Time course of socio-cognitive processes using ERPs: an introduction

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CS 886 – guest lecture
November 12, 2024

Importance of the face for non-verbal communication and social interactions

Faces: a window to others' minds

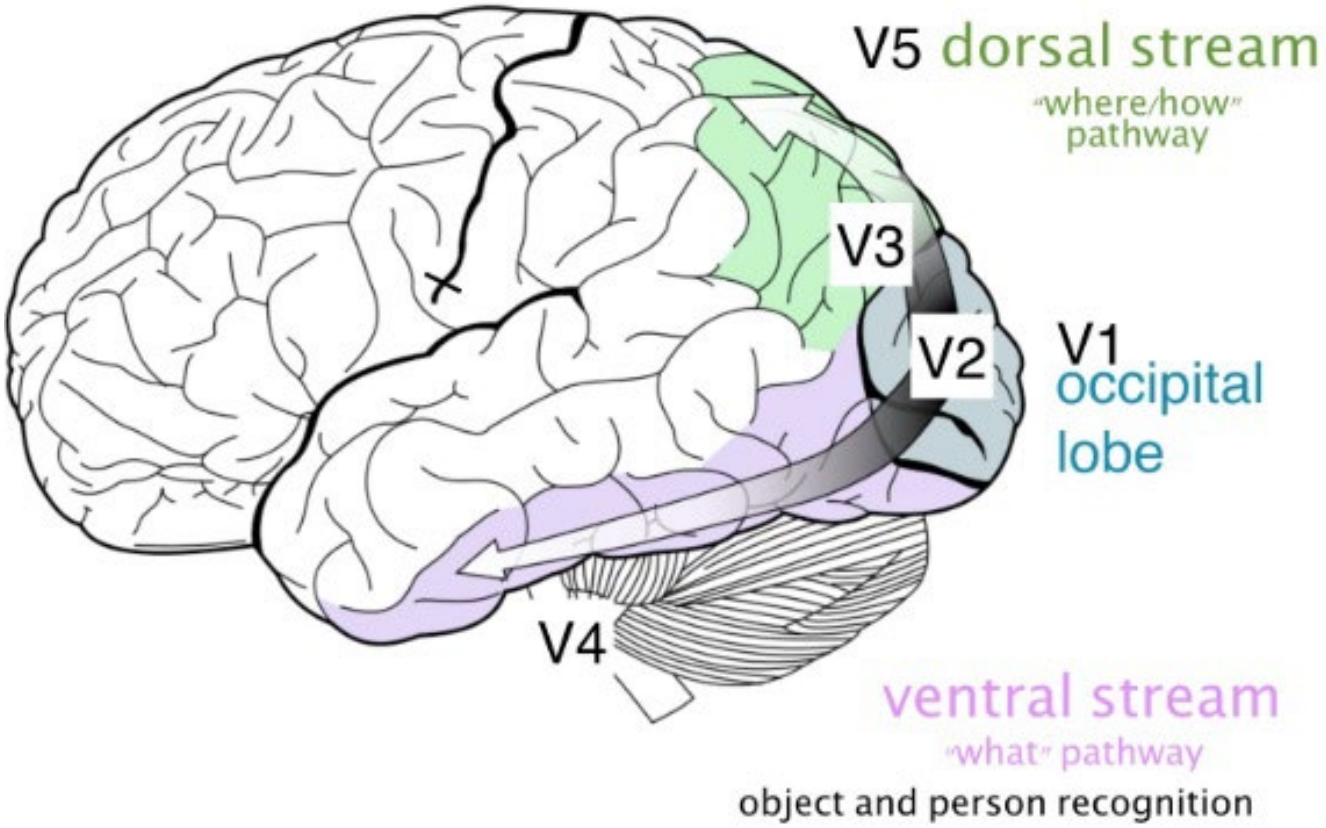
Identity

Gaze

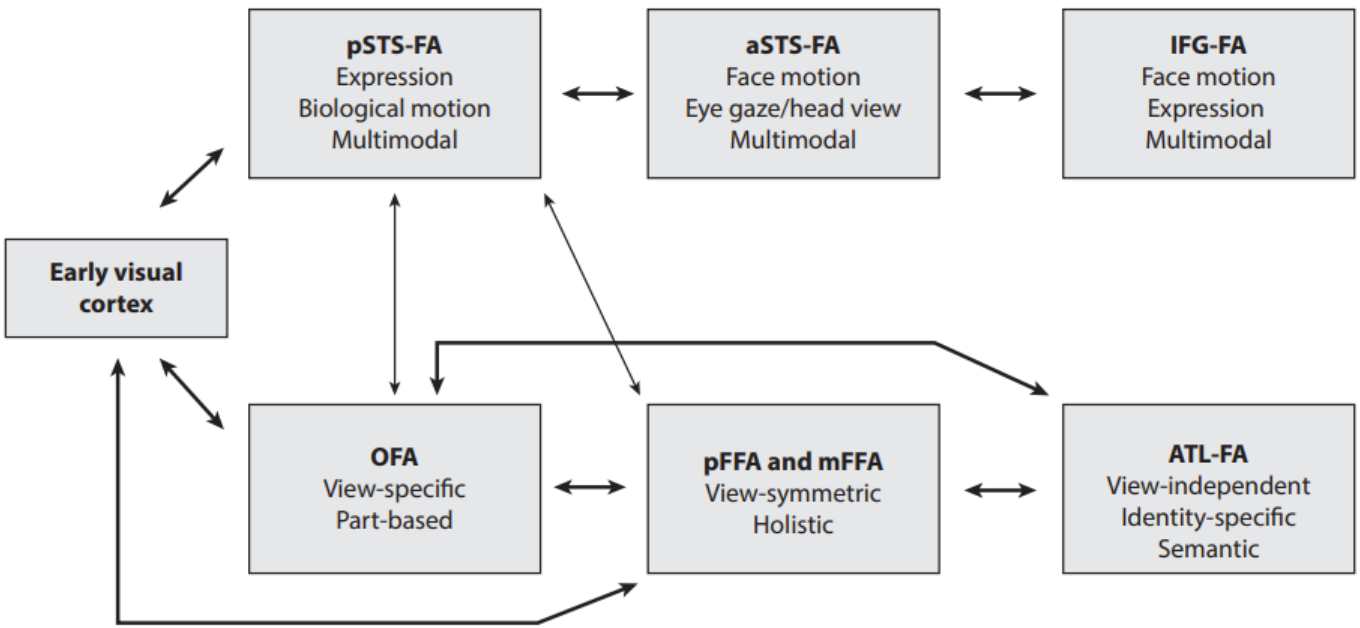
Emotions

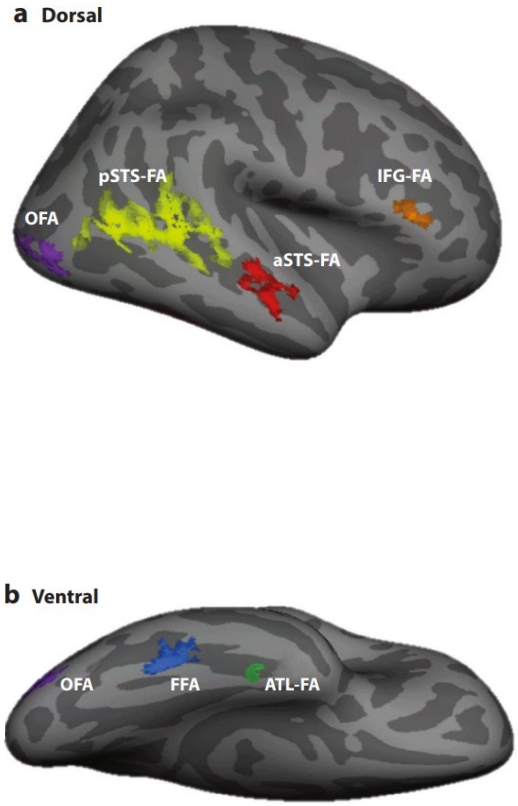
attractiveness
gender
age
trust

Reminder: 2 visual processing pathways



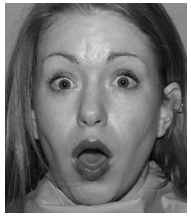
Face processing model - imaging literature

