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Are ERPs to threat-related facial expressions driven by perceived arousal?

Department of Psychology, University of Waterloo, Waterloo ON

Amie J. Durston*
ajdurston@uwaterloo.ca

Roxane J. Itier
ritier@uwaterloo.ca

Background

- Few studies compare anger and fear within subjects[1-4]

- The P2[5,6] and enhanced posterior negativity (EPN)[7] are sensitive to these faces, potentially due to their arousal and valence.

- No one has empirically tested this assumption

Aims
- Replicate P2 and EPN effects
- Determine if arousal (or valence) explain these results

Methods

Participants
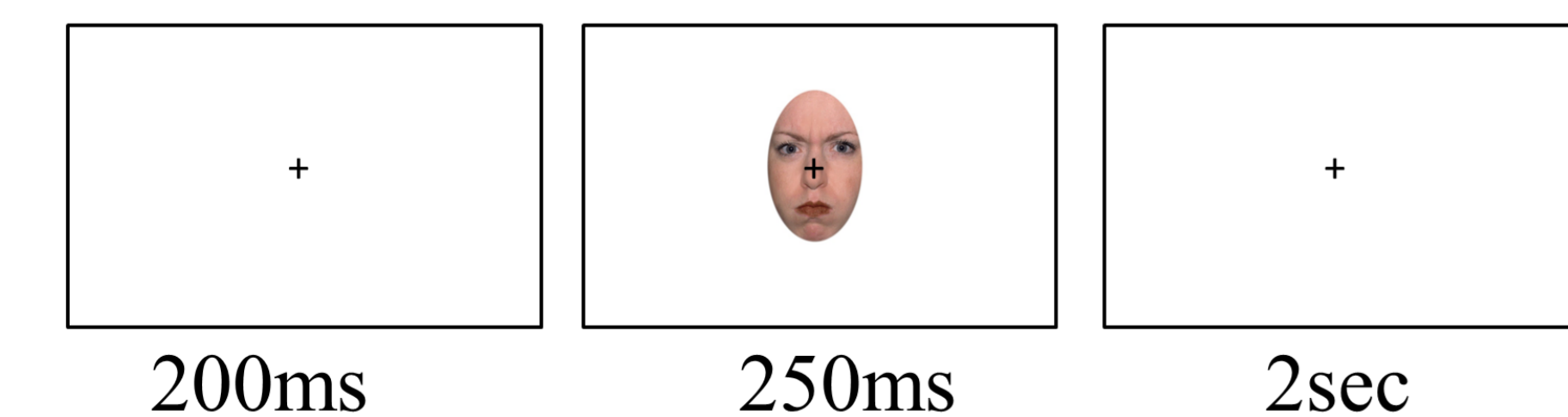80 young adults (17-35ys)
M_{age} = 20.92; 40 females

Faces
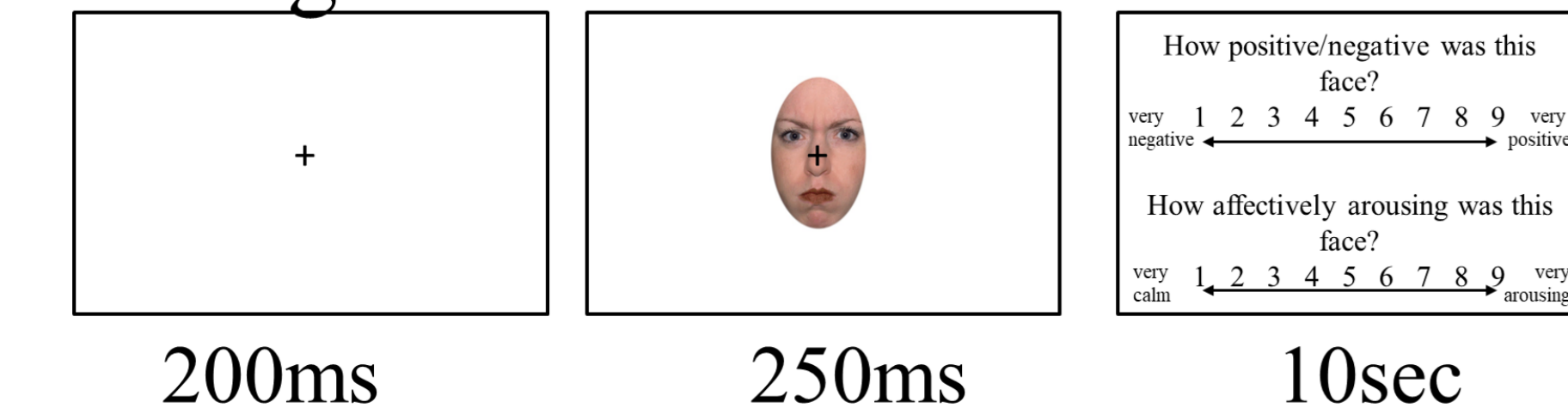4 different databases[8-11]

