Fusiform face area activation while viewing memes

Shivesh, Hana, Huy, Matt

Fusiform Gyrus and Fusiform Face Area

- Humans need a quick way to accurately extract information about faces to socially interact and communicate with each other
- Fusiform face area (FFA) is important in perception of faces
  - FFA activates more when viewing faces versus when viewing non-face objects (left)
  - However, it does not discriminate well between human faces and anthropomorphic non-human animal faces and face-like inanimate objects (right)

Essence of a Meme

- Memes are shared content over social media that are usually humorous or relatable
- Memes come in the form of text or image with text, but otherwise vary greatly in content (political, wholesome, etc.) and function (shared experience, sway opinion, etc.)
- Often recontextualized popular media (such as a scene from a movie or a painting) with texts that are completely unrelated to the original content

WE SHALL OVER COMB

TRUMP 2016

When you bite into a raisin cookie thinking it's chocolate chip

THAT MOMENT WHEN YOU FIND

THE PERFECT AVOCADO AT THE

Collis

FFA and Memes? What's up with that?

- Memes are becoming ever-ubiquitous in social media and popular culture
- It would be interesting to study how viewing memes affects our brains
  - Specifically, do memes with faces vs no-faces differ in how they affect our brains?
- Answering this question and understanding how memes cause activation in our brains may allow us to answer other prevalent questions like, "what makes someone more likely to share a meme?" or "do memes enhance our social bonding and how do they improve our social network?"
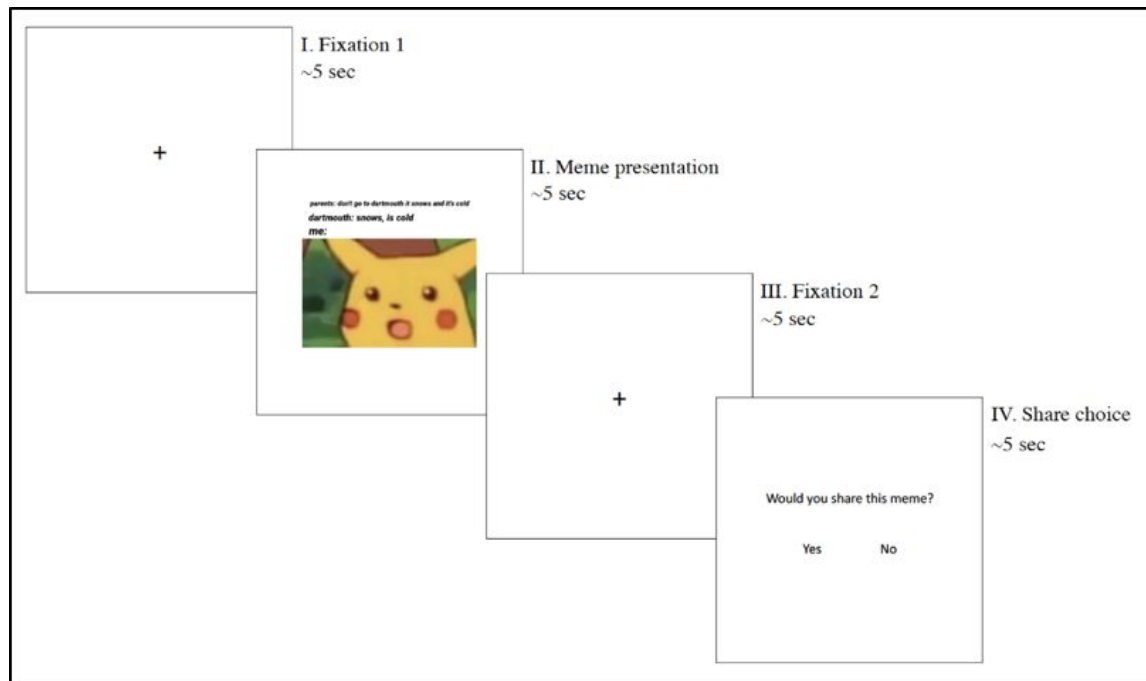
Aims: Overview

- Objectives:
  - 1) Face vs. No Face FFA Univariate Contrast

  - 2) Face vs. No Face FFA Multivariate Prediction

  - 3) Face vs. Unsure Univariate Contrast

fMRI + Behavioral Survey → Preprocessing → Analysis

Methods: Meme Paradigm

- 10 Subjects (PSYC060 at Dartmouth College, Screened)

- 76 Total Memes, 2 runs

- Sequence: (4-6s)
  - Fixation
  - Meme
 - Fixation
  - Share?

- fMRI data collection

- Exit Survey

Methods: Data Acquisition

- Structural Scan (Pinel Localizer)

- 2 Meme Scans (Runs 1-38, 39-76)

- Pre-Processing Steps
  - Z-scored each voxel within run
  - Single trial model convolved with a double-gamma hemodynamic response function.
  - Added high pass filter, linear/quadratic trends, CSF Mask
  - Added global spikes and frame differencing spikes.
  - Ran ordinary least squares regression for each voxel.