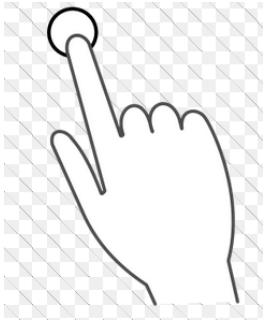




Duchaine & Yovel, 2015

Brain processes are extremely fast





Identity, gender, basic emotion discrimination tasks – RT < 500ms

Measures of processing time

*__Reaction times__ – end result of discrimination process

*__Saccade latencies__ – only in specific paradigms

*__Electroencephalography (EEG)__- non-invasive measure of underlying neuronal activity

- Continuous measure - from stimulus to response
- **ERP** components - physiological markers for specific cognitive processes

The ERP/MEEG techniques in research

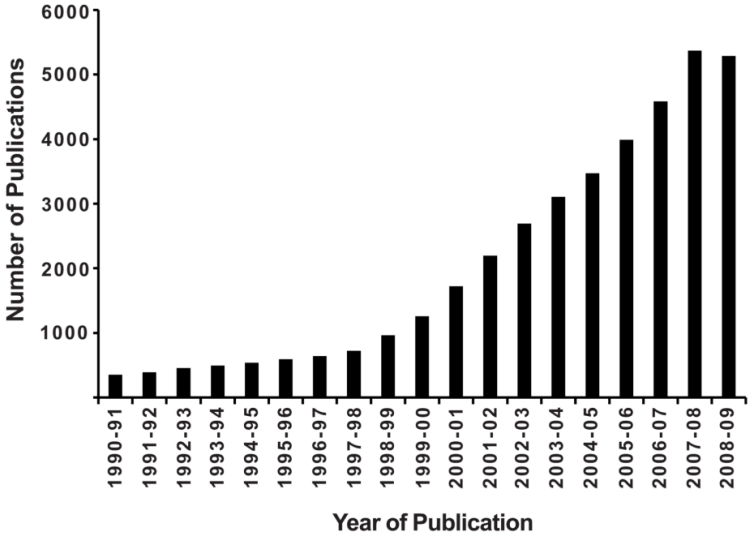
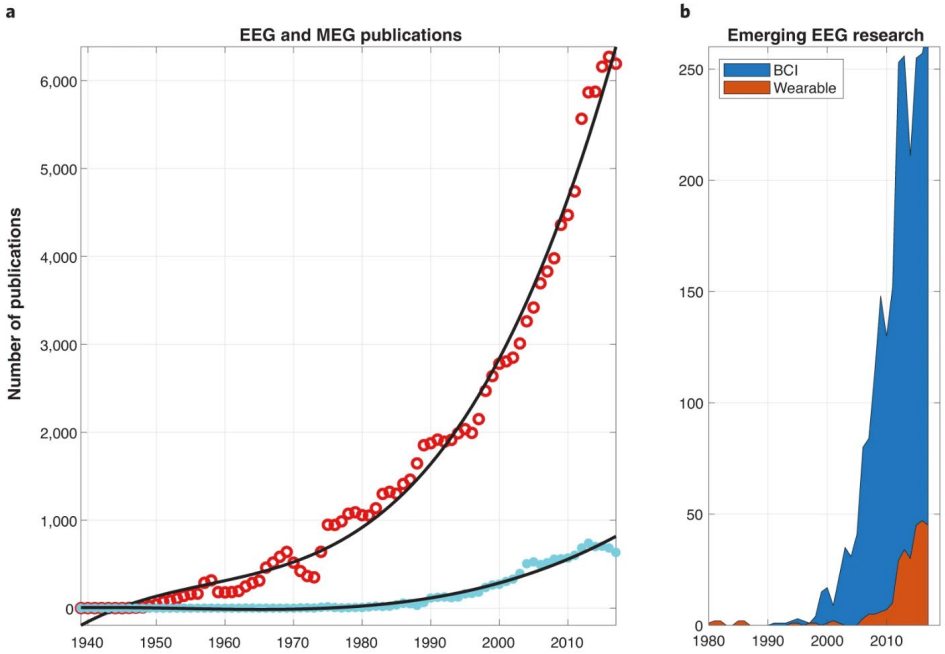


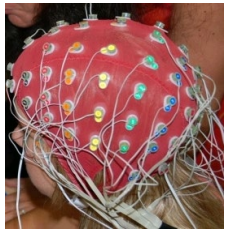
Figure 5.
Number of event-related potential papers by year of publication. Data derived from PsychInfo searches for the terms event-related potential, ERP, or evoked potential in any search field.

