LEIBNIZ RESEARCH CENTRE FOR WORKING ENVIRONMENT AND HUMAN FACTORS

Leibniz Association

Interrupting Working Memory: Frontal Theta and Posterior Alpha Oscillations Reflect Reactivation Processes

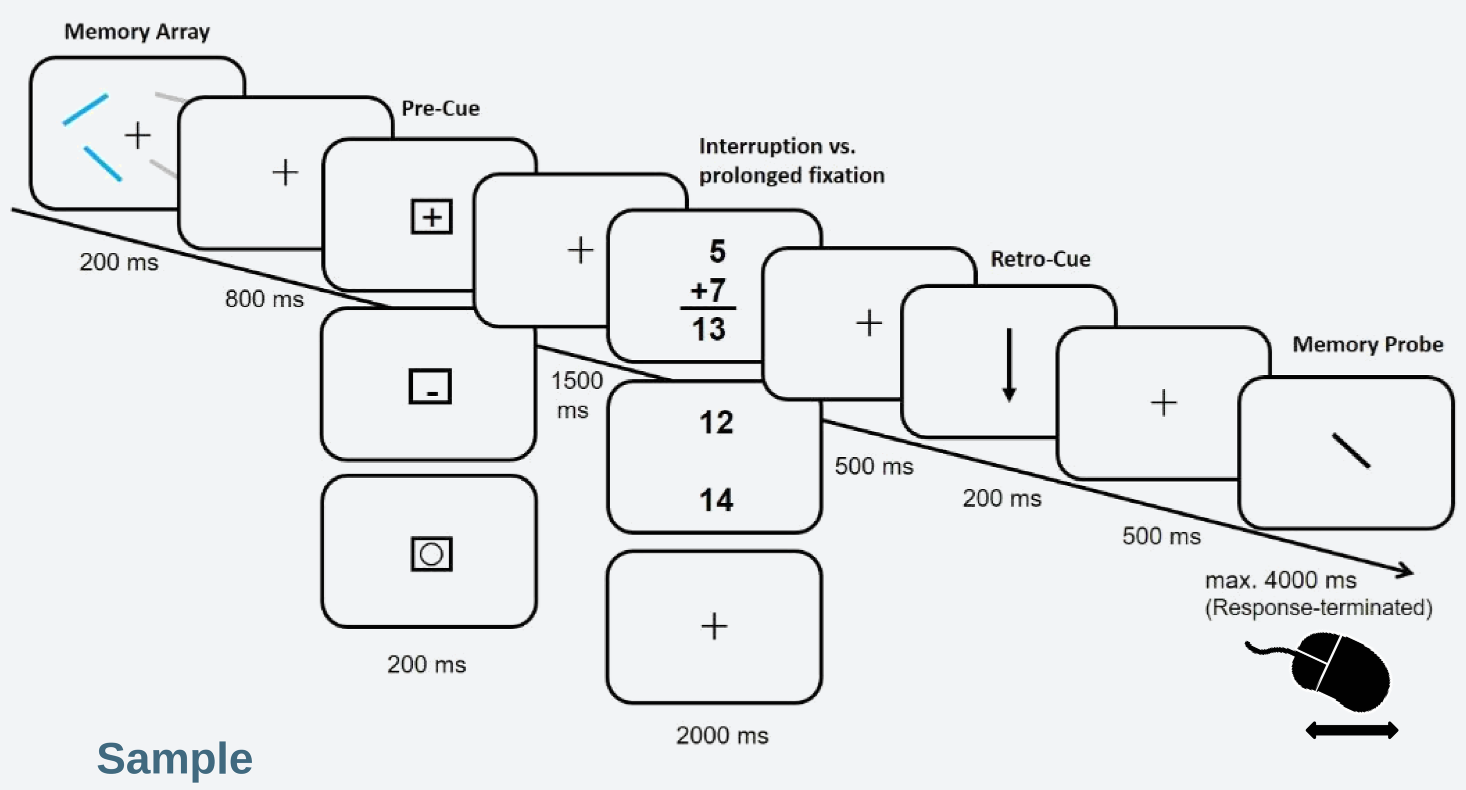
Bianca Zickerick[1], Marlene Rösner[1], Melinda Sabo[2], Katrine Bergeron[3], & Daniel Schneider[1]

