# Let's Face It—N170 Rules: Temporal Processing of Facial Features in the Brain Using Event-Related Potentials

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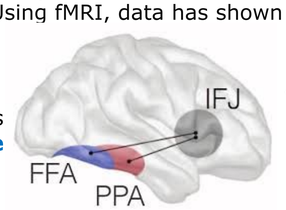
## **Introduction:** The Purpose of Replication

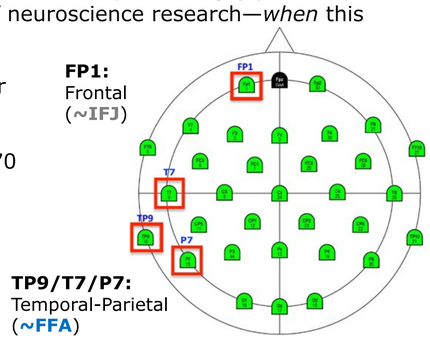
- The reproducibility of experiments is a fundamental part of the scientific method (1), necessary to draw reliable and generalizable conclusions about data. However, with the rapid increase of new research, scholars have discovered that many scientific studies are nearly impossible to reproduce (2). In the year 2010 (3), this controversial phenomenon was coined the **Replication Crisis.**
- The field of *psychology* has been at the center of the controversy. In 2015, Open Science Collaboration estimated that only 36% of 100 replicated studies in psychological science showed significant findings, compared to 97% significance found by the original studies (4).
- How do we, as scientists, increase the validity of replicating studies? Some researchers suggest that before a research lab attempts to publish, they should always follow up preliminary results with an exact replication of their own (5). Therefore, credible statistical significance can be achieved before the study is replicated by another lab.
- Here, I will **conduct replication of an established EEG study of the timing of brain processing for facial recognition**. My study (n=4) confirms what is already known in literature: the presence of the N170 brain wave when viewing human faces.

## **Background:** Why EEG?

- Most neuroscience research involves two main focuses: localization and timing. The majority of studies have focused on the first—*where* processing occurs. Using fMRI, data has shown activity in two distinct areas:
  - Observing faces: activity increases in **fusiform face area (FFA)**
  - Observing objects: activity increases in **parahippocampal place area (PPA)**




- Along with activation of either the FFA or PPA, data shows activity in the **inferior frontal junction (IFJ)** at the same time, which is an area of the prefrontal cortex for visual processing (6). This opens the door for the second focus of neuroscience research—*when* this processing occurs.
- To support these findings for facial recognition, I will see activation of both of these areas at the time of the N170 peak—the **FP1** electrode (representing where **IFJ** is) and the **TP9, T7,** and **P7** electrodes (representing where **FFA** is)

