Investigating face and body perception in humans with naturalistic, more ecologically valid stimuli

UNIVERSITÄT OSNABRÜCK

John Jairo Madrid Carvajal[1], Peter König[1], Debora Nolte[1]

[1] *University of Osnabrück, Germany*

Introduction

- Translating classical laboratory-based setups into the real world (the wild) represents a major challenge in neuroscience.
- Using ecologically valid conditions to study brain functioning is still a pressing issue within cognitive neuroscience [1]–[3]
- Neuroscience in the wild involves many significant changes in how we design, conduct, and analyze ecologically valid experiments [4]
- Faces are often perceived in natural scenes
- Classical experiments investigating face perception in humans usually involve static, controlled laboratory setups and highly manipulated/edited stimuli [5][6]
- Previous research on face perception has used natural scenes [7] and real-life free-viewing scenarios as stimuli revealing unknown EEG signatures of face processing [8]
- There is still a lack of studies investigating the implications of using naturalistic, unedited images to study face perception.

Goal:

- **Translate a classical experimental paradigm into the wild**
- **Create an intermediate setup that combines EEG and VR**
- **Investigate ERP responses to faces and bodies compared to objects using images retrieved from previous gazes during a walk in a virtual city.**

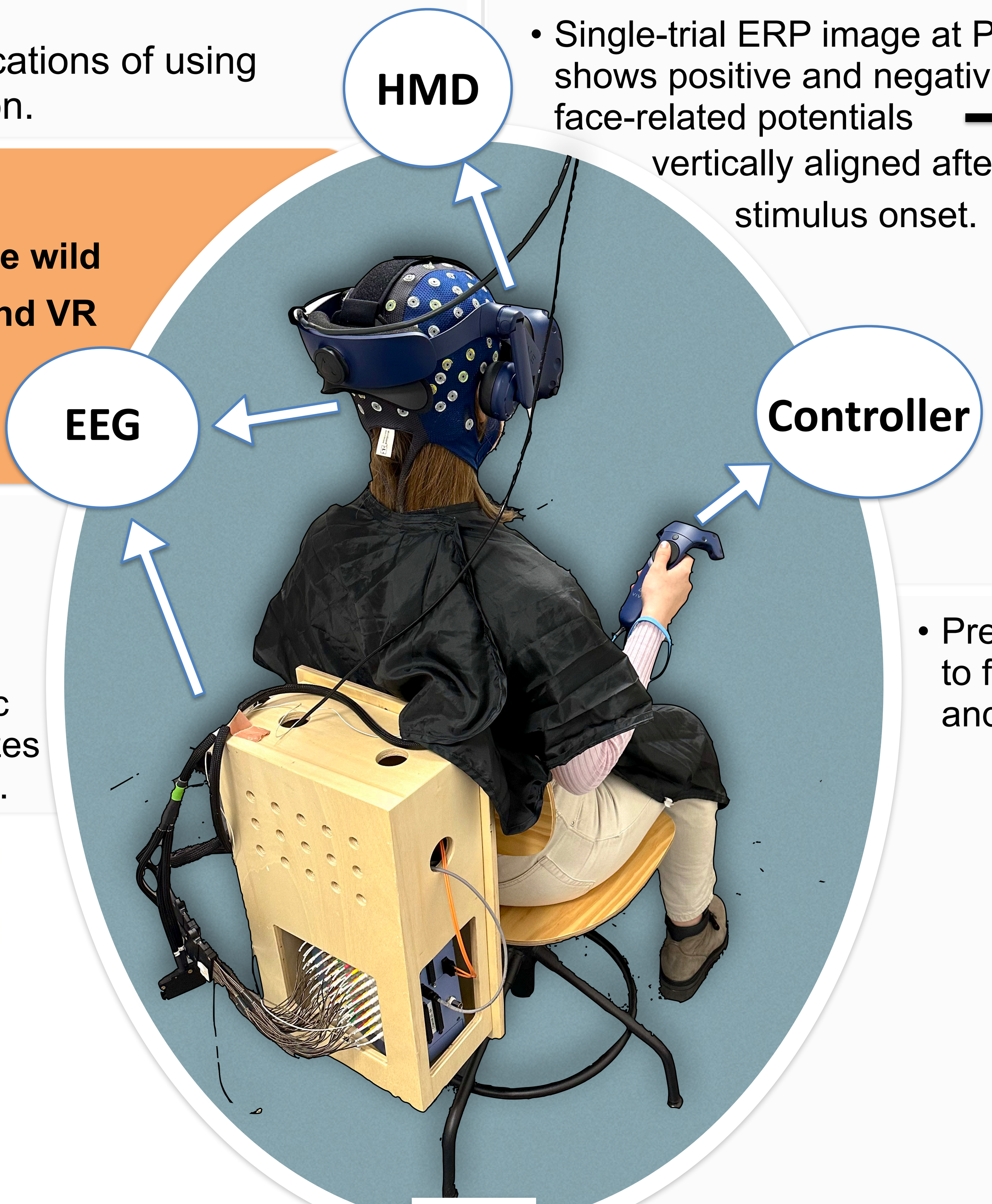


Fig. A

Methods

- We combined EEG and VR (fig. A) to investigate ERP responses to faces and bodies (N170) using naturalistic images (fig. B) retrieved from participants' previous gazes during a free-viewing exploration in a virtual city (fig. C).

