

Potentials Evoked by Ocular Fixations while Processing Emotional Facial Expressions

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Objectives

The processing of **Emotional Facial Expressions** (EFE) is usually performed through either the analysis of the oculomotor activity or the cerebral activity evoked and time-locked to the appearance of faces.

New methodology: cerebral activity synchronized to the ocular fixations → **Eye Fixation Related Potentials** (EFRPs) → literature only on complex scenes such as natural scenes, not yet on faces, nor on EFES.

This study's contribution is twofold :

- 1) methodological contribution on the usability of EFRPs for the study of face processing and EFES
- 2) upstream research on the cognitive mechanisms involved in emotional information processing → here for **disgust vs. Neutral for natural EFES**

Literature only on ERPs of EFES → expectations:

Modulation of the mean amplitude of the **N170** and the **EPN** (early posterior negativity) components due to the emotional condition (disgust) compared to the neutral condition [Batty & Taylor, 2003; Trautmann et al., 2013].

Experiment

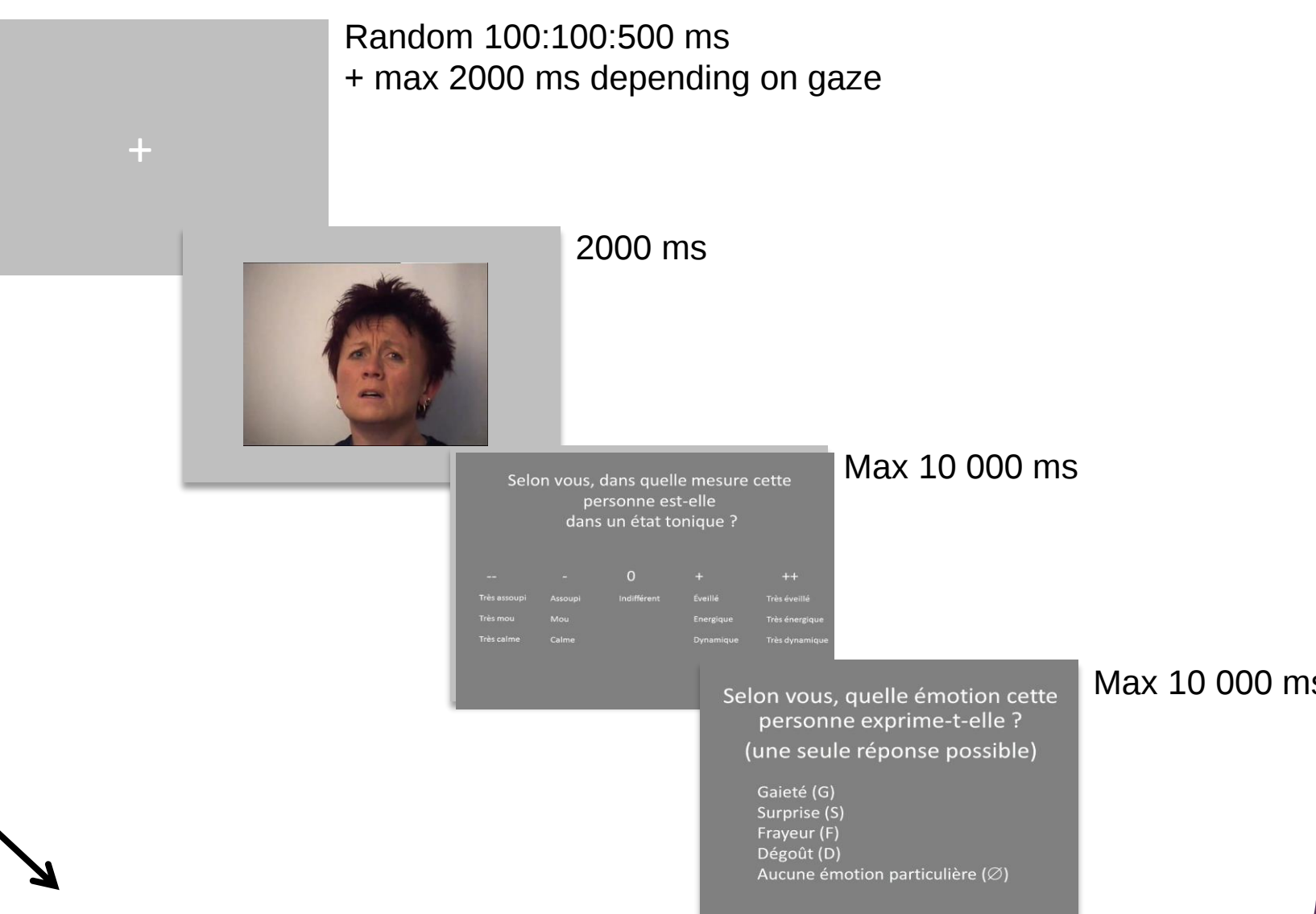
- 15 participants between 20 and 40 years old
- **DynEmo database**: actual people expressing their emotions –happiness, surprise, fear, disgust, neutral-, not actors. Apex of the emotional response, evaluated by 20 judges.
- **ecological material** [Tcherkassof et al., 2009]