- Beta for each of 76 meme presentations for each of 10 subjects

Methods: Overview

- Objectives:
  - **1) Face vs. No Face FFA Univariate Contrast**

  - 2) Face vs. No Face FFA Multivariate Prediction
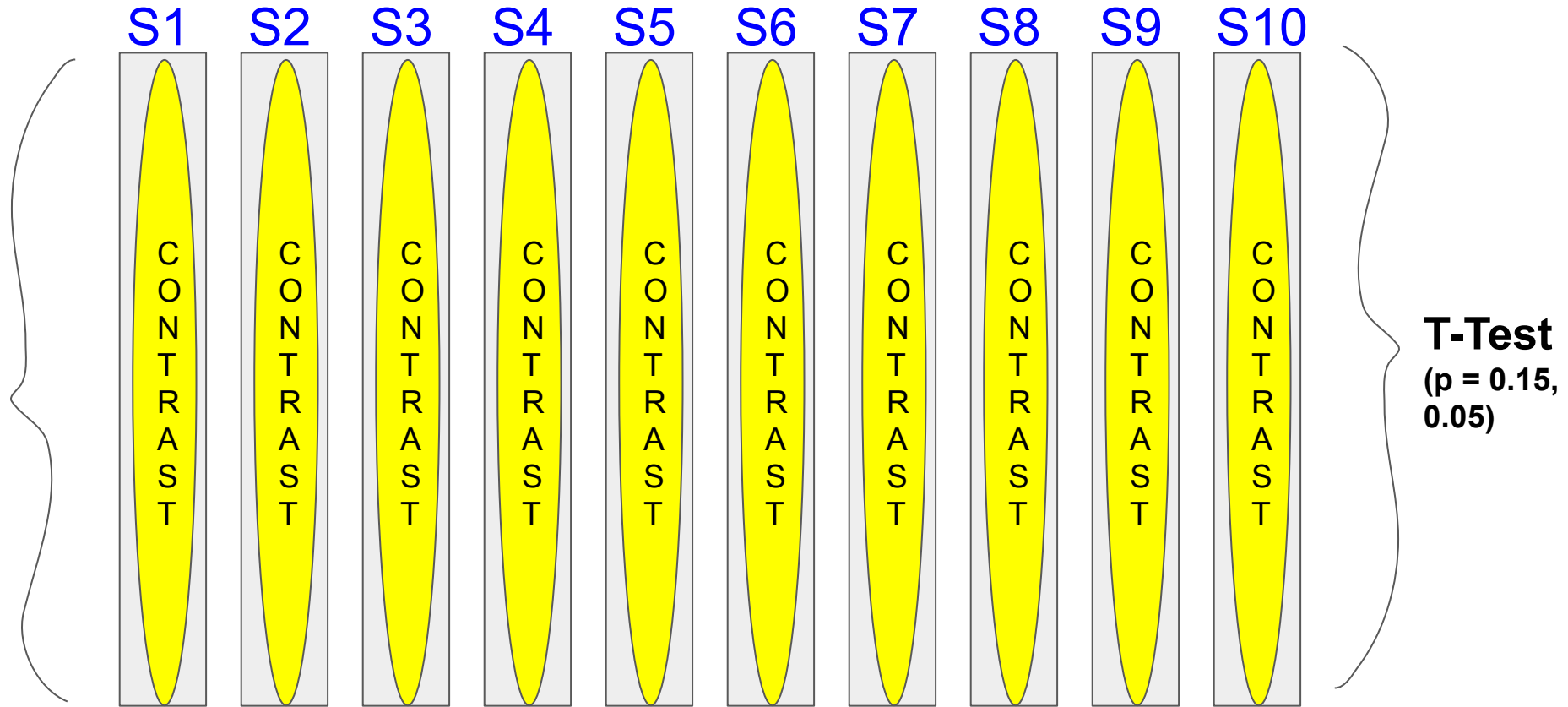
  - **3) Face vs. Unsure Univariate Contrast**