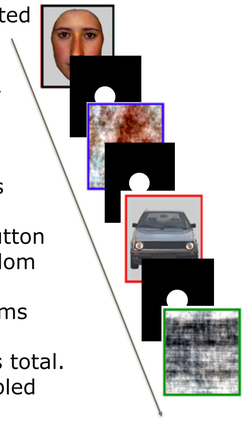



## Methods

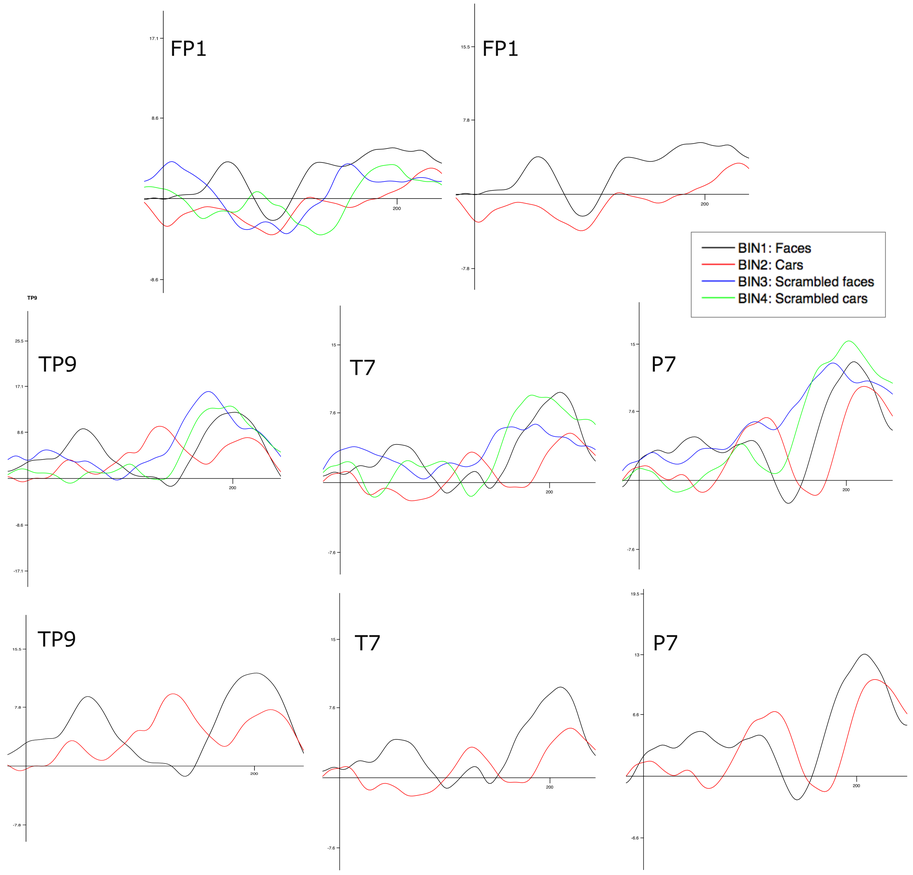
Goal: observing a N170 waveform after a human face is presented (a negative peak at about 170 ms), but not objects or textures

Materials: electroencephalogram (EEG) machine, 4 participants, controller with two buttons

Procedure:
- Chosen at random by the computer, one of the four images is presented for 300 ms
- After participant response (click one button for face, other button for car), a black screen with white dot is presented for a random time between 1100-1300 ms
- Then the next image chosen at random is presented for 300 ms
- Then the black screen with white dot for 1100-1300 ms
- The process continues… for a total of 43 trials/block, 8 blocks total.
- Each participant views a total of 40 faces, 40 cars, 40 scrambled faces, 40 scrambled cars in the end, and ERPs are averaged.



## **Results:** Observing N170




## Conclusions

- In the FFA, represented here by three Temporal-Parietal electrodes, a negative-going peak was observed between 140-200 ms. This means that when a face was presented, facial processing in the brain occurred ~170 ms later.
- Waves for cars, scrambled faces, and scrambled cars did *not* follow this waveform trend. This means that the brain does not process objects (i.e. cars) or textures (i.e. scrambled images) in the same way that it processes faces.
- Therefore, my study using 4 participants was a successful replication of previous research.
- **Significance:** This study reveals that the human brain has a higher processing power for identifying *human* faces. Even objects like a car, which could be said to have *human-like* features, are not processed in the same way.
- **Application:** This research can give better understanding of diseases, birth defects, and injuries that cause abnormal or inhibited facial recognition in people. It can also give us insight into our daily processing in human interaction and communication. In the context of learning and education, interventions and curriculum can be designed with the salience of human faces in mind to make information and instruction more memorable for students of all ages.
- **Future Research:** A similar study with focus on the processing of objects in the PPA. Then, further investigations of the neural connections and processing relationships between the IFJ and both FFA and PPA.

## References

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(5) Novella, Steven. "Where Are We With the Replication 'Crisis.'" *Science*, 2018, sciencebasedmedicine.org/where-are-we-with-the-replication-crisis/.
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