Woodman, 2010

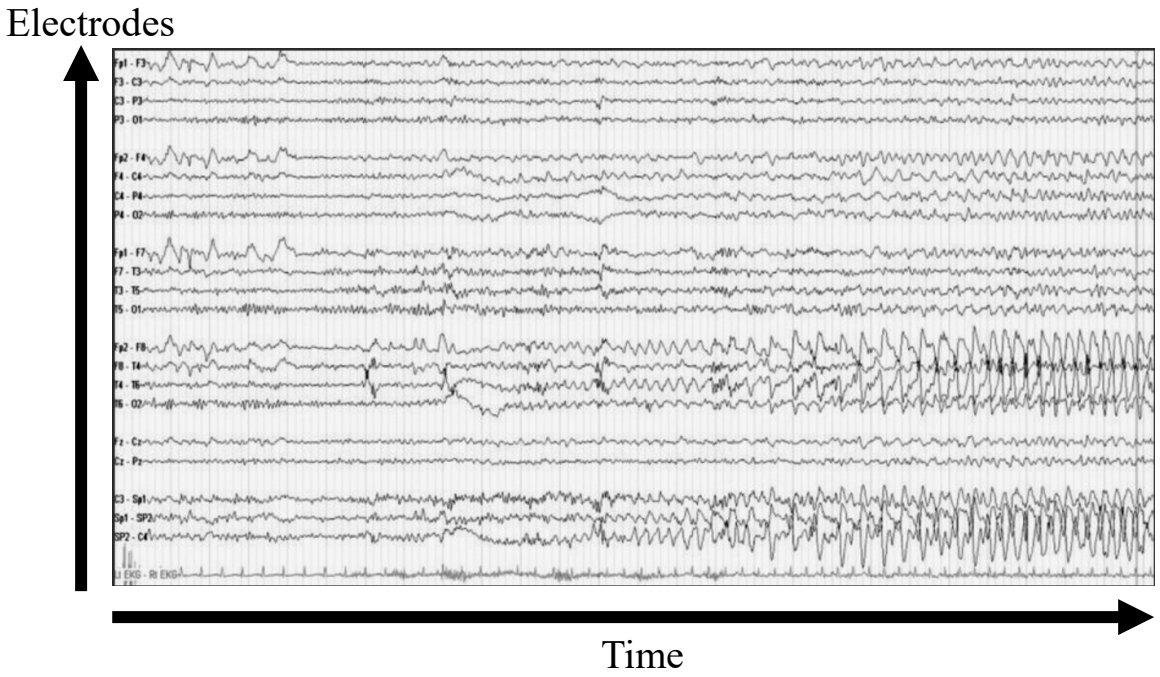


Pernet et al., 2020

Electroencephalography - EEG



- EEG data reflects changes in scalp-recorded electrical activity over time



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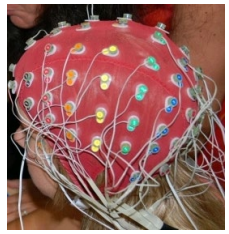
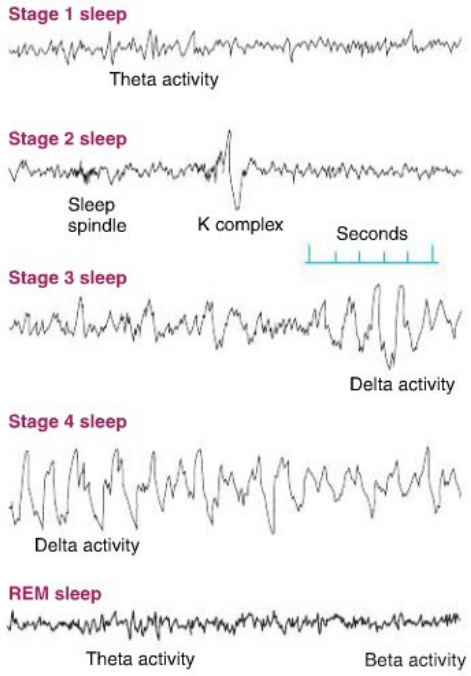


- voltage differences between electrodes placed on scalp
- helps diagnosis (e.g. epilepsy; anomalies in rhythmic brain activities, sleep stages ..)
- Used in research



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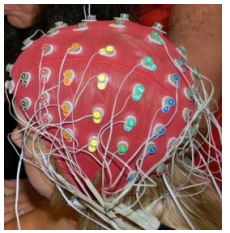
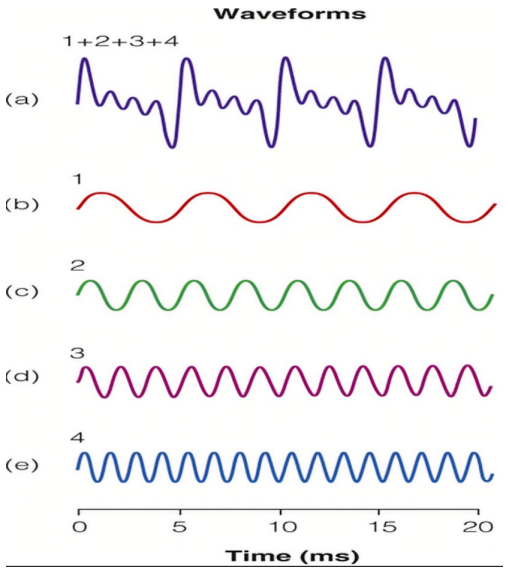
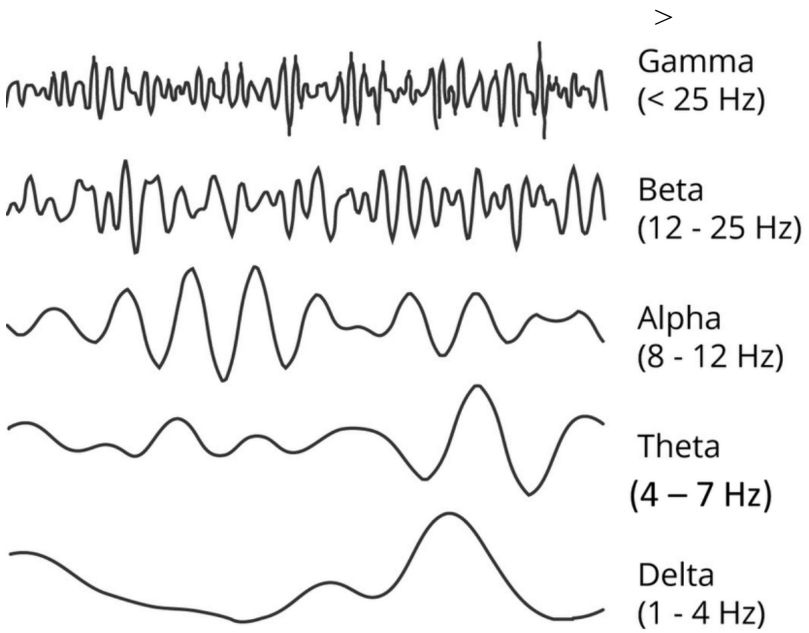
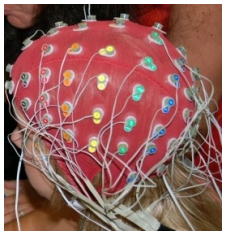


- Combination of oscillations or sine waves of varying frequencies

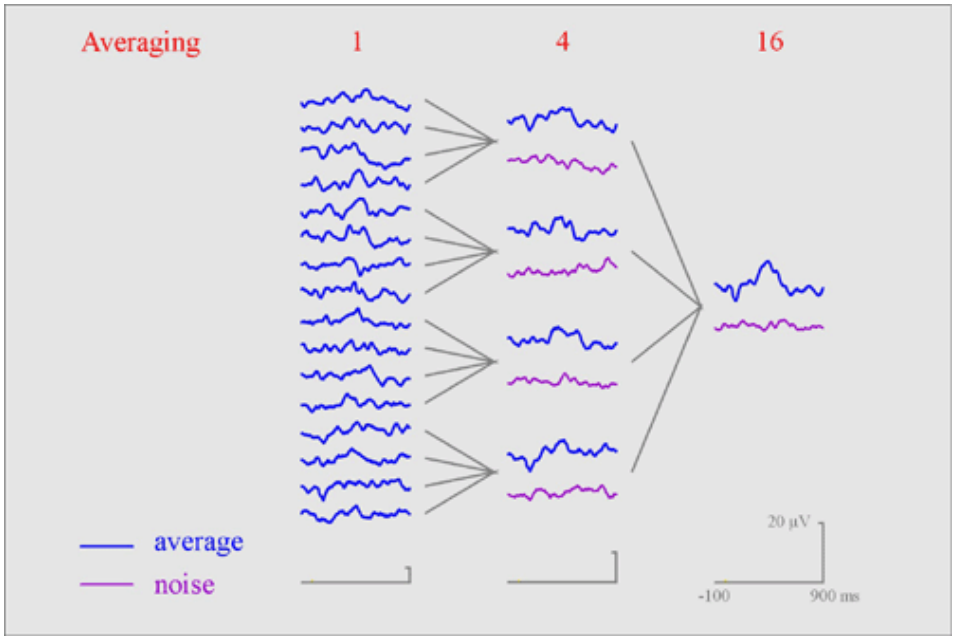


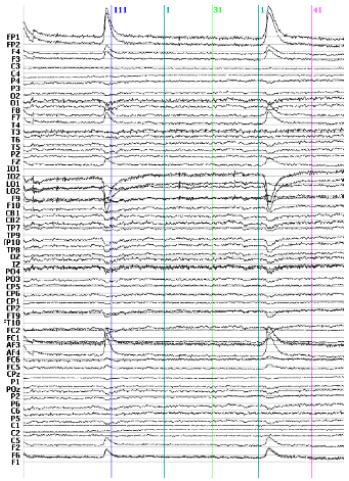


Event-Related Potentials (ERPs)