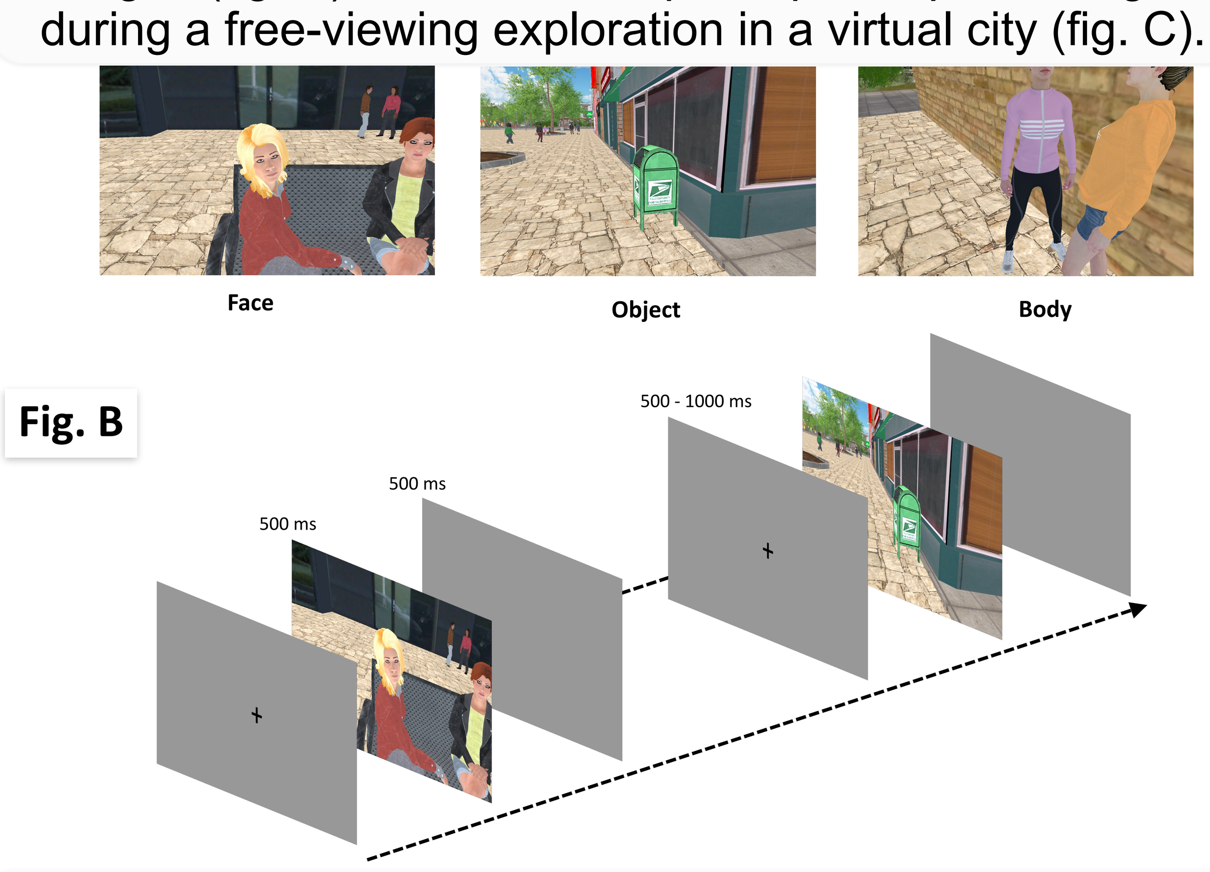


Fig. B

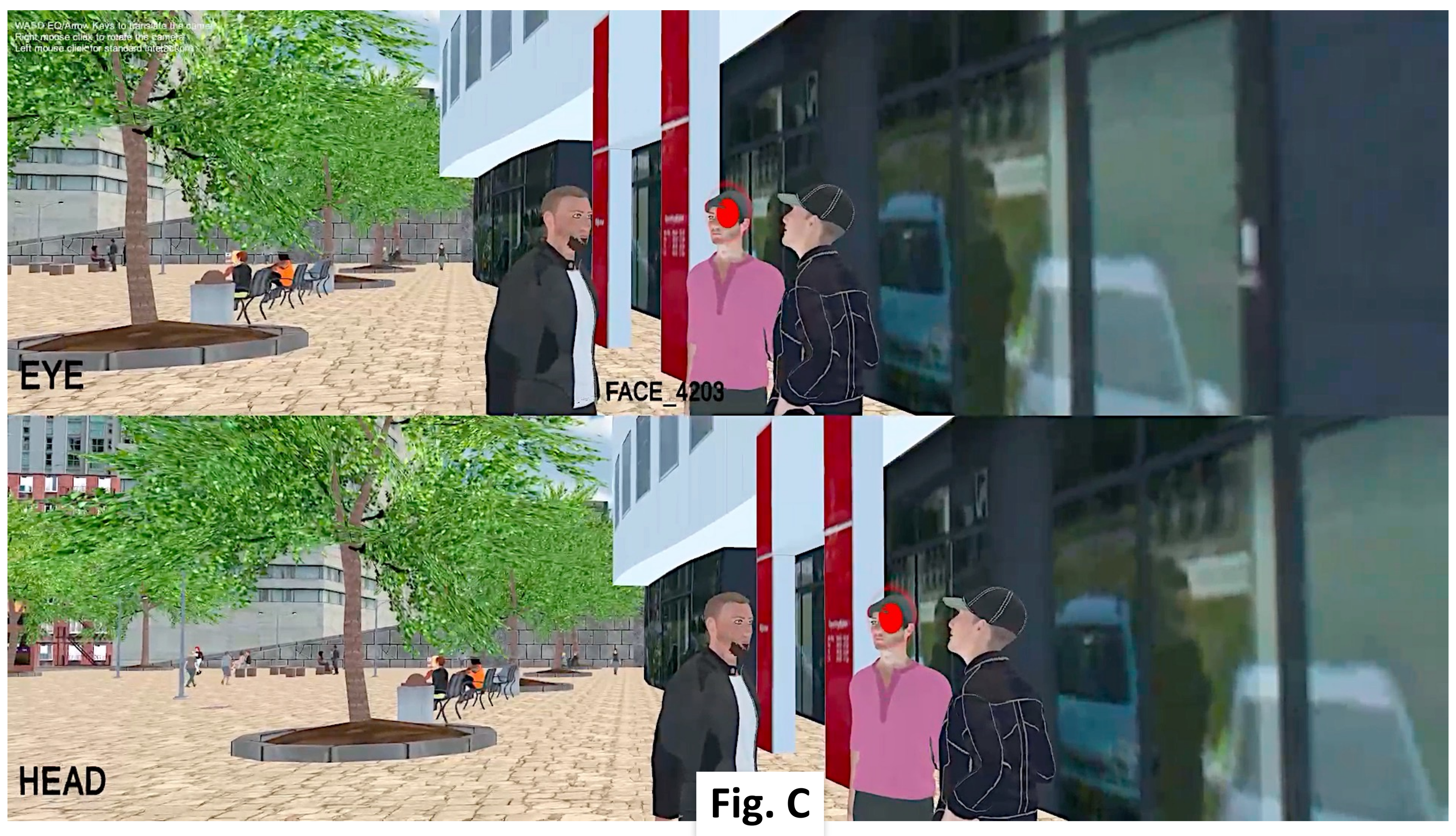


Fig. C

- We aligned EEG and VR streams' timestamps to identify stimulus onset (fig. D)

