

3RD NEUROERGONOMICS CONFERENCE 2021

# BEST TALK AWARD

1ST PLACE (EX-AEQUO)

KATHARINA LINGELBACH, SABRINA GADO,  
JOCHEM RIEGER, MATHIAS VUKELIĆ

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FOR

INVESTIGATING THE EMOTION-COGNITION INTERACTION:  
EFFECTS OF AFFECTIVE DISTRACTORS ON WORKING MEMORY LOAD

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# NEUROERGONOMICS

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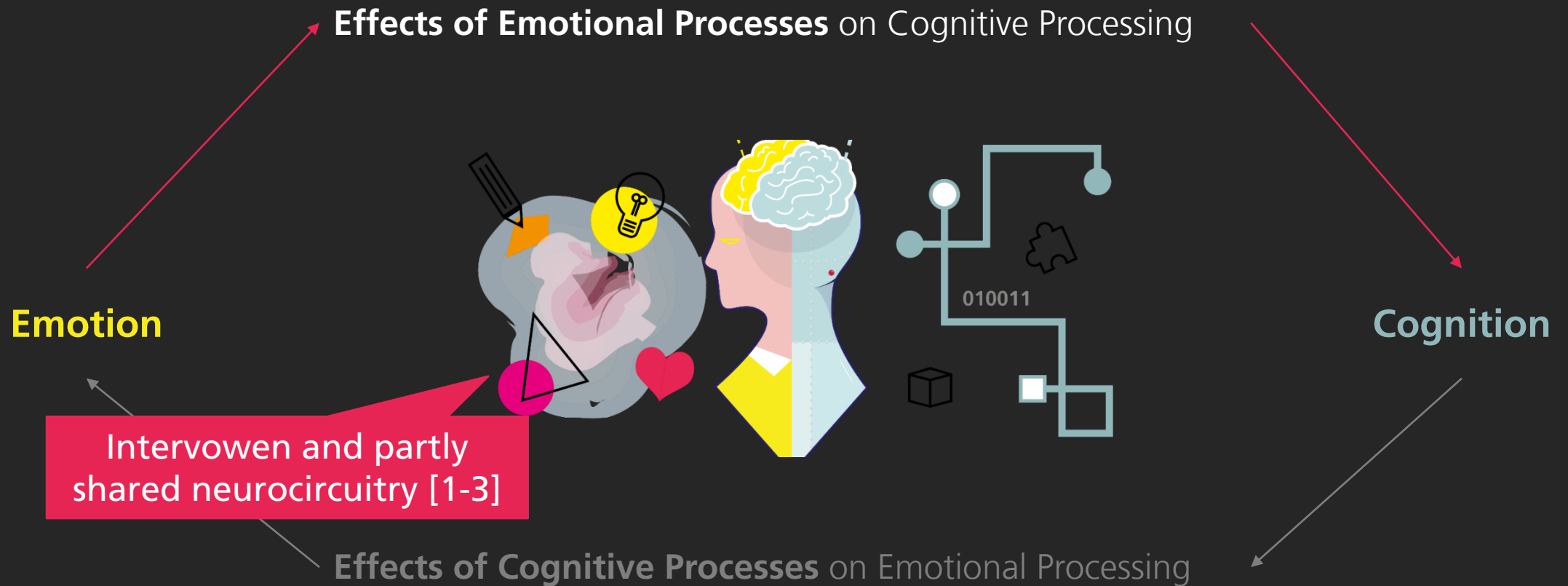


