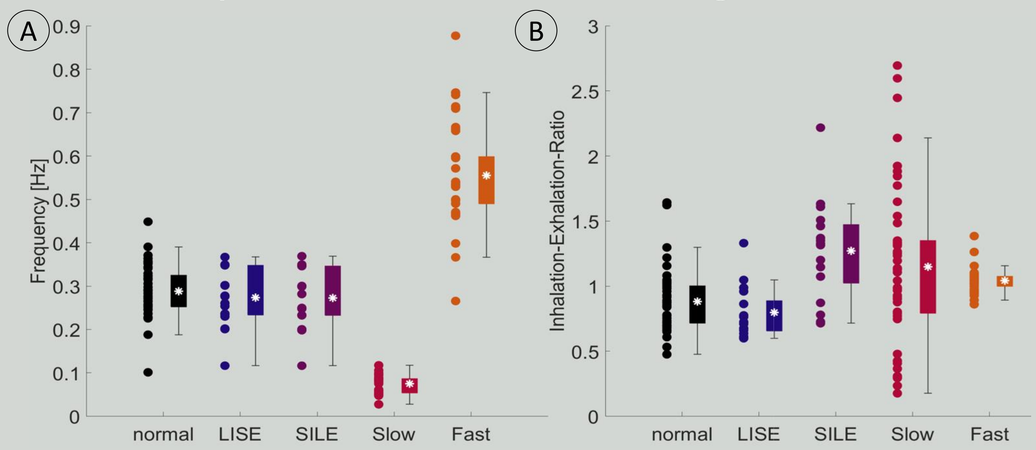


Figure 2: Ⓐ Frequency [Hz] and Ⓑ Inhalation-Exhaltion ration during spontanious respiration (**normal**) and the practicing of different breathing techniques (**LISE**: Long inspiration – short expiration, **SILE**: Slow inspiration – long expiration, **Slow**: Box breathing, **Fast**: 2x resting frequency of participants). ✱ Symbolizes groupmean

Previously performed breathing technique is a predictor for the reaction time, but not for the fraction of correct responses.

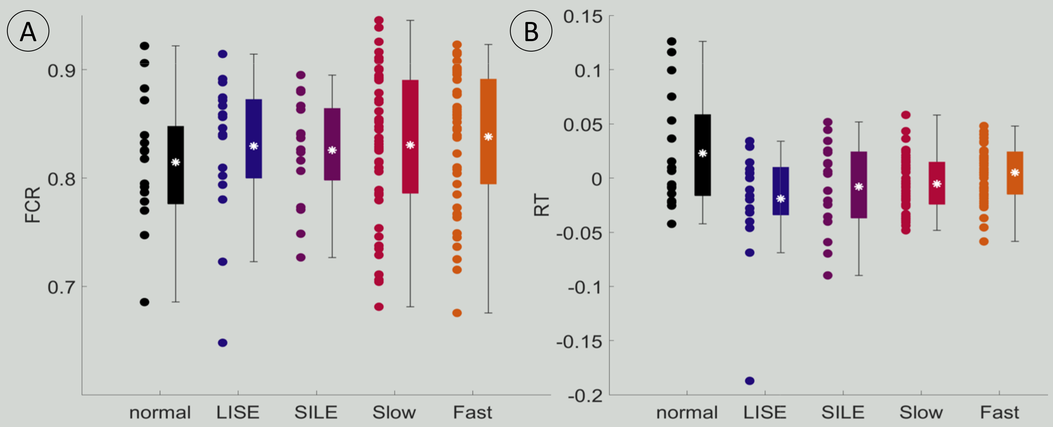


Figure 3: Performance of participants in Emotion discrimination paradigm measured as Ⓐ fraction of correct responses (FCR) and Ⓑ reaction times for blocks containing **normal** respiration (no intervention) or a breathing technique (**LISE**: Long inspiration – short expiration, **SILE**: Slow inspiration – long expiration, **Slow**: Box breathing, **Fast**: 2x resting frequency of participants). ✱ Symbolizes groupmean

Influence of breathing techniques changes over time.

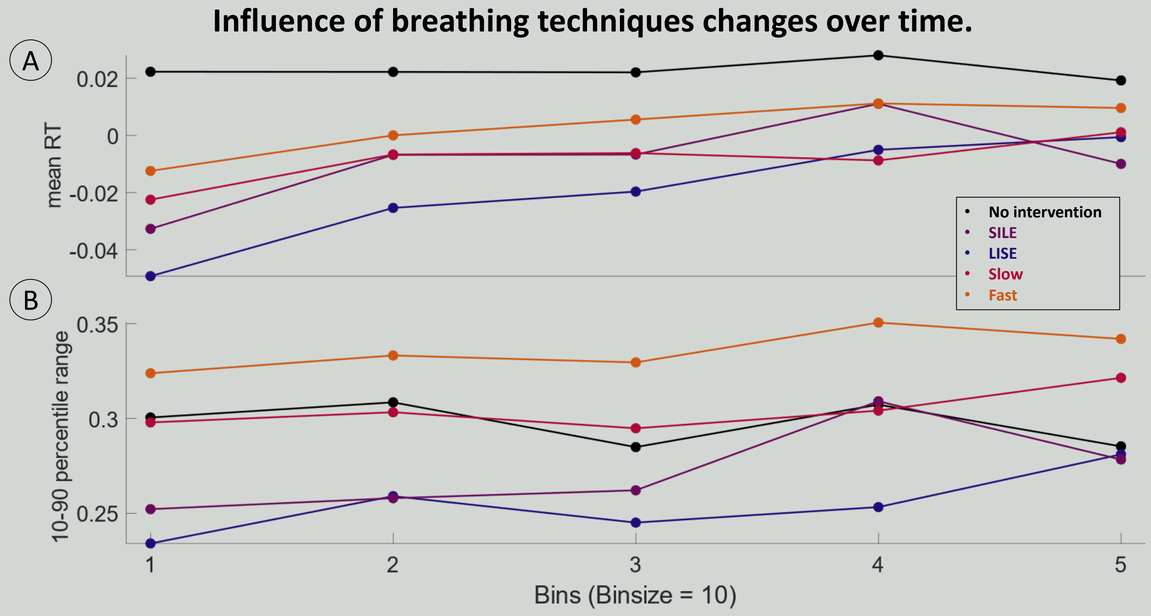


Figure 4: Ⓐ Mean reaction time and Ⓑ 10-90 percentile range for trial bins (binsize = 10) after performing different breathing techniques (**LISE**: Long inspiration – short expiration, **SILE**: Slow inspiration – long expiration, **Slow**: Box breathing, **Fast**: 2x resting frequency of participants).

Conclusion

- Participants successfully followed the breathing instruction
- Reaction times were reduced by breathing practice, regardless of the technique used.
- Response accuracy was not affected
- Examining changes in brain activity and heart rate during breathing techniques could provide deeper insights into the underlying physiological mechanisms
- Investigating the influence of breathing techniques on cognitive performance seems worthwhile; the next step is to develop an appropriate control condition to isolate the specific effects of breathing practice.

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