

# Investigating feedback activity underlying face processing with high-resolution fMRI

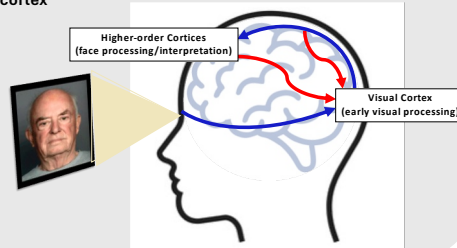
## INTRODUCTION

- Face processing depends on both cortical **feedforward** (visual signals) and **feedback** (top-down expectations) mechanisms.
- Deficits in face processing are observed in conditions such as schizophrenia, autism spectrum disorder, and PTSD.
- Thus, studying feedback and feedforward mechanisms in face processing will increase our understanding of these clinical conditions.
- However, it is challenging to separate feedback signals and feedforward input.
- In this study, we aimed to probe feedback-related influences on face perception using fMRI, examining the contributions of internal related signals and sensory evidence processing.

### What is feedforward vs. feedback?

**Feedforward (Bottom-Up):** visual cortex extracts sensory information (edges, contrasts) and integrates it with **higher-order regions** to interpret the features as a face

**Feedback (Top-Down):** higher-order cortices decides sensory input is a face by recognizing patterns and comparing features against internal representations of faces, and refining ongoing visual processing in the **visual cortex**

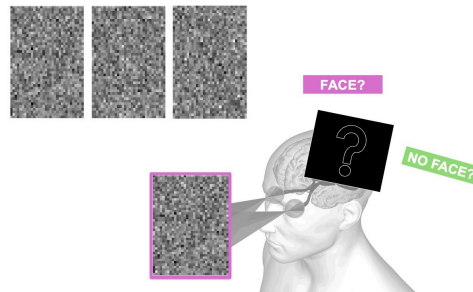
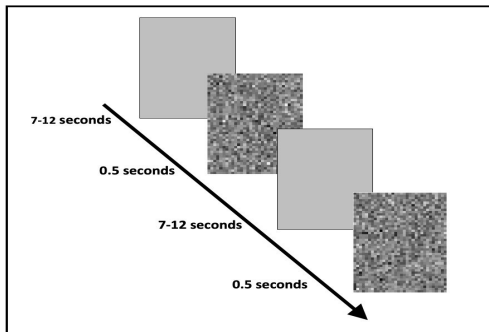


### Research Questions:

- How do feedback processes influence face detection when no meaningful feedforward input is present?
- Which brain regions are involved when a person perceives a face compared to not perceiving one?

## STUDY DESIGN

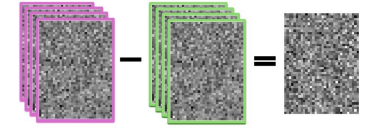
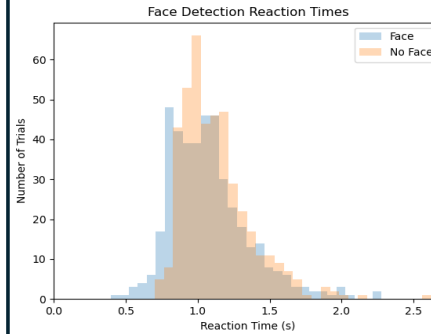
- Two participants were presented with noise stimuli (greyscale, 3° x 2.23° visual angle, 43 x 32 pixels, 25% RMS contrast) in a 7T MRI scanner.
- Scan sessions consisted of 5-6 runs (30-40 stimuli presentations each, ISI = 7-12 s).
- Participants were instructed that half the images contained a face covered by noise, and to press a button to indicate seeing a face (they were unaware that no face stimuli were ever presented).



## RESULTS

### BEHAVIORAL

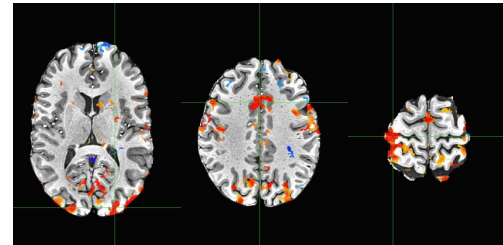
- Participant 1 completed 22 runs (860 trials).
- We calculated the percentage of “face” trials (49.65%).



**Figure 2. Stimulus contrast: Face > No Face.** Multiple trials would reveal contrast image to resemble a face-like structure

**Figure 1. Response times to face detection trials.** Response times were slightly faster when participants reported perceiving a face in noise stimuli (1.078±0.277s; mean ± std) compared to when they reported not perceiving a face (1.129±0.245 s)

### BRAIN IMAGING

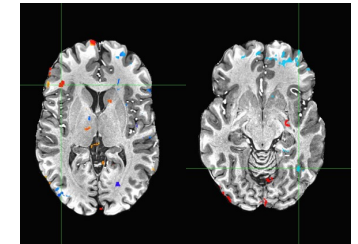


**Figure 3.** Participant either perceived a face in the noise stimuli (“Face” condition) and did not perceive one (“No Face”). Both conditions showed increased activation in the (a) right visual, (b) prefrontal, and (c) left motor cortices (shown above are images when faces were perceived)

### Acquisition Parameters

- Each run consisted of 180 volumes of 3D-EPI with resolution of (0.85 mm)<sup>3</sup> with parameters: TR = 66 ms (RF), 2.442 s (volume); TE = 21.1 ms; flip angle = 18°; partial fourier = 3/4; GRAPPA = 3/4 (phase y/phase z).
- T1-weighted MPRAGE with resolution = (0.6 mm)<sup>3</sup>; TI = 1280 ms; flip angle = 7°.

**Analysis.** AFNI (Cox, 1995) using afni\_proc.py. Data were first adjusted for motion during the scan, aligned to anatomical, blurred with a 4mm kernel and adjusted to ΔS (%) before multiple regression (face perceived vs. no face).



**Figure 4.** Face > No Face Contrast (Left) greater activation in left insula during Face (Right) decreased activation in right fusiform area during Face

## Conclusion & Future Directions

- Greater activation in the right FFA and slower responses during “no face” trails suggest prolonged visual evidence accumulation without early convergence onto a stable face percept.
- “Face” responses were faster, with reduced activation in the right FFA and increased activity in the left insular cortex, indicating rapid perceptual commitment when ambiguous or weak visual features are interpreted as face-like, with the insula contributing to salience signaling and reinforcement of the perceptual decision.
- Future work will include increasing our sample size and using follow-up layer analyses in the fusiform face area and insula, and refining task to better isolate these regions of interest to better distinguish feedback from feedforward contributions in face processing.

## ACKNOWLEDGEMENTS

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**CONTACT:** esther.lin@nih.gov