## INVESTIGATING THE EMOTION-COGNITION INTERACTION

### *Effects of Emotional Distractors on Working Memory Load*

Katharina Lingelbach

# Rethinking the Relation between Emotion and Cognition



# Typical emotional distractions in our everyday life



# Effects of Emotional Distractors on Working Memory Load

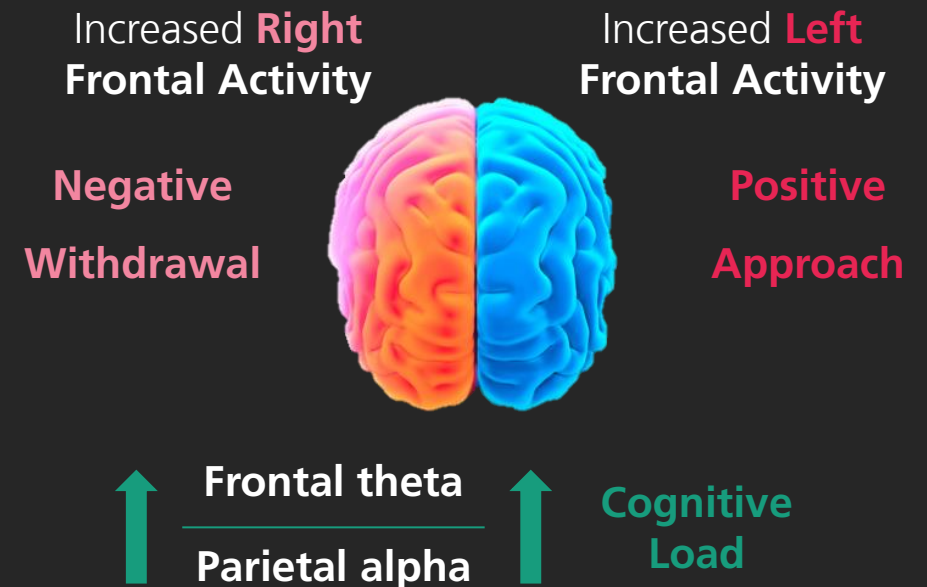


## State of the Art

- Detrimental effects of emotional distraction on cognitive processes [4-6]
- Strongest emotional interference when i) **cognitive load is low** and ii) distractors' **valence deviates from neutral** [1,7]

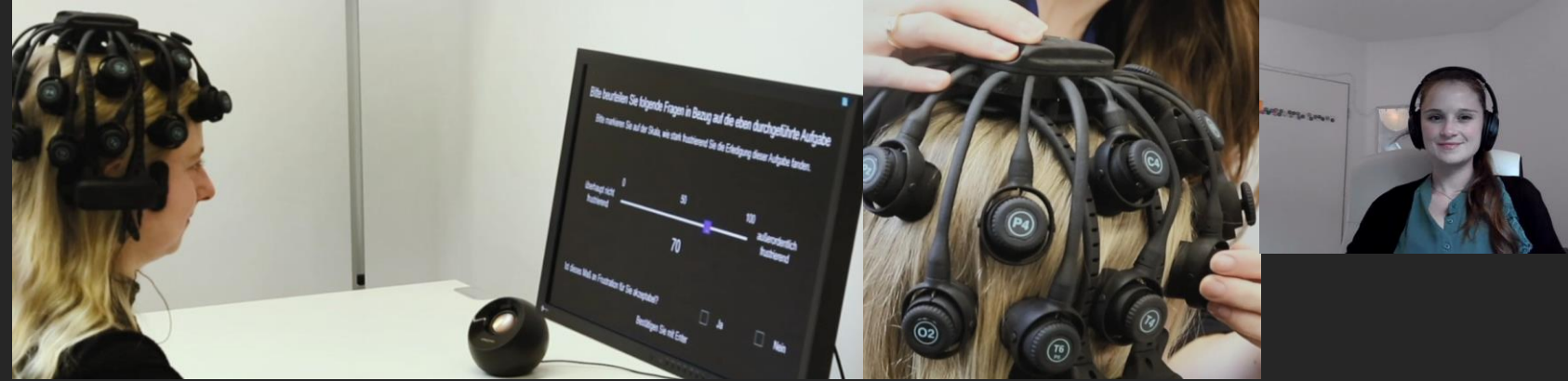
## Neurophysiological effects

- Investigating **emotion** & **cognition** with electroencephalography (EEG)
  - **Emotion states: Frontal alpha** (8 – 12 Hz) **asymmetry** (FAA) [e.g., 8]
  - **Cognitive states: Ratio of frontal theta** (4 – 7 Hz) and **parietal alpha power** (WL) [e.g., 9]