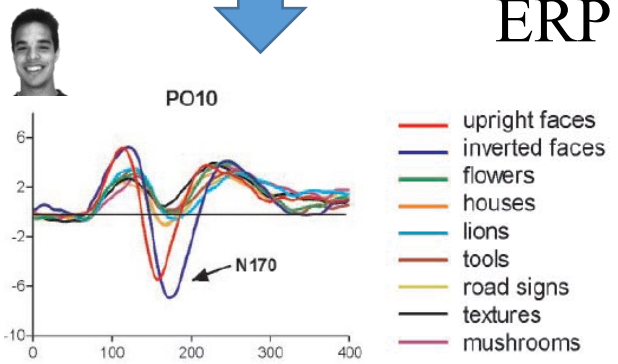
- special analysis of EEG signal
- link activity to perception/processing of stimulus/task
- averaging activity across many trials





EEG

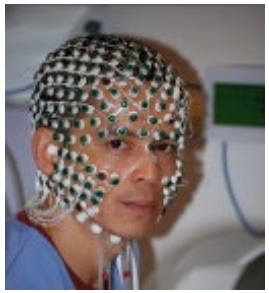
ERP



Itier & Taylor, 2004
Cerebral Cortex

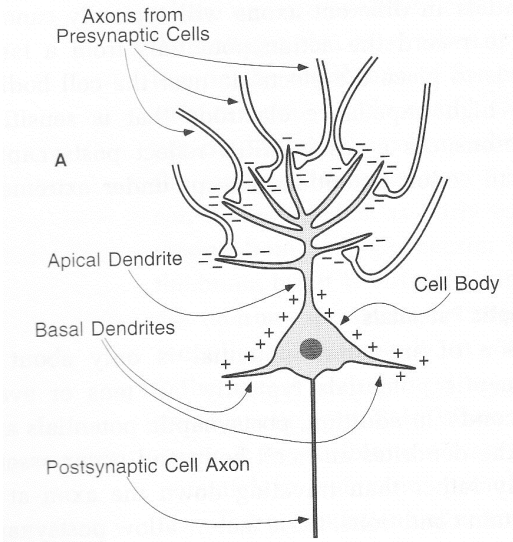
EEG/ERPs

- Totally non-invasive (scalp)
- Excellent temporal resolution – **“when”** but poor spatial resolution
- Measures cortical activity, not deep sources
- Length of participant “preparation”
- Poor signal to noise ratio (large trial number required + complex sophisticated preprocessing pipeline)

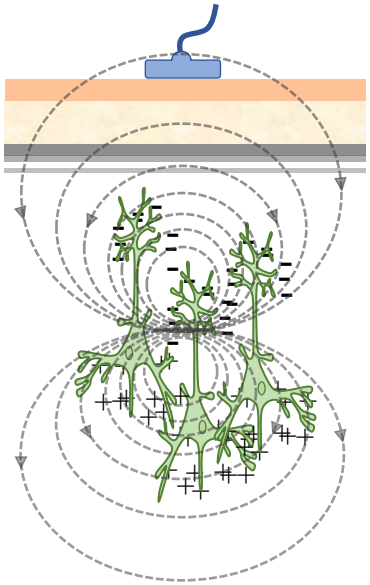


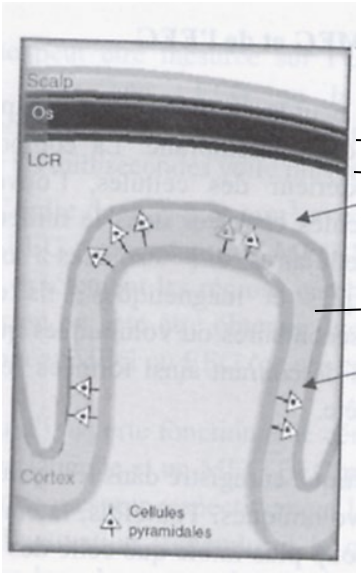
Physiological bases of EEG

- ***Direct*** measure of neuronal activity – post-synaptic potentials
- Postsynaptic currents last 10 to 100ms
- Currents reach the scalp only if they are strong enough
- Scalp activity comes from neurons in cortex whose dendrites form a column
- Deep and circular structures aren't caught