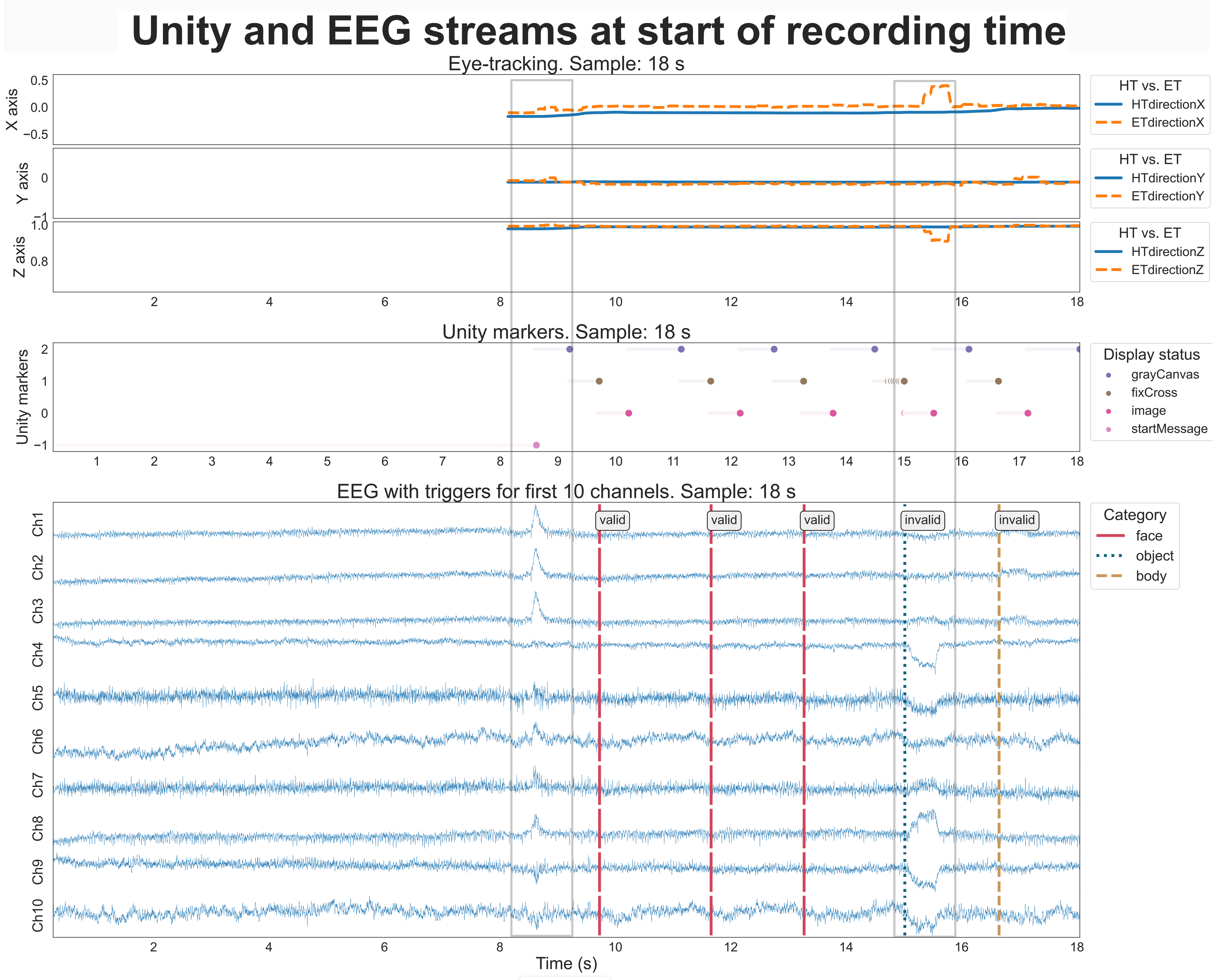