[1] Cromheeke & Mueller (2014). Probing emotional influences on cognitive control: an ALE meta-analysis of cognition emotion interactions. *Brain Struct Funct* 219, 995–1008.  
[4] Dolcos, & Denkova (2014). Current emotion research in cognitive neuroscience: Linking enhancing and impairing effects of emotion on cognition. *Emotion Review* 6, 362–375.  
[5] Iordan et al. (2013). Neural signatures of the response to emotional distraction: A review of evidence from brain imaging investigations. *Front Hum Neurosci* 7, 200.  
[6] Wessa et al. (2013). Goal-directed behavior under emotional distraction is preserved by enhanced task-specific activation. *Soc Cogn Affect Neurosci* 8, 305–312.  
[7] Shafer et al. (2012). Processing of emotional distraction is both automatic and modulated by attention: evidence from an event-related fMRI investigation. *J Cogn Neurosci* 24, 1233–1252.  
[8] Smith et al. (2017). Assessing and conceptualizing frontal EEG asymmetry: An updated primer on recording, processing, analyzing, and interpreting frontal alpha asymmetry. *Int J Psychophysiol* 111, 98–114.  
[9] Gevins et al. (1997). High-resolution EEG mapping of cortical activation related to working memory: Effects of task difficulty, type of processing, and practice. *Cereb Cortex* 7, 374–385.

# Research Questions

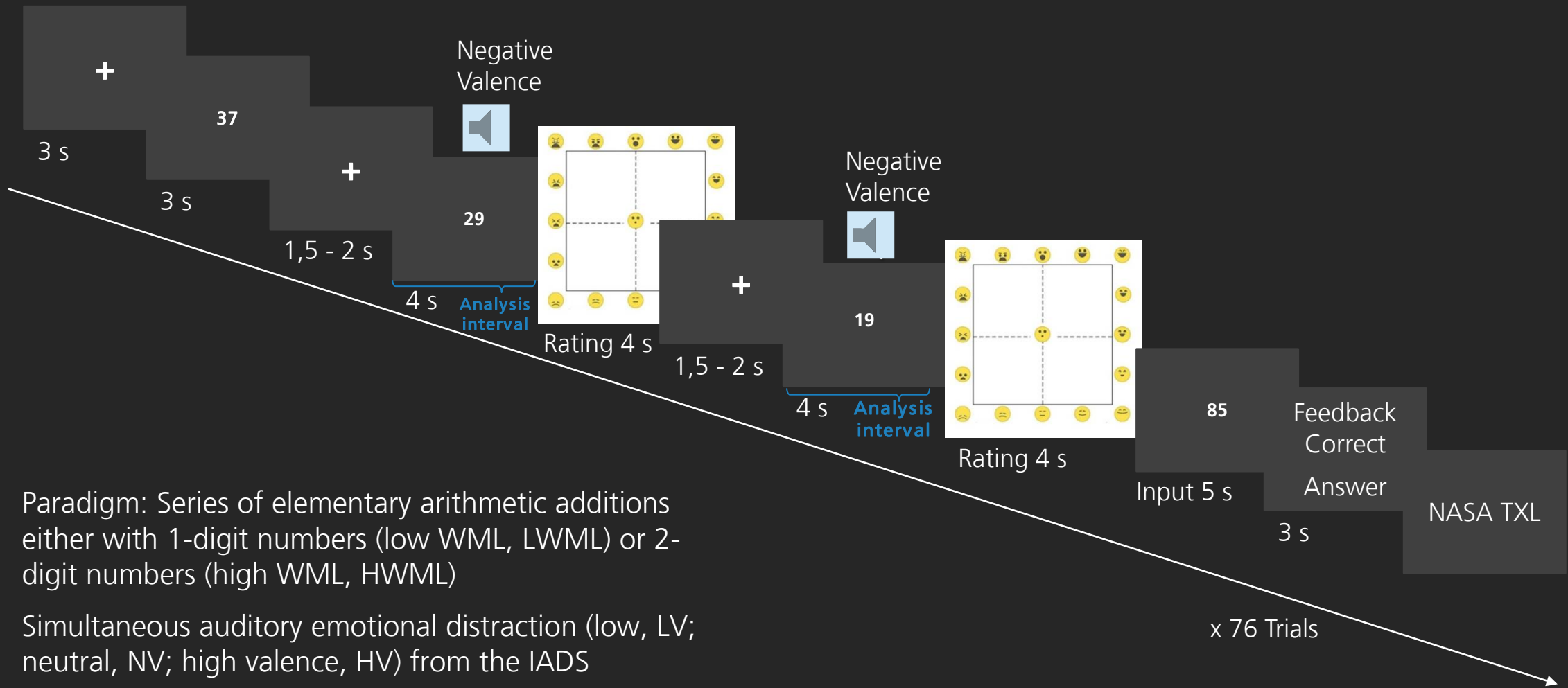
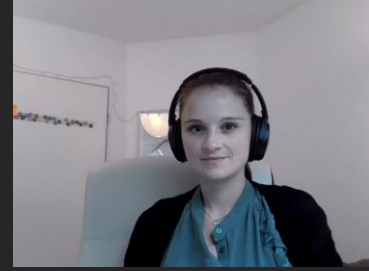