- 12 pictures for the disgust condition, 24 for the neutral one.

1st part: Attentive exploration



2nd part: Annotation (arousal & emotion)



'try and be empathic with the people displayed in the pictures'

Co-registration: EEG and Eye-movements

Data acquisition

EEG:

- BrainCap - 64 active electrodes (Brain Products GmbH)
- Reference FCz - Ground AFz
- Sampling frequency: 1000 Hz



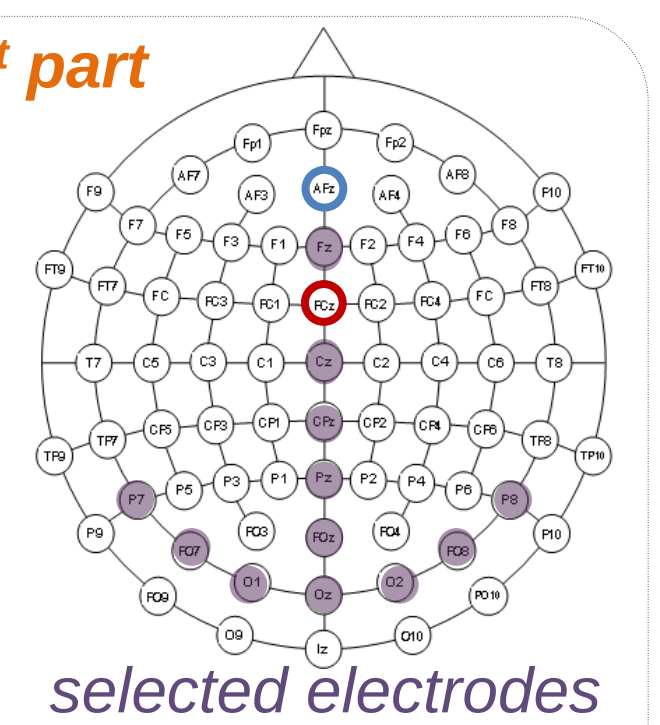
Eye-Tracker:

- Eyelink 1000 (SR Research)
- Sampling frequency: 1000 Hz

Data processing *only on the 1st part*

Synchronization:

- Same sampling frequency
- Time-alignment with common hardware triggers



selected electrodes

Artifacts rejection: *Semi-automated*

- Frequency filtering: 1-70 Hz + 50 Hz notch filter
- Channels: Visual inspection & interpolation
- Ocular artifacts: SOBI algorithm, cancelation of sources most correlated to EOG
- Epochs: rejection (0.8% in average) based on a variance criterion (if > mean + 3 sd).

Marker extraction:

- ERPs: stimulus appearance, baseline correction -200 to 0 ms,
- EFRPs: ocular fixations, baseline correction -200 to -100 ms
- components: P1, N170 & EPN

Repeated measure ANOVAs & Tukey post-hoc tests.