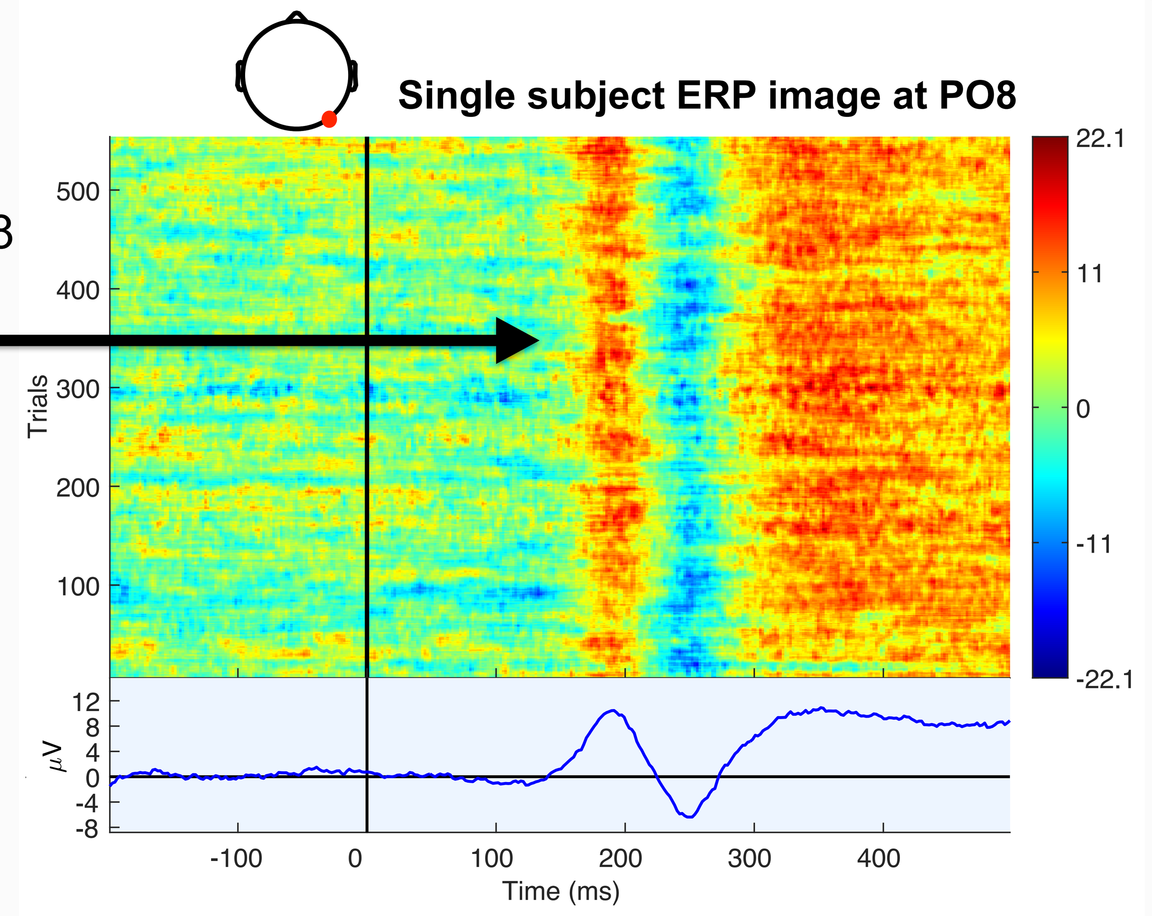