- 1 How do **auditory distractors** and their affective valence **influence** neurophysiological indices associated with **valence** and **working memory load**?
- 2 Which **correlates** can capture **interactions between cognitive control and affective-emotional distraction** processes?
- 3 Do we observe stronger emotional interference effects (i) **under low WML** because of sufficient available resources to process emotional distractors and (ii) for **emotional stimuli** due to a higher salience and relevance?



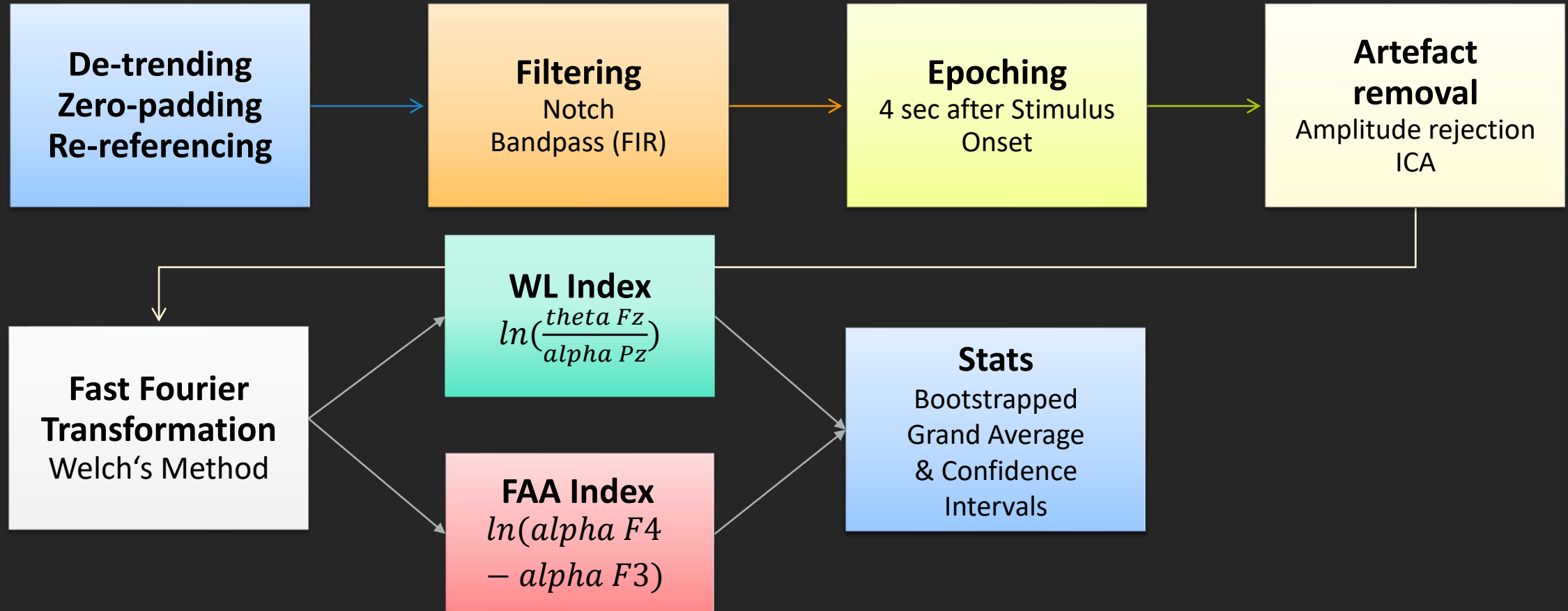
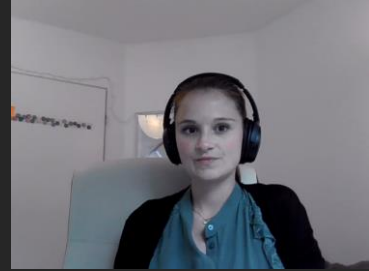
Pilot study with  $N = 12$  (five women; 1 diverse;  $M = 24 \pm 2.6$  years) using a dry mobile EEG