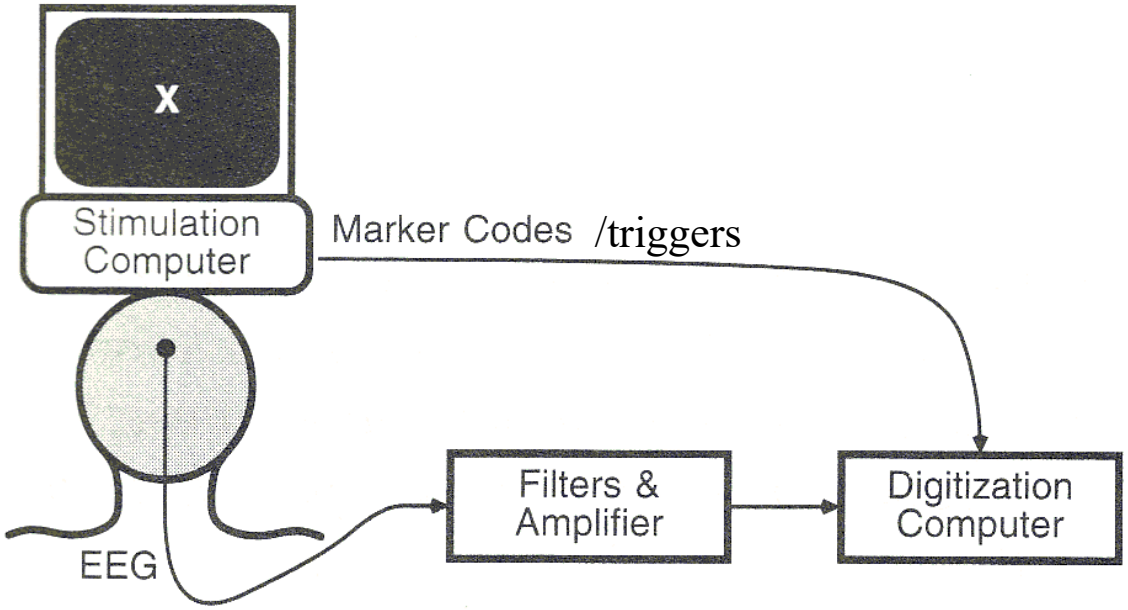


Luck, 2005





ERP experiment set-up



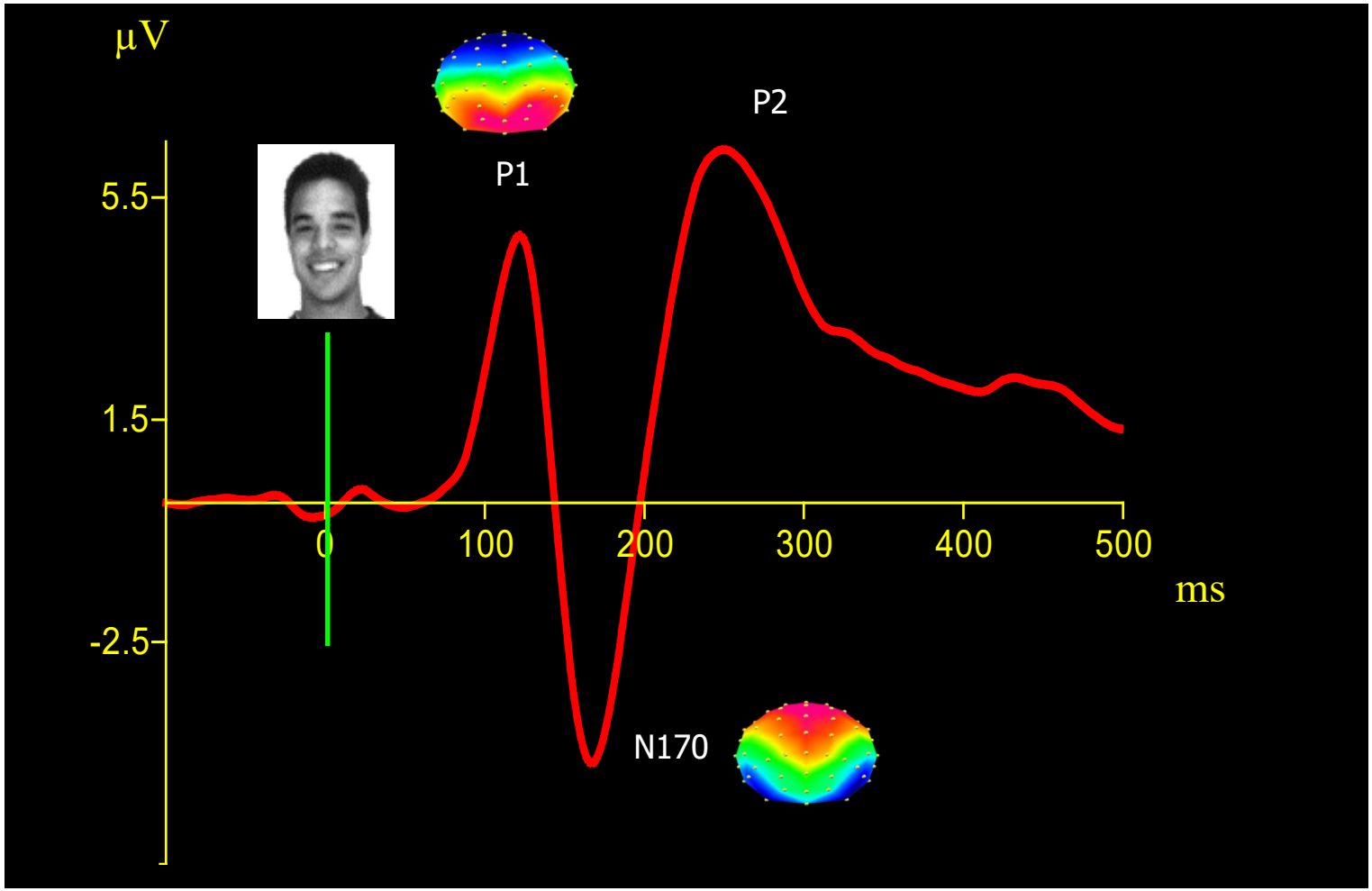
Luck, 2005

ViewSonic

When does visual discrimination occur ?

Early Visual ERPs : P1, N170, P2, EPN

Later ERPs: P3, LPP



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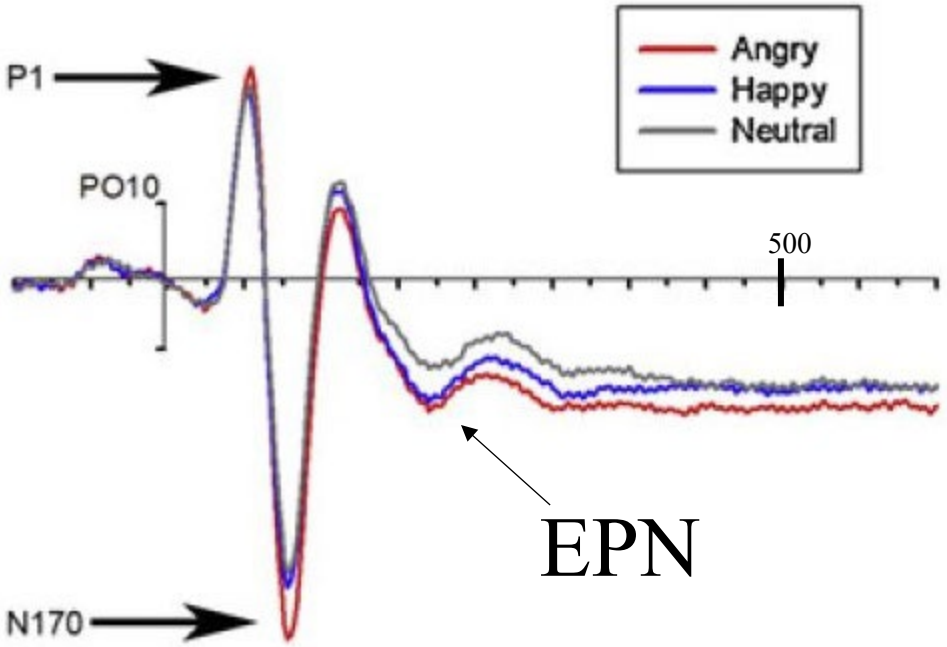
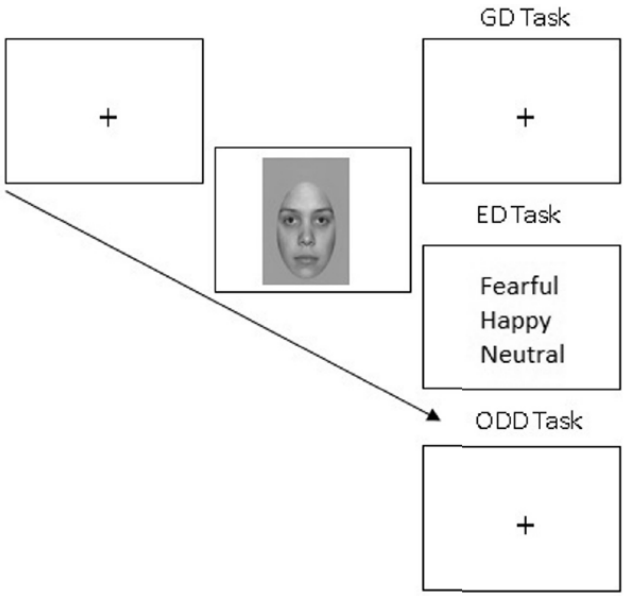


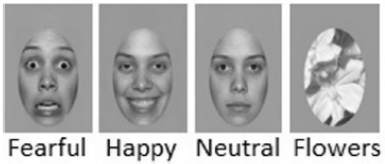
-emotion > neutral
-valence or arousal?
-220-350ms but may start around 150ms, right after N170

Rellecke et al., 2012, Biological Psychology

Role of task demands?

Emotion perception – gender, emotion, oddball tasks





Linear Modeling toolbox (LIMO) – Mass univariate

3 emotion x 3 task ANOVA @ every time point and electrode

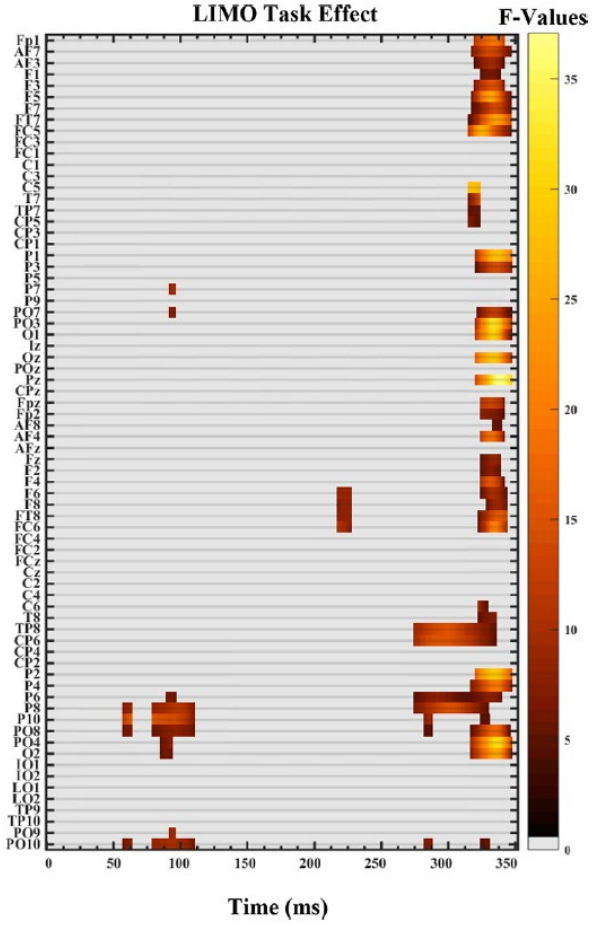
Threshold-free Clustering Enhancement (TFCE) correction