[1]LEIBNIZ RESEARCH CENTRE FOR WORKING ENVIRONMENT AND HUMAN FACTORS, [2]RUHR-UNIVERSITY BOCHUM, [3]MCGILL UNIVERSITY

BACKGROUND

- **Interruptions** (secondary tasks) have been frequently shown to **deteriorate working memory performance**, leading to increased error rates and response times [1].
- The reasons for this detrimental impact can be attributed to higher cognitive demands as interruptions require a **switch of attention** from a primary to a secondary task and the intention to resume the primary task afterwards [2].
- However, the **attentional control processes** underlying these attentional switches between working memory representations have not yet been investigated.
- Therefore, the current study focused on **frontal theta** (4-7 Hz) and **posterior alpha** (8-14 Hz) oscillations to gain insights into the **reactivation of task-relevant information** following high- and low- demanding interruptions compared to the absence of an interruption task.

EXPERIMENTAL DESIGN



Sample

40 healthy participants

(Age: 19-30 years, *M* = 24; 27 females)

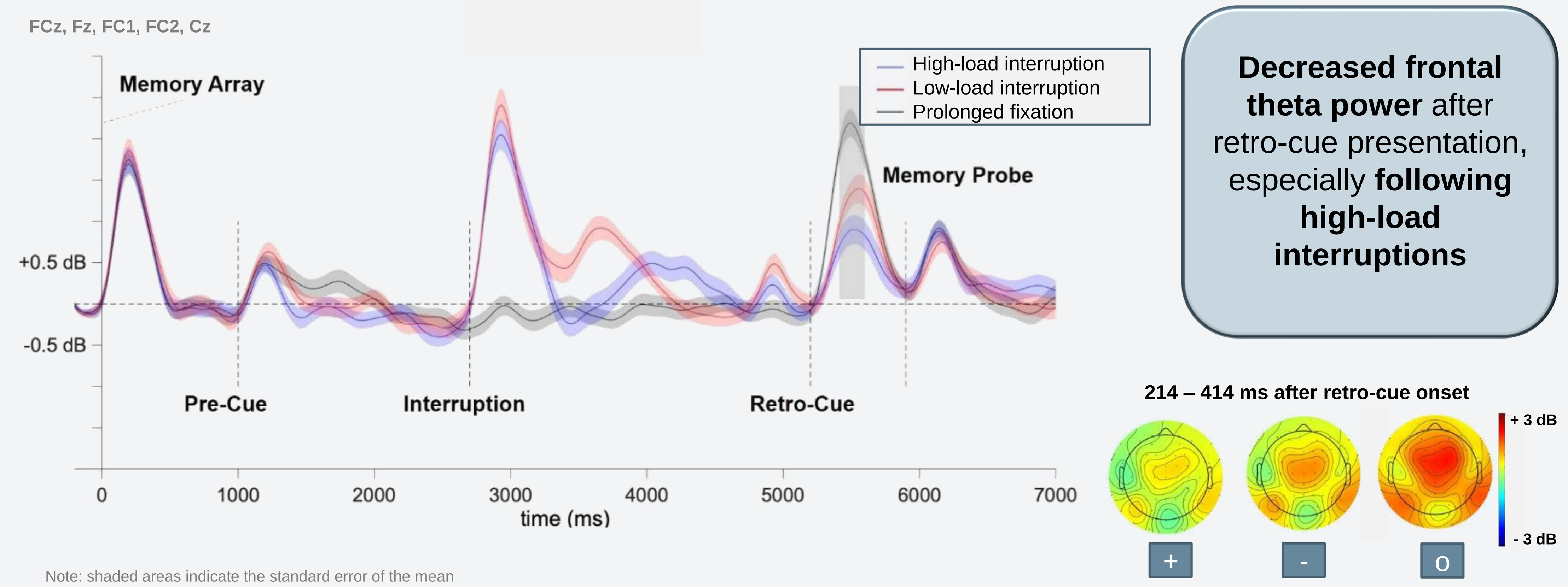
Conditions

+ **High-load interruption:** math equation (correct or false?)