# Experimental Procedure with an Exemplary Trial



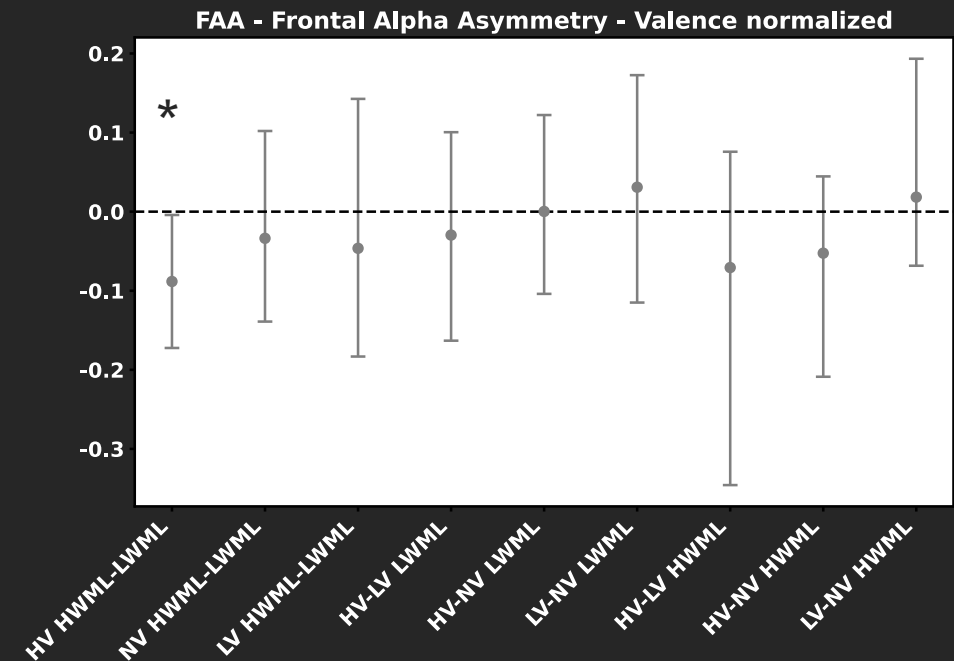
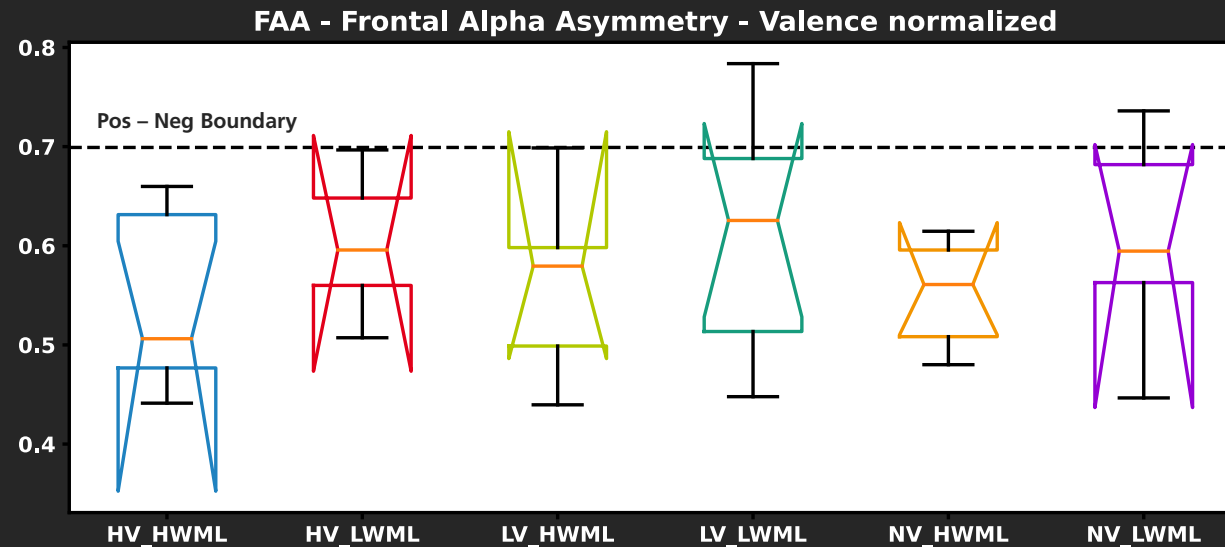
- Paradigm: Series of elementary arithmetic additions either with 1-digit numbers (low WML, LWML) or 2-digit numbers (high WML, HWML)
- Simultaneous auditory emotional distraction (low, LV; neutral, NV; high valence, HV) from the IADS