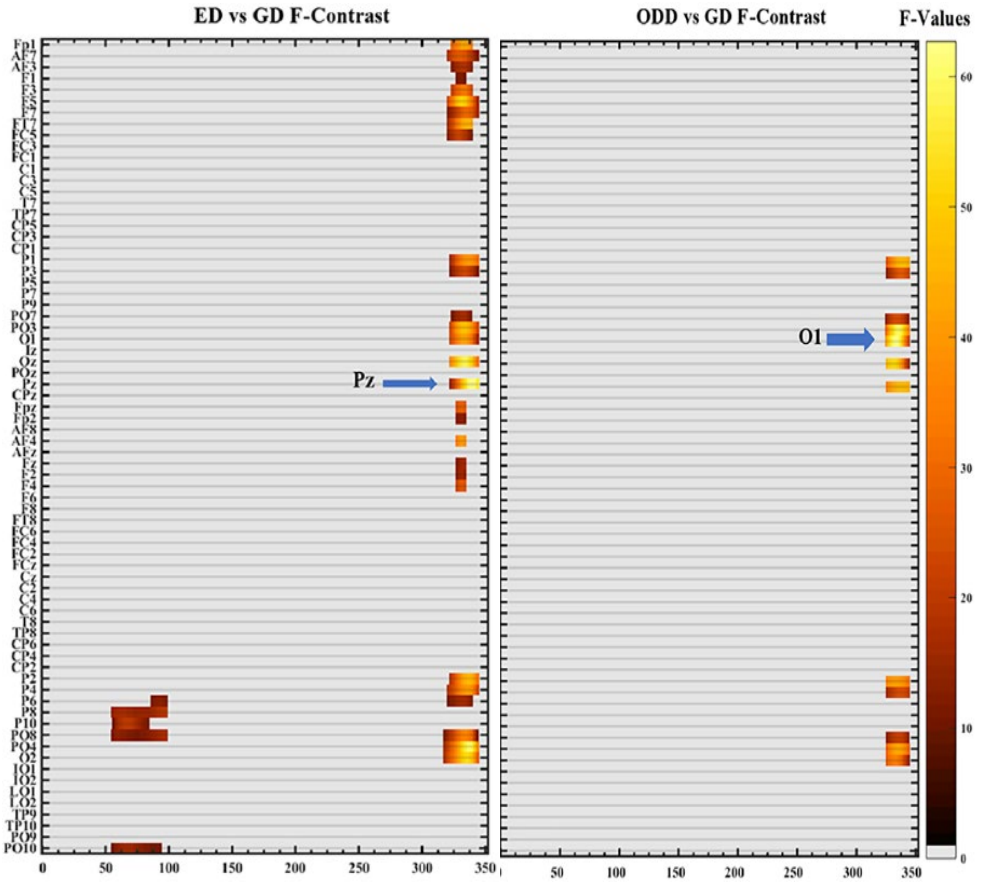
Reduce Type I and Type II errors

N=24 (11F, 13M) with LIMO
Gaze-contingent presentation (with eye tracker): nose fixation
96 trials/condition
Within-subject
Tasks blocked; block order counterbalanced

Itier & Neath-Tavares, 2017, Brain Research
Durston & Itier, 2021, Brain Research

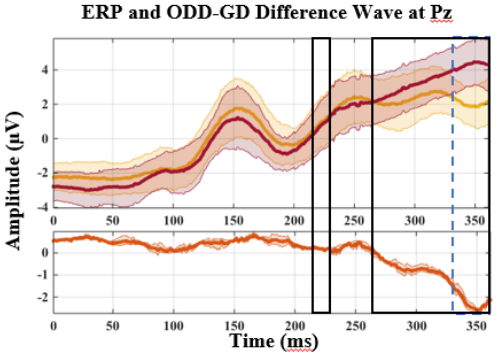
Emotion perception – gender, emotion, oddball tasks

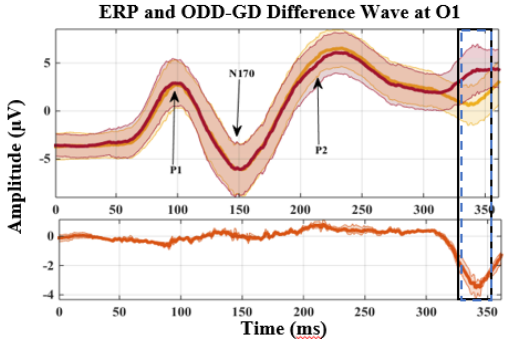




RT: GD << ED

ED-ODD contrast n.s.