Scanpaths of one participant:

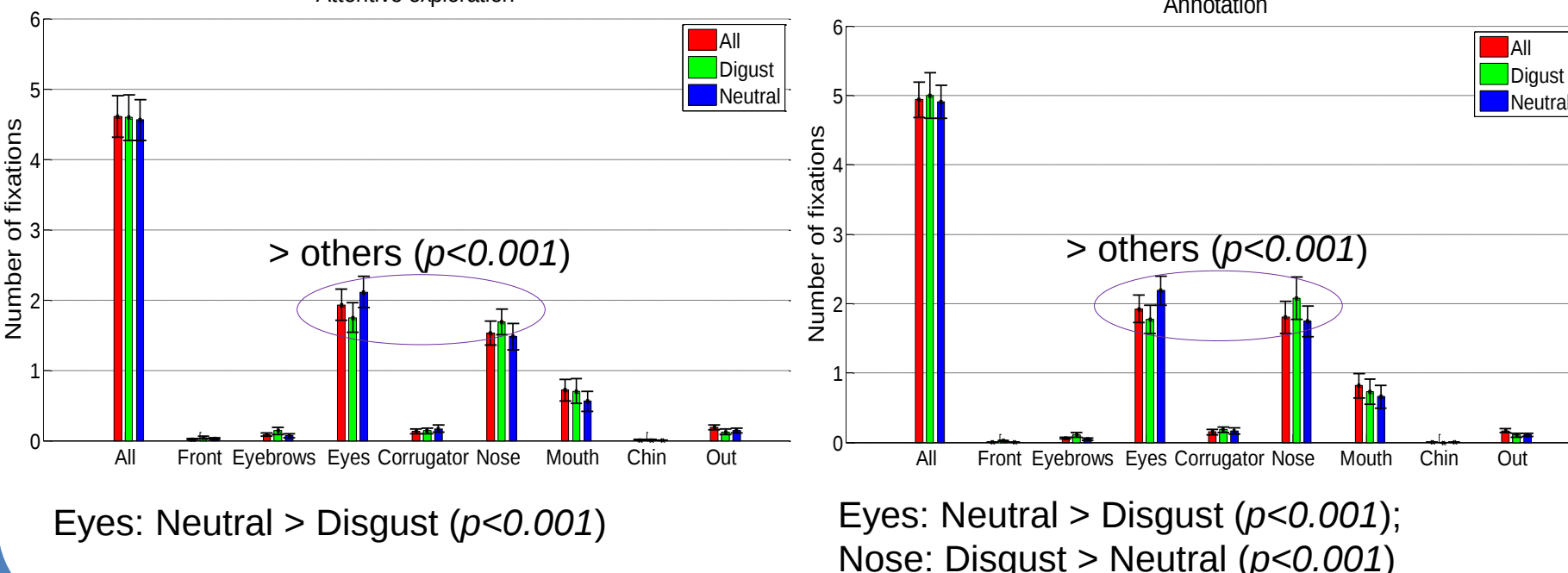
Ocular activity



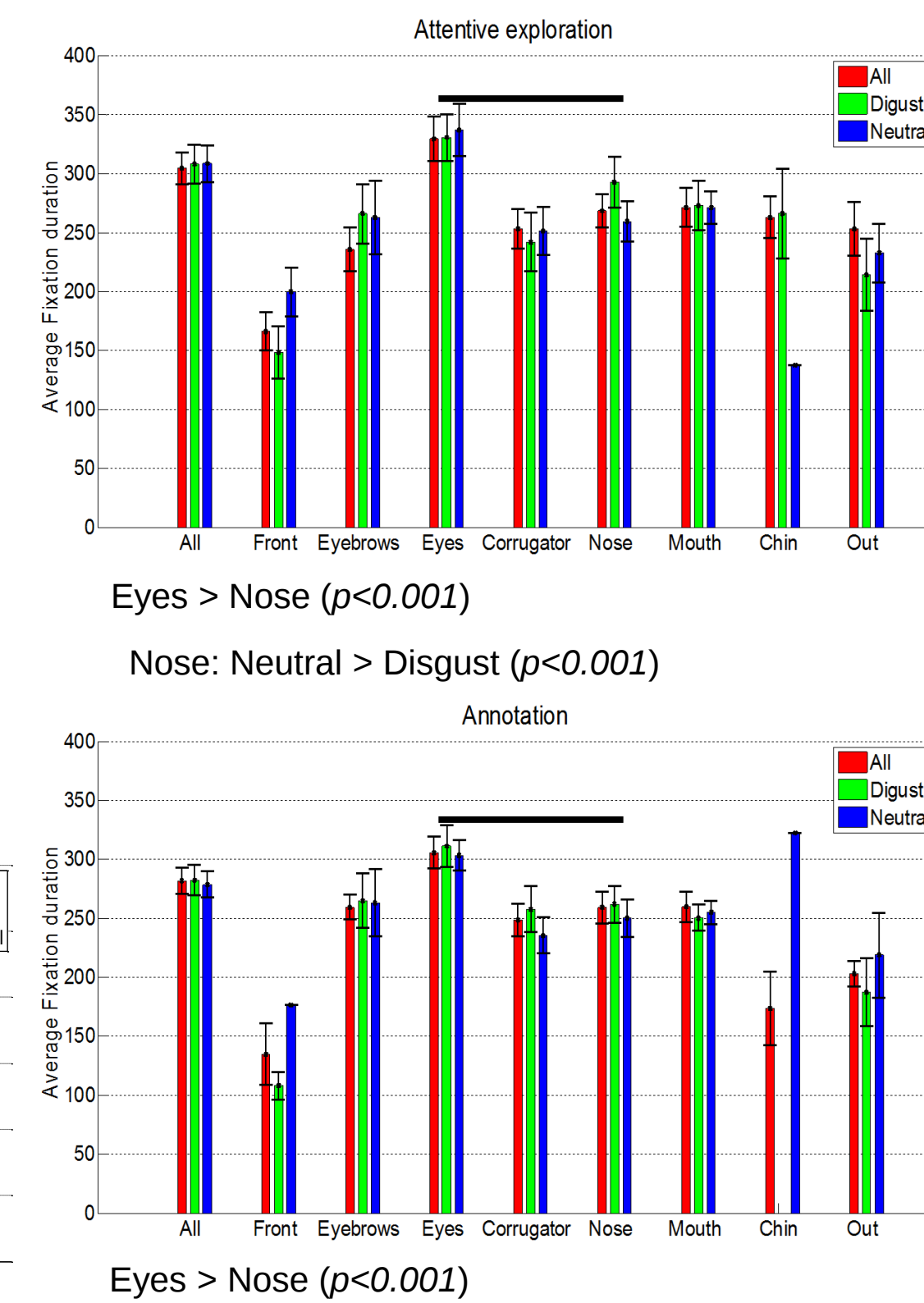
Recognition rates:

	H	S	F	D	N	Other
N	0.03	0.19	0.05	0.09	0.63	0.02
D	0.02	0.06	0.16	0.67	0.06	0.03

Number of fixations:



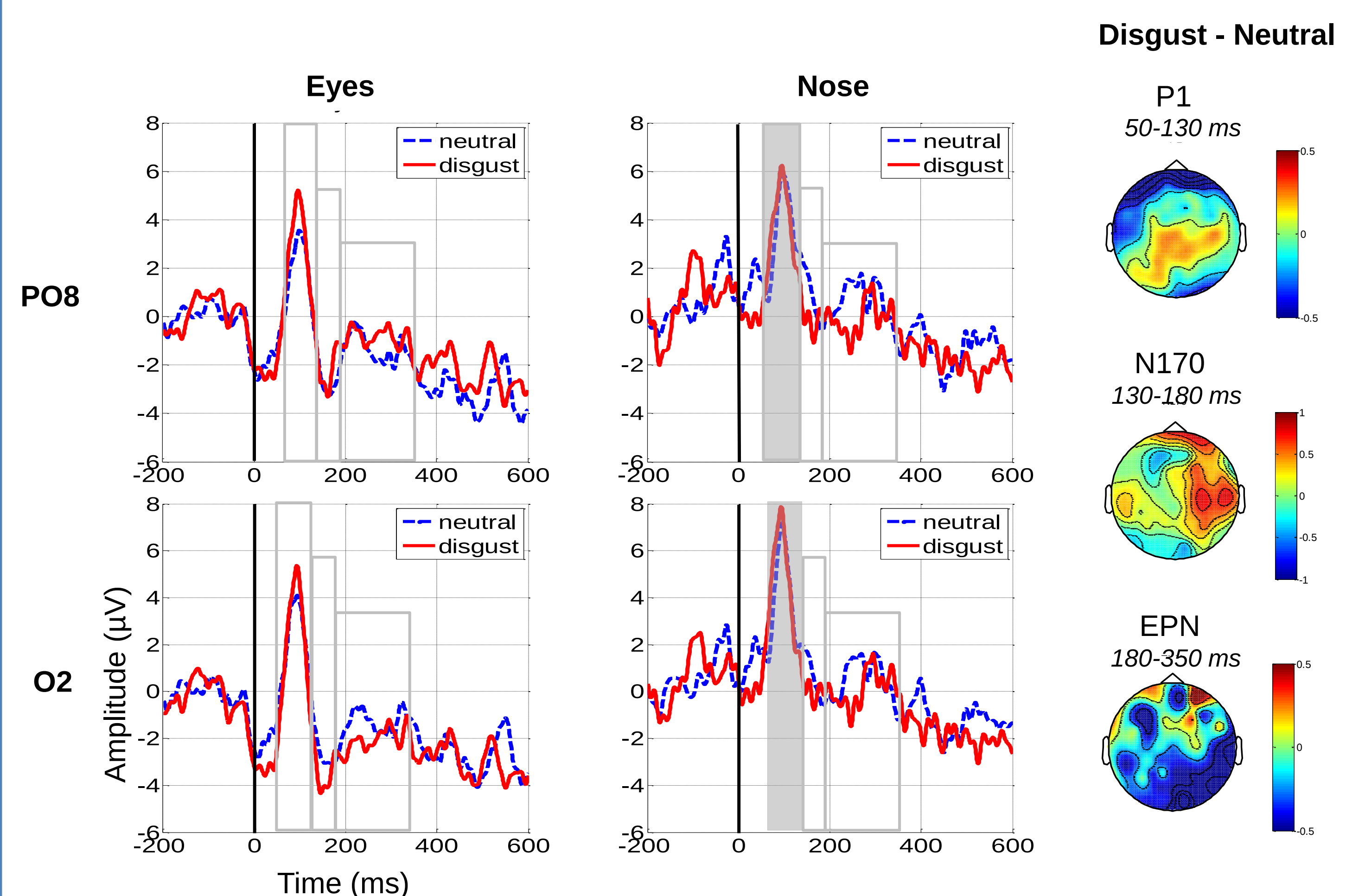
Fixation duration:



Eye Fixation Related Potentials

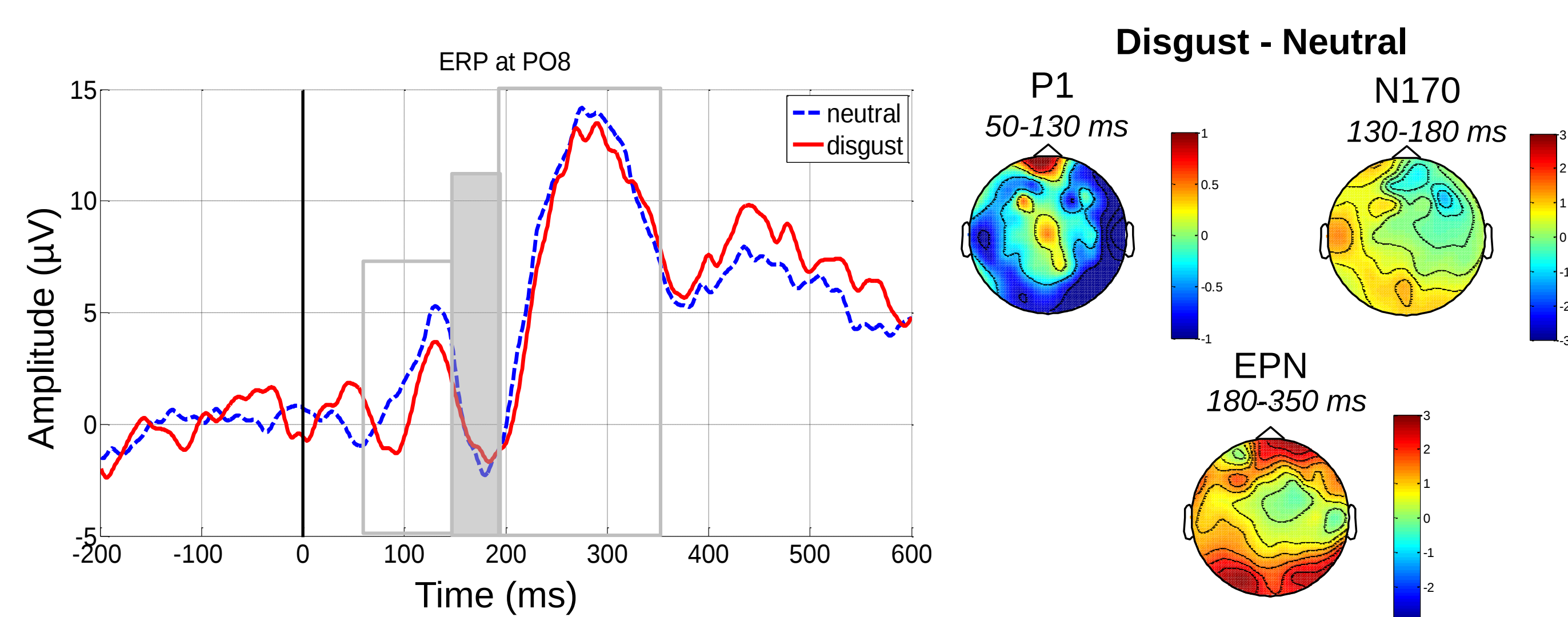
- **disgust > neutral** for the P1, nose only, at P8, PO8 and O2 ($p<0.05$).

- **nose > eyes** for the N170, neutral only, at P8, POz, PO8, Oz, O1 and O2 ($p<0.05$)
- **nose > eyes** for the EPN, disgust at POz O2 / neutral at P7, PO8, Oz, O1 and O2 ($p<0.05$).



Event Related Potentials

disgust < neutral for the N170 trend, e.g. on electrode PO8 ($p=0.06$)



Conclusions

Promising preliminary study!

Main results: ERP modulation close to the literature and existent EFRP modulation, with different patterns than for ERPs, and modulation depending on ROI.

Limits: number of participants, should use own responses to label the trials, investigate more ROIs, more electrodes and refine the time windows. Additional challenge: denoise the overlapped potentials.

References:

- Batty, M. & Taylor, M.J. (2003). Early processing of the six basic facial emotional expressions, Cognitive Brain Research, 17: 613-620.
- Trautmann, S. A., Domínguez, J., Escera, C., Herrman, M. & Fehr, T. (2013). The Perception of Dynamic and Static Facial Expressions of Happiness and Disgust Investigated by ERPs and fMRI Constrained Source Analysis. PloSOne, 8 (6), e66997.
- Tcherkassof, A., Dubois, M., Adam, J.-M., Mandran, N., Meillon, B., Caplier, A., Mermillod, M., Benoît, A.-M. & Guérin-Dugué, A. (2009). Création d'un corpus d'expressions émotionnelles faciales spontanées et dynamiques : DynEmo. Rapport de fin de projet, Agence Nationale de la Recherche, France, mars, 15 p.

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