# EEG Processing Pipeline



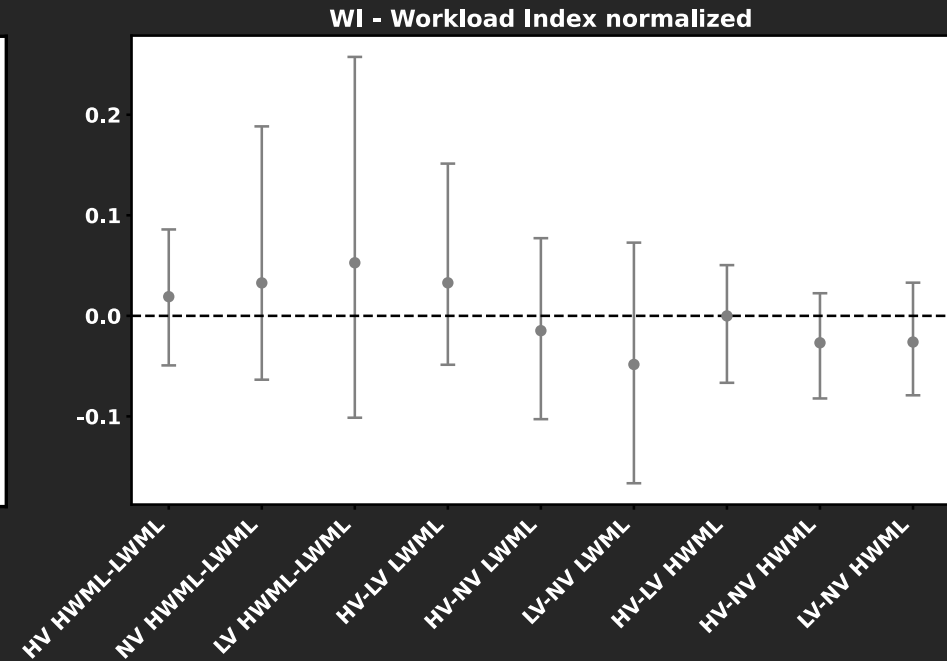
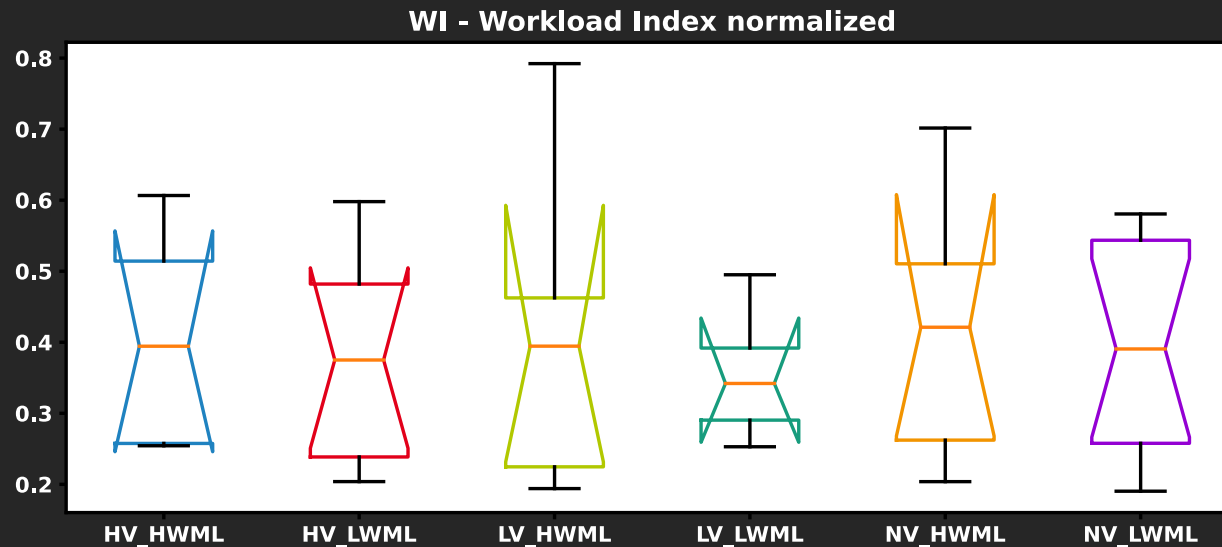
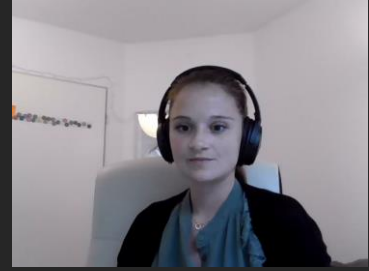