40 identities x 4 emotions = 160 faces

EEG
64-channel ActiChamp 10-20 cap
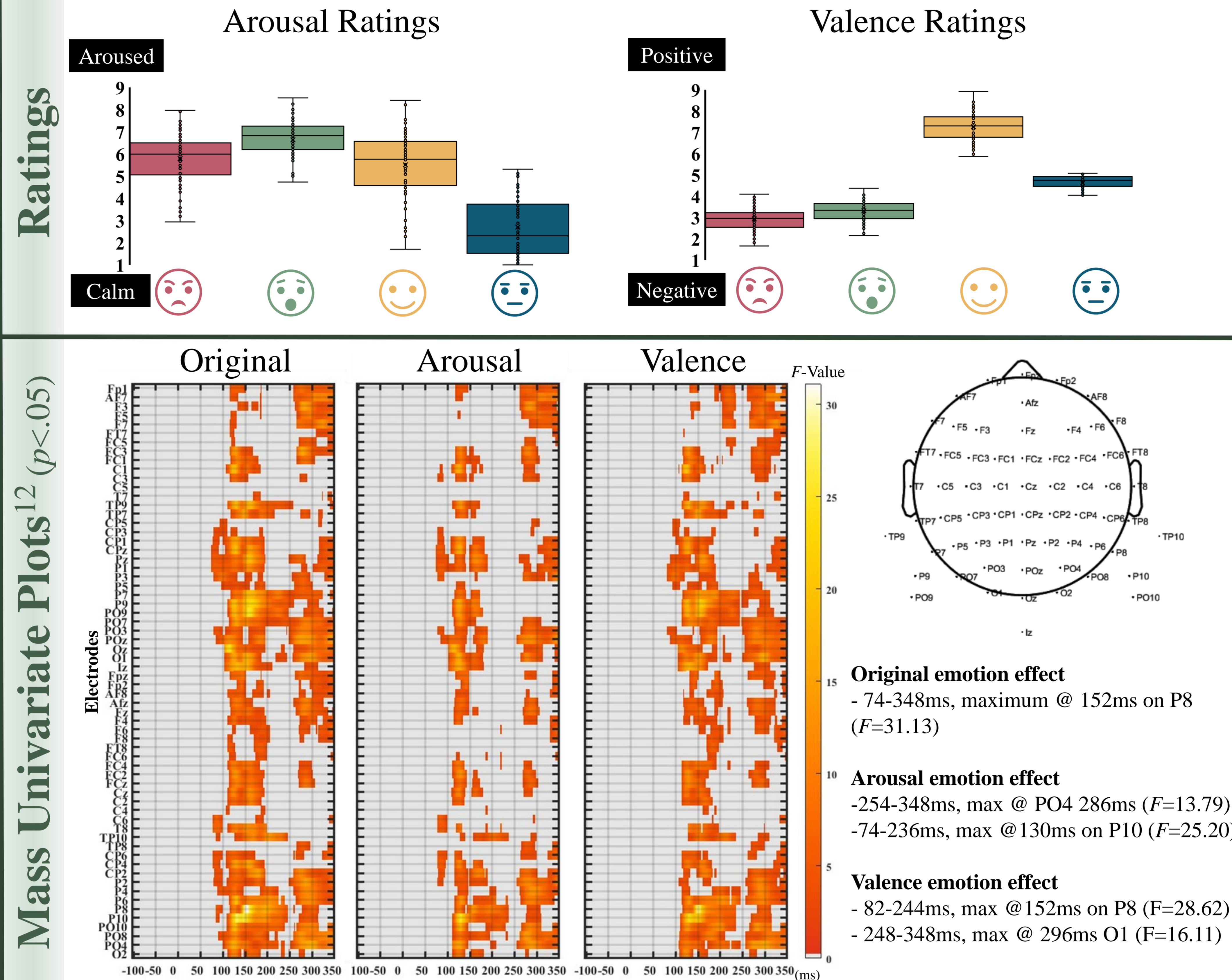