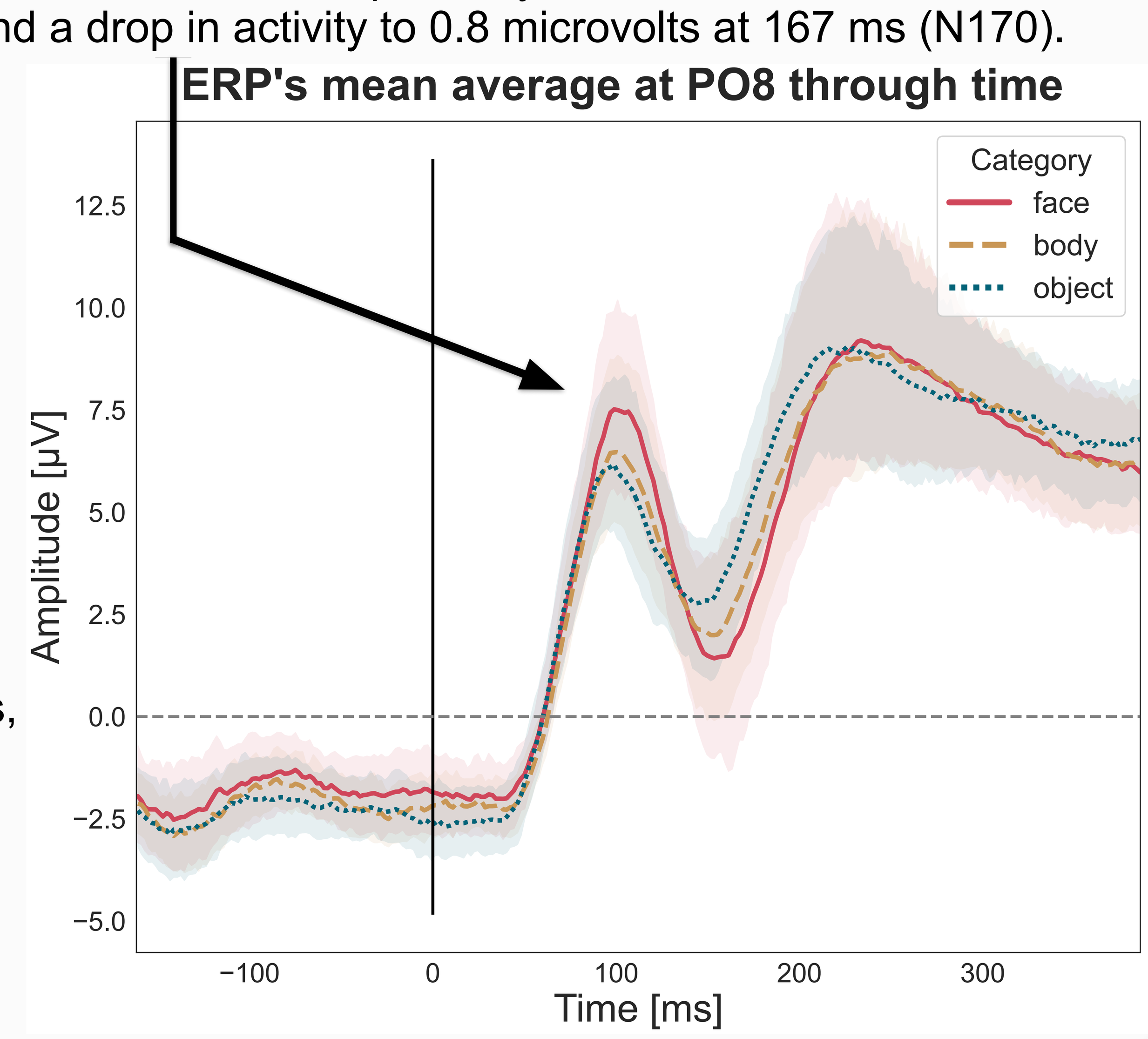