# Effects of Emotional Distractors and WML on the FAA



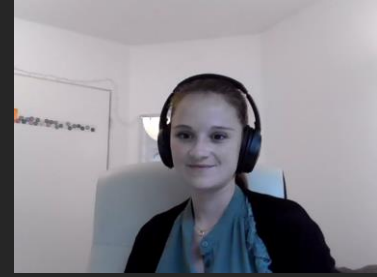
- 1 Emotional processing is altered by the level of working memory load
  - reduced FAA values and, therefore **less positive evaluation for positive stimuli under high working memory load**
  - **emotional evaluation** was rather **negative** independent of the condition

# Effects of Emotional Distractors and WML on the WL



- 2 Neutral stimuli seem to have the strongest emotional interference effects during working memory load compared to positive and negative stimuli (non-significant trend).
- There were no significant differences between the conditions.

# Take Home Message

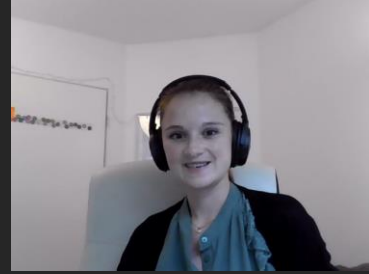


- 1 Emotional processing is altered by the level of working memory load with strongest effects on positive stimuli
  - 2 Neutral auditory distractors seem to induce additional workload compared to emotional stimuli
  - 3 The FAA revealed differences between the conditions but not the WL
- ! Future research is necessary to investigate new approaches that not only explain the consequences of the interaction, but the interaction process itself!



**Implications** of this research include (1) **higher context sensitivity** and (2) **holistic evaluation** of identified mental states in **safety-critical environments**, e.g., during driving or in human-computer interactions.

# Questions?



Thanks to the Team ;-)



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