- **Low-load interruption:** number comparison (lower number larger or smaller?)

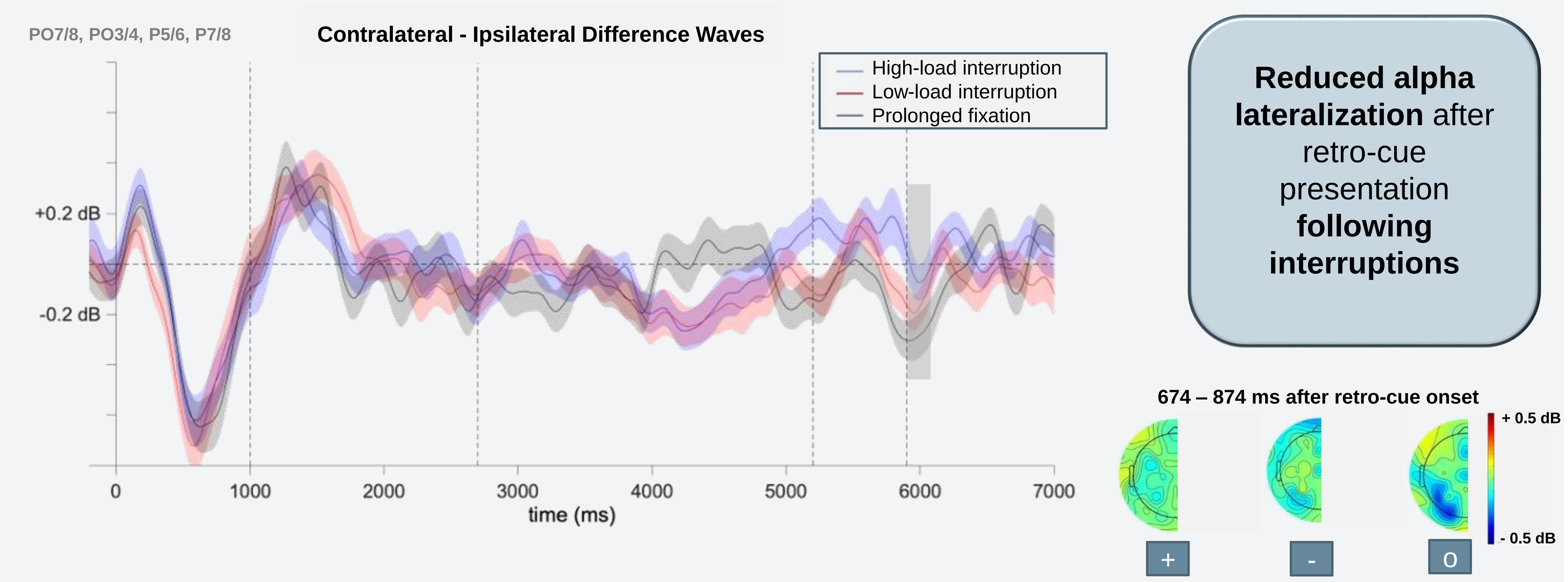
o **Prolonged fixation**

FRONTAL THETA POWER



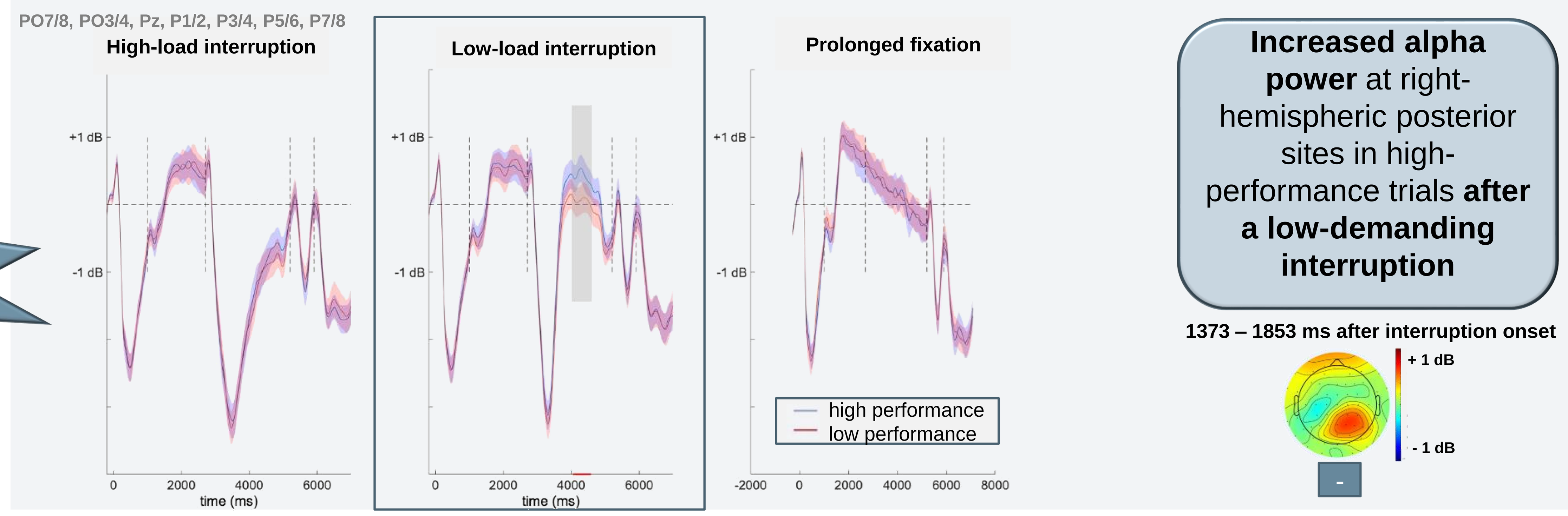
Decreased frontal theta power after retro-cue presentation, especially **following high-load interruptions**

HEMISPHERIC ALPHA POWER ASYMMETRIES



Reduced alpha lateralization after retro-cue presentation **following interruptions**

TOTAL ALPHA POWER - BEHAVIOR RELATIONS



Increased alpha power at right-hemispheric posterior sites in high-performance trials **after a low-demanding interruption**

CONCLUSION

Interruptions, in particular cognitively more demanding interruptions, **negatively affect the retrieval of working memory representations**, probably due to

- **fewer cognitive control resources** (i.e., decreased frontal theta power) [3]
- **impaired reallocation of attention** towards task-relevant information of the primary task (i.e., reduced alpha power lateralization) [4].

However, there is hope!

Efficient inhibition of the interruption task before resuming the primary task **benefits working memory performance**

BEHAVIORAL RESULTS

Significantly **increased error rates and response times after interruptions,** particularly after high-load interruptions

The more complex, the worse

REFERENCES

[1] Bailey, B.P., & Konstan, J.A. (2006). *Comp. In Hum. Beh.* , *22* (4), 685-708.

[2] Clapp, W. C., Rubens, M. T. & Gazzaley, A. (2010). *Cereb. Cortex, 20* (4), 859-872.

[3] Cavanagh, J.F., & Frank, M.J. (2014). *Trends Cognit. Sci.*, *18* (8), 414-421.

[4] De Vries, I.E.J., Van Driel, J., Karacaoglu, M., & Olivers, C.N.L. (2018). *Cereb. Cortex*, *28* (11), 4090 – 4104.

Bianca Zickerick
Information Processing Research Unit
zickerick@ifado.de

Cognitive Neuroscience Society (CNS) 2020 Virtual Meeting