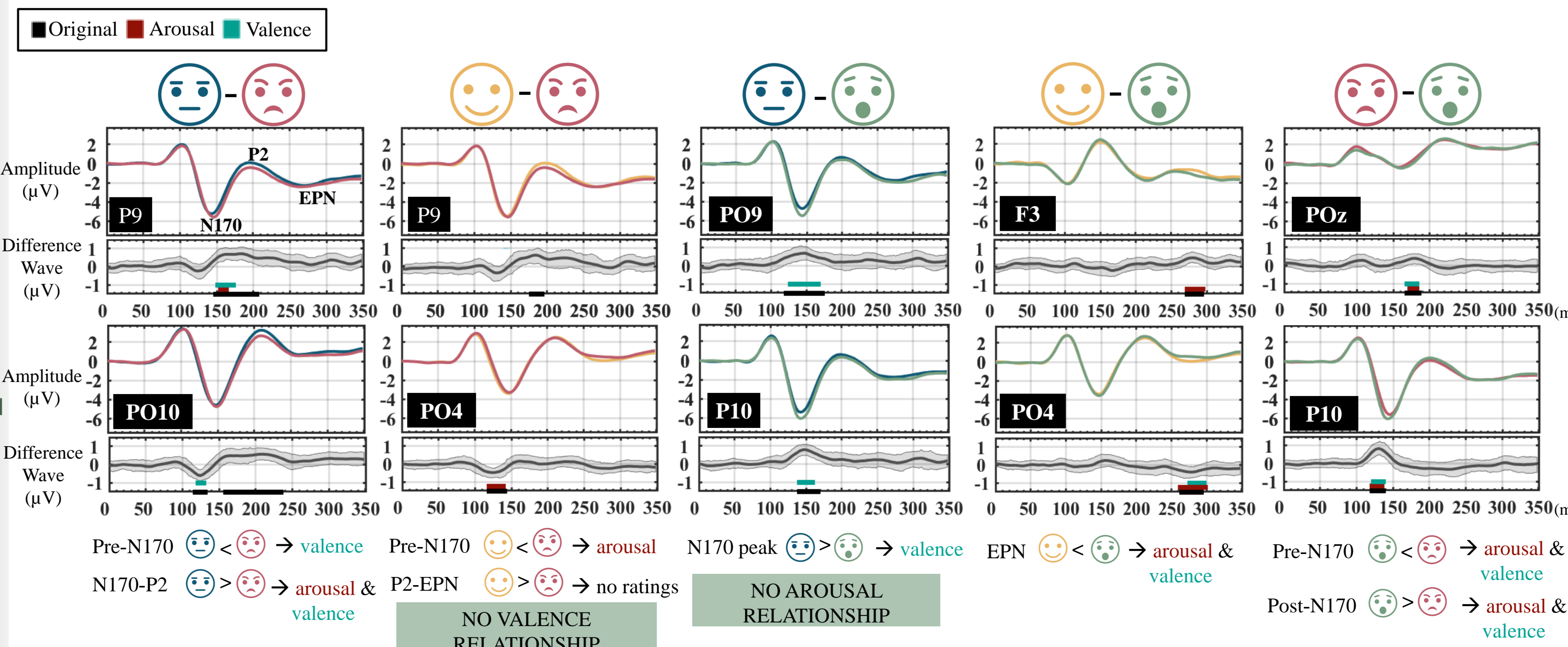500Hz sampling, Cz online reference