Durston & Itier, 2021, Brain Research

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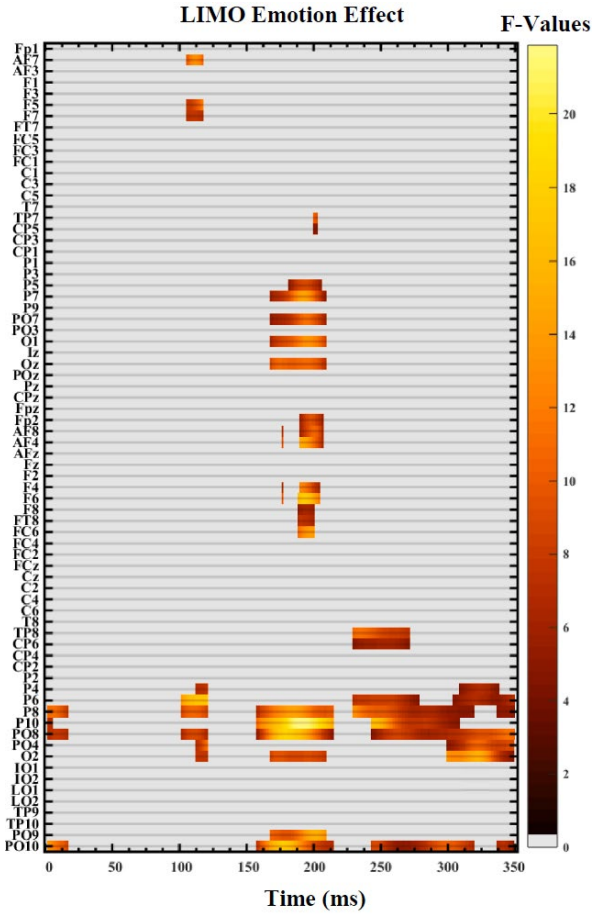
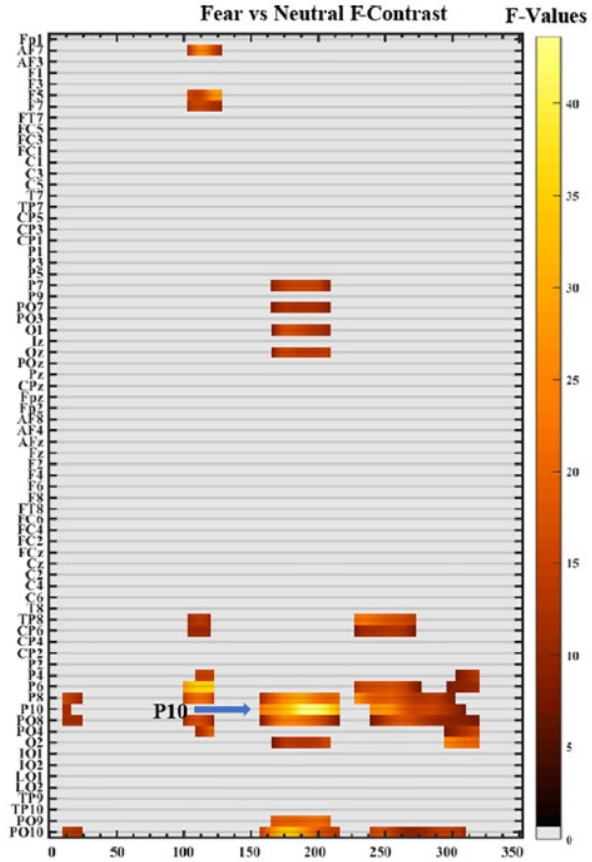
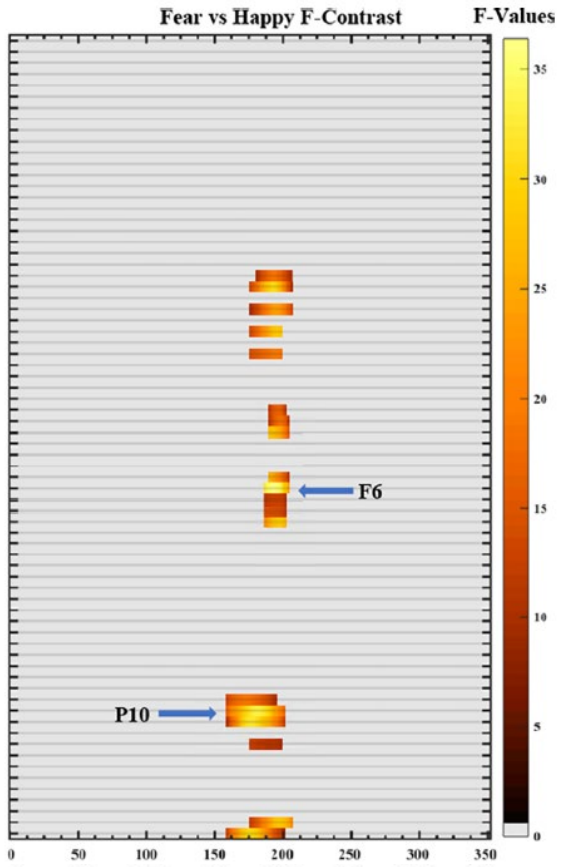
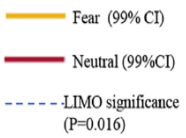
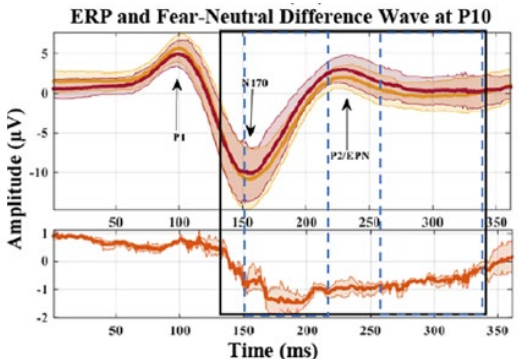


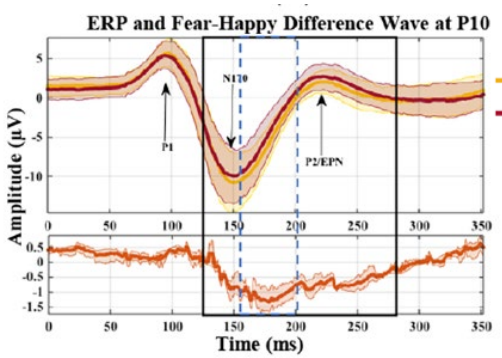




No Task x emotion interaction anywhere!

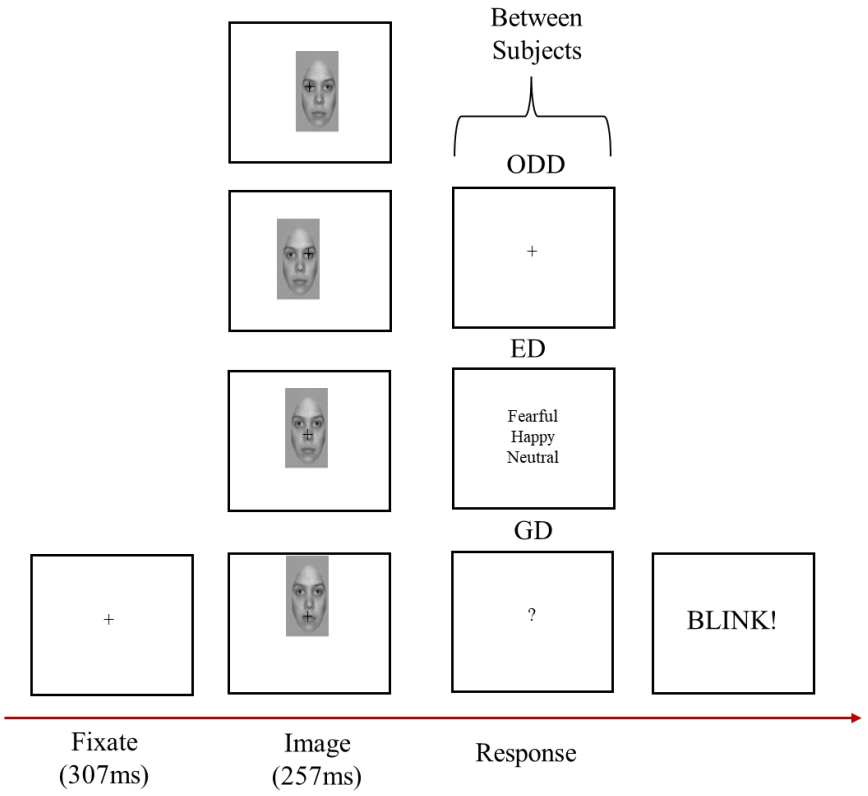


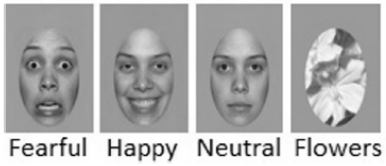




Durston & Itier, 2021, Brain Research

Emotion perception – gender, emotion, oddball tasks





N=54 (19 ED, 17 GD, 18 ODD)

