Objectives

- Study the Emotional Facial Expressions (EFE) processing: experimental data based on EEG activities synchronized with ocular fixations.
- Observations: Event-Related Potential (ERP) at the stimulus onset and first Eye Fixation-Related Potential (EFRP).
- Methodology: Estimation using the General Linear Model (GLM) because of responses overlap (Kristensen et al., 2011) between the ERP at the stimulus onset and the first EFRP.
- Components linked to emotional processing: N170, EPN (Early Positive N400), LPP (Late Positive Potential), (Schupp et al., 2011).
- Focus on LPP: elaborative processing and conscious recognition (Schupp et al., 2003).

Assumptions

- The LPP latency includes the first fixation onset.
- The LPP amplitude estimated by average on the signal time-locked at the stimulus onset is also function of the response at the first fixation that begins the visual exploration of the Emotional Facial Expression.
- By GLM to be able to split what is due to the perception of the stimulus presentation without eye movements and what is due to the perception of the first gaze region.

Examples of scalp maps

Neutral

Disgust

Surprise

Happiness

Behavioral results

- Recognition rate, Fixations duration and first fixation latency
  - Mean (sd)

Co-registration: EEG and Eye-movements

Data acquisition

- EEG: BrainCap - 64 active electrodes
  - Reference FCz - Ground AFz
  - Sampling frequency: 1000 Hz

Data pre-processing

- Time alignment with common hardware triggers
- Artifacts rejection: Semi-automated procedure
- Frequency filtering: 1-70 Hz + 50 Hz notch filter
- Channels: Visual inspection & interpolation
- Ocular artifacts: SIOI algorithm, cancelation of sources most correlated to EOG
- Epochs: rejection (6.8% in average) based on a variance criterion (if > mean + 3 sd)

ERG and EFRP estimations by GLM

Estimation with GLM: ERP at the stimulus onset

- Overlap: ERP at the stimulus onset (Av(t)) and EFRP at the first fixation onset (a1(t))
  - Model for the ith trial: X(t) = e(t) + a1(t) − e(t−τ) + i
  - Matrix formulation:
    \[ x = D_{o} \cdot a_{1} + D_{o} \cdot a_{2} + N \]
  - Toepilz matrices with their respective lattices
- \( x(t) \): potential evoked at the stimulus onset (ERP)
- \( a_{1}(t) \): potential evoked at the stimulus onset (First EFRP)
- \( a_{2}(t) \): potential evoked at the stimulus onset (Second EFRP)

Solution

- \( \hat{a}_{GLM} \) such as \( \min ( mean^{2} ) = \min ( || x - D_{o} \cdot a_{1} + D_{o} \cdot a_{2} ||^{2} ) \)
  - \( \hat{a}_{GLM} = (D_{o}^{T} \cdot D_{o})^{-1} \cdot D_{o} \cdot x \)

Conclusions

- It is the first attempt to distinguish in the LPP response what comes from to the stimulus presentation alone (Av(t)GLM). In contrast, the usual estimation (Av(t)1/GLM) includes the very beginning of the EFE exploration (first fixation).
- Cognitive processing from the first fixation onset strengthens an activities pattern at left frontal site - more involved for positive EFE (Ahern, Schartner, 1979): Becoming significant across EFE. But, at right frontal site - more involved for negative EFE - another activities pattern, only elicited by the stimulus presentation, is at once significant across EFE.
- These findings are in line with faster and facilitated perceptual processing for negative EFE (Schupp et al., 2004).

References