Methods: Study 1 Paradigm - Face vs. NoFace
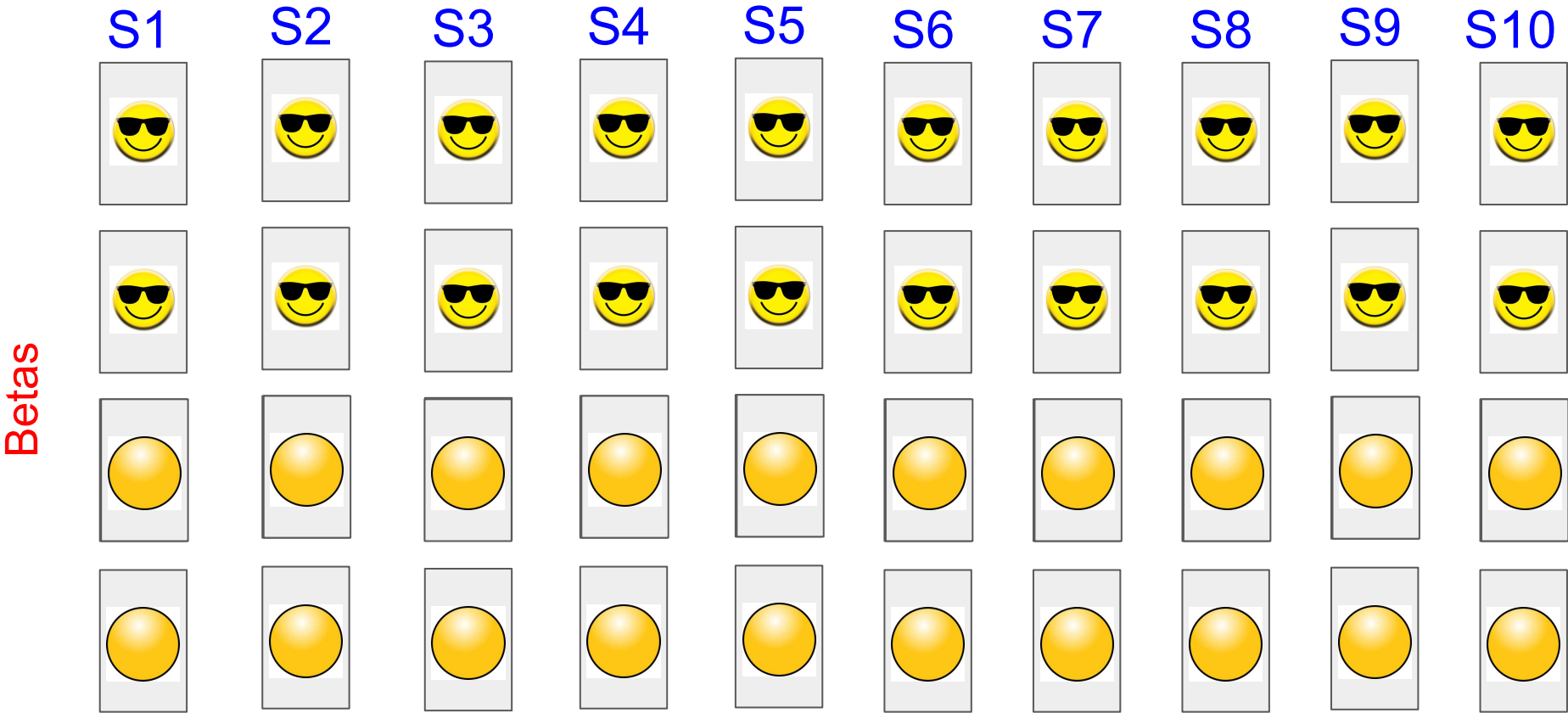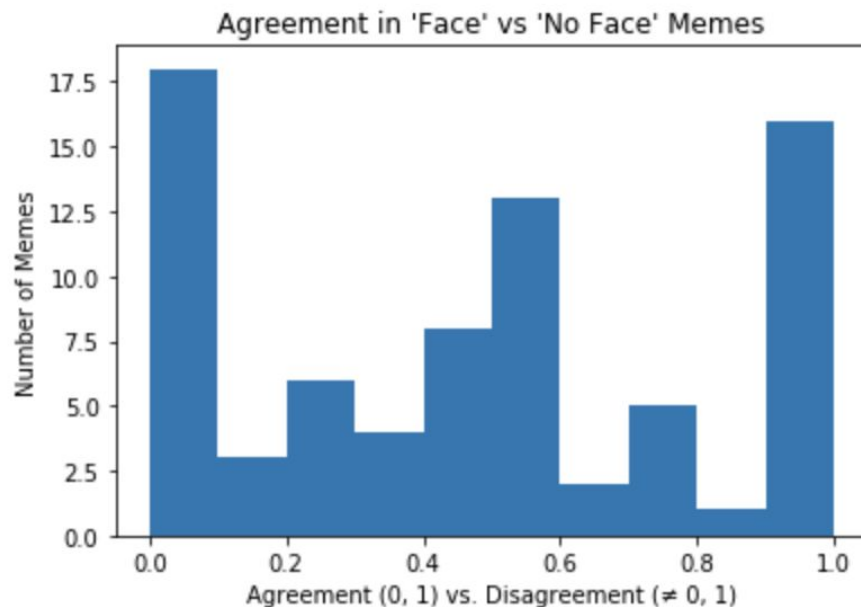
Betas

Methods: Study 1 Paradigm - Face vs. NoFace

Methods: Study 1 Paradigm - Face vs. NoFace

S1 S2 S3 S4 S5 S6 S7 S8 S9 S10

CONTRAST

T-Test
(p = 0.15, 0.05)