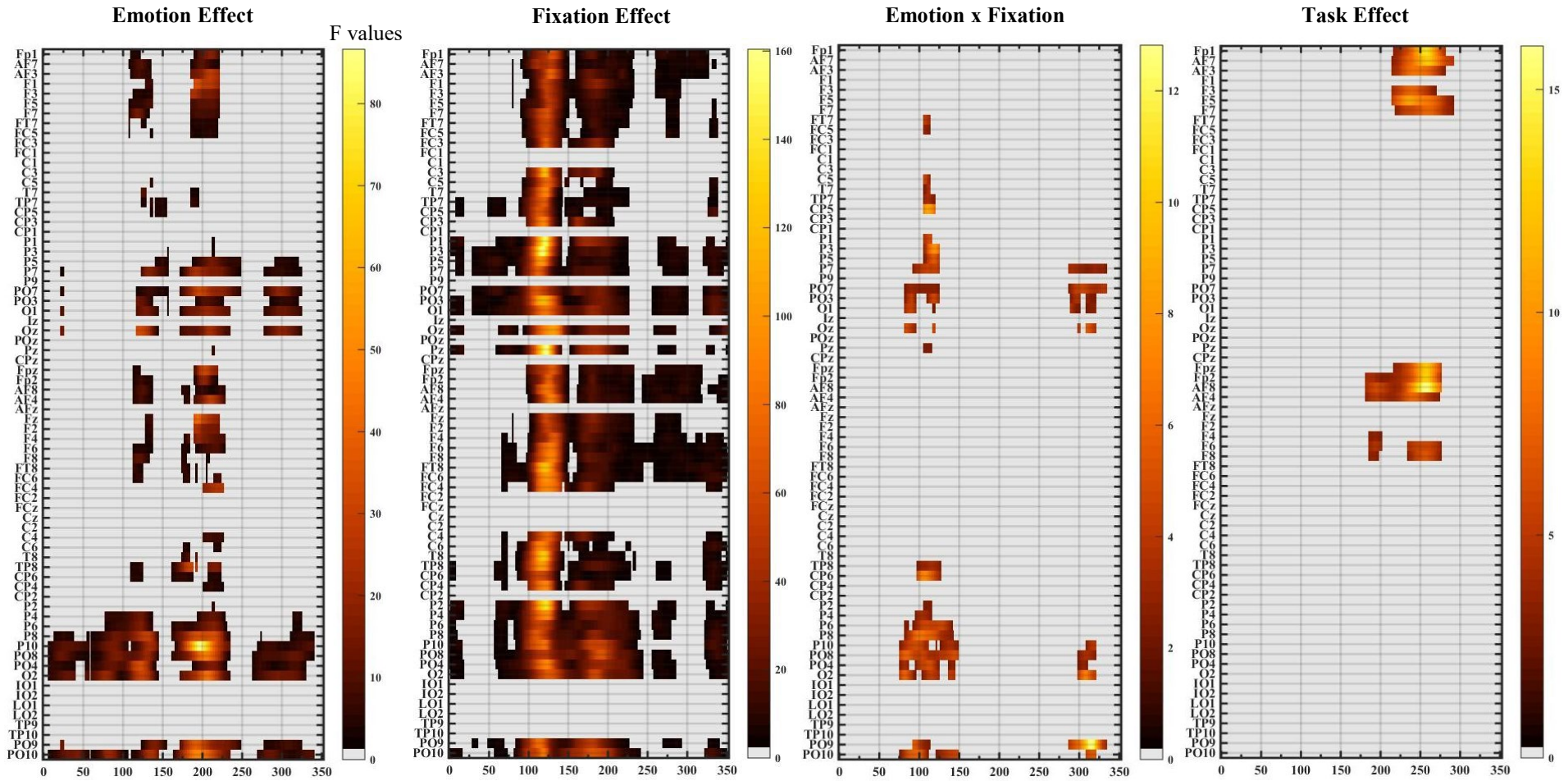
Gaze-contingent presentation (with eye tracker):
left eye, right eye, nose and mouth fixations

80 trials/condition

3 emotion x 4 fixation location x 3 task mixed model ANOVA in LIMO

Itier & Durston, 2023, Scientific Report
Neath & Itier, 2015, Brain and Cognition
Neath-Tavares & Itier, 2016, Biological Psychology

Emotion perception – gender, emotion, oddball tasks



No Task x emotion interaction anywhere!

No Task x emotion x fixation

Itier & Durston, 2023

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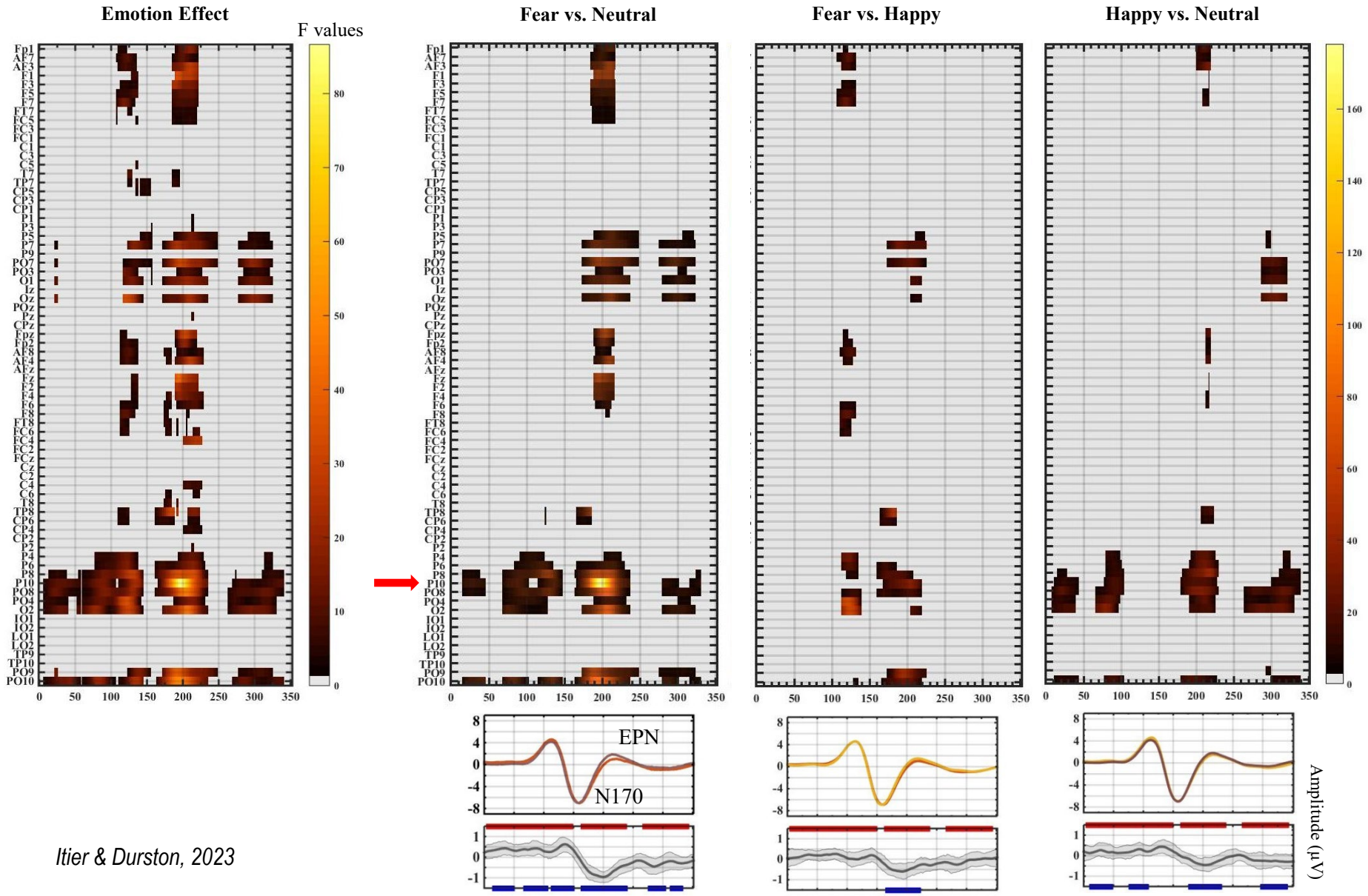

Itier & Durston, 2023

Thank you!

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Canada Research Chair program (CRC)
Canada Fondation for Innovation (CFI)
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Conseil de recherches en sciences naturelles et en génie du Canada