Fig. D

Results

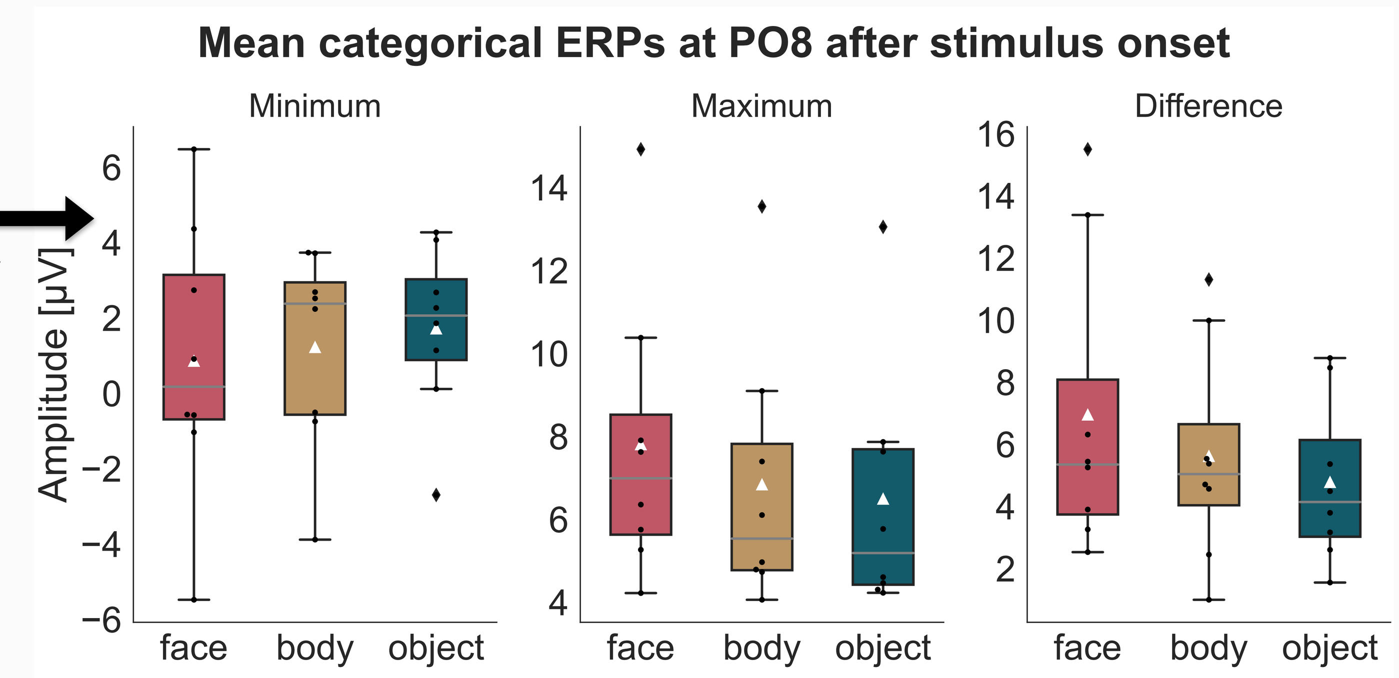


- Single-trial ERP image at PO8 shows positive and negative face-related potentials vertically aligned after stimulus onset.
- Preliminary results (8 subjects) show a robust mean ERP to faces at PO8 with positivity of 7.8 microvolts at 100 ms and a drop in activity to 0.8 microvolts at 167 ms (N170).



- Comparing faces to objects, the positivity was changed after about six microvolts, and the drop in activity differed by about one microvolt.

- Average ERPs to faces have the strongest maximum and minimum activity with a larger difference in amplitude.
- ERPs to bodies are stronger compared to objects, but weaker than faces.



Conclusion & Discussion

- We successfully translated a classical experimental paradigm into a more practical setup combining EEG and VR that can inform and inspire subsequent fully wild investigations.
- We reproduced previous findings associated with a negative ERP component sensitive to faces from a different experimental design perspective.
- This methodological approach sets the stage for wilder, more dynamic investigations.

References:

[1] S. A. Nastase, A. Goldstein, and U. Hasson, "Keep it real: rethinking the primacy of experimental control in cognitive neuroscience," NeuroImage, vol. 222, p. 117254, Nov. 2020.

[2] E. S. Finn, E. Glerean, U. Hasson, and T. Vanderwal, "Naturalistic imaging: The use of ecologically valid conditions to study brain function," NeuroImage, vol. 247, p. 118776, Feb. 2022.

[3] P. König, A. Melnik, C. Goeke, A. L. Gert, S. U. König, and T. C. Kietzmann, "Embodied cognition," in 2018 6th International Conference on Brain-Computer Interface (BCI), Jan. 2018, pp. 1–4.

[4] P. J. Matusz, S. Dikker, A. G. Huth, and C. Perrodin, "Are We Ready for Real-world Neuroscience?," J. Cogn. Neurosci., vol. 31, no. 3, pp. 327–338, Mar. 2019.

[5] M. J. Farah, K. D. Wilson, J. N. Tanaka, and M. Drain, "What Is "Special " About Face Perception?" 1998.

[6] S. Bentin, T. Allison, A. Puce, E. Perez, and G. McCarthy, "Electrophysiological Studies of Face Perception in Humans," J. Cogn. Neurosci., vol. 8, pp. 551–565, Nov. 1996.

[7] G. A. Rousselet, M. J.-M. Macé, and M. Fabre-Thorpe, "Animal and human faces in natural scenes: How specific to human faces is the N170 ERP component?," J. Vis., vol. 4, no. 1, p. 2, Jan. 2004.

[8] A. L. Gert, B. V. Ehinger, S. Timm, T. C. Kietzmann, and P. König, "Wild lab: A naturalistic free viewing experiment reveals previously unknown EEG signatures of face processing." 2021.

E-mail: jmadridcarva@uni-osnabrueck.de | Tweeter: @JohnMadrid92