Tasks
Gender Task

200ms   250ms   2sec

Rating Task

200ms   250ms   10sec

Results

Ratings

Arousal Ratings

Valence Ratings

Mass Univariate Plots[12] ($p<.05$)

Original   Arousal   Valence   F-Value

Original emotion effect
- 74-348ms, maximum @ 152ms on P8 (F=31.13)

Arousal emotion effect
- 254-348ms, max @ PO4 286ms (F=13.79)
- 74-236ms, max @130ms on P10 (F=25.20)

Valence emotion effect
- 82-244ms, max @152ms on P8 (F=28.62)
- 248-348ms, max @ 296ms O1 (F=16.11)

Follow-up ERPs ($p<.008$)

■Original ■Arousal ■Valence

Pre-N170 😐<😠 → valence
N170-P2 😠>😐 → arousal & valence

Pre-N170 🙂<😠 → arousal
P2-EPN 🙂>😠 → no ratings
NO VALENCE RELATIONSHIP

N170 peak 😐>😮 → valence
NO AROUSAL RELATIONSHIP

EPN 🙂<😮 → arousal & valence

Pre-N170 😠<😮 → arousal & valence
Post-N170 😮>😠 → arousal & valence

Conclusions

- Arousal (and valence) do play a role in ERP responses to facial expressions

- Which component is impacted by ratings depends on the contrast. Although timepoints around the N170 are the most frequently related to ratings.

- P2 effects are seen in anger contrasts[5] (not fear[6,13]) but do not relate to ratings.

- Only happy and fear differed on the EPN, which relates to both valence and arousal.

- The anger and fear comparison yielded the most overlap between the three analyses.

- Researchers should consider participant's perceptual experience

References

1. Almeida, P. R. et al. Perceived arousal of facial expressions of emotion modulates the N170, regardless of emotional category: Time domain and time–frequency dynamics. *International Journal of Psychophysiology* **99**, 48–56 (2016).

2. Turano, M. T. et al. Fear boosts the early neural coding of faces. *Social Cognitive and Affective Neuroscience* **12**, 1959–1971 (2017).

3. Smith, E., Weinberg, A., Moran, T. & Hajcak, G. Electrocortical responses to NIMSTIM facial expressions of emotion. *International Journal of Psychophysiology* **88**, 17–25 (2013).

4. Calvo, M. G., Marrero, H. & Beltrán, D. When does the brain distinguish between genuine and ambiguous smiles? An ERP study. *Brain and Cognition* **81**, 237–246 (2013).

5. Han, S. et al. From structure to concepts: The two stages of facial expression recognition. *Neuropsychologia* **150**, 107700 (2021).

6. Durston, A. J. & Itier, R. J. The early processing of fearful and happy facial expressions is independent of task demands – Support from mass univariate analyses. *Brain Research* **1765**, 147505 (2021).

7. Schupp, H. T. et al. The facilitated processing of threatening faces: an ERP analysis. *Emotion* **4**, 189–200 (2004).

8. Ma, D. S., Correll, J. & Wittenbrink, B. The Chicago face database: A free stimulus set of faces and norming data. *Behav Res* **47**, 1122–1135 (2015).

9. Tottenham, N. et al. The NimStim set of facial expressions: Judgments from untrained research participants. *Psychiatry Res* **168**, 242–249 (2009).

10. Langner, O. et al. Presentation and validation of the Radboud Faces Database. *Cognition and Emotion* **24**, 1377–1388 (2010).

11. Ebner, N. C., Riediger, M. & Lindenberger, U. FACES—A database of facial expressions in young, middle-aged, and older women and men: Development and validation. *Behavior Research Methods* **42**, 351–362 (2010).

12. Pernet, C. R., Chauveau, N., Gaspar, C. & Rousselet, G. A. LIMO EEG: A Toolbox for Hierarchical LInear MOdeling of ElectroEncephaloGraphic Data. *Comput Intell Neurosci* **2011**, 831409 (2011).

13. Itier, R. J. & Durston, A. J. Mass-univariate analysis of scalp ERPs reveals large effects of gaze fixation location during face processing that only weakly interact with face emotional expression. *Sci Rep* 13, 17022 (2023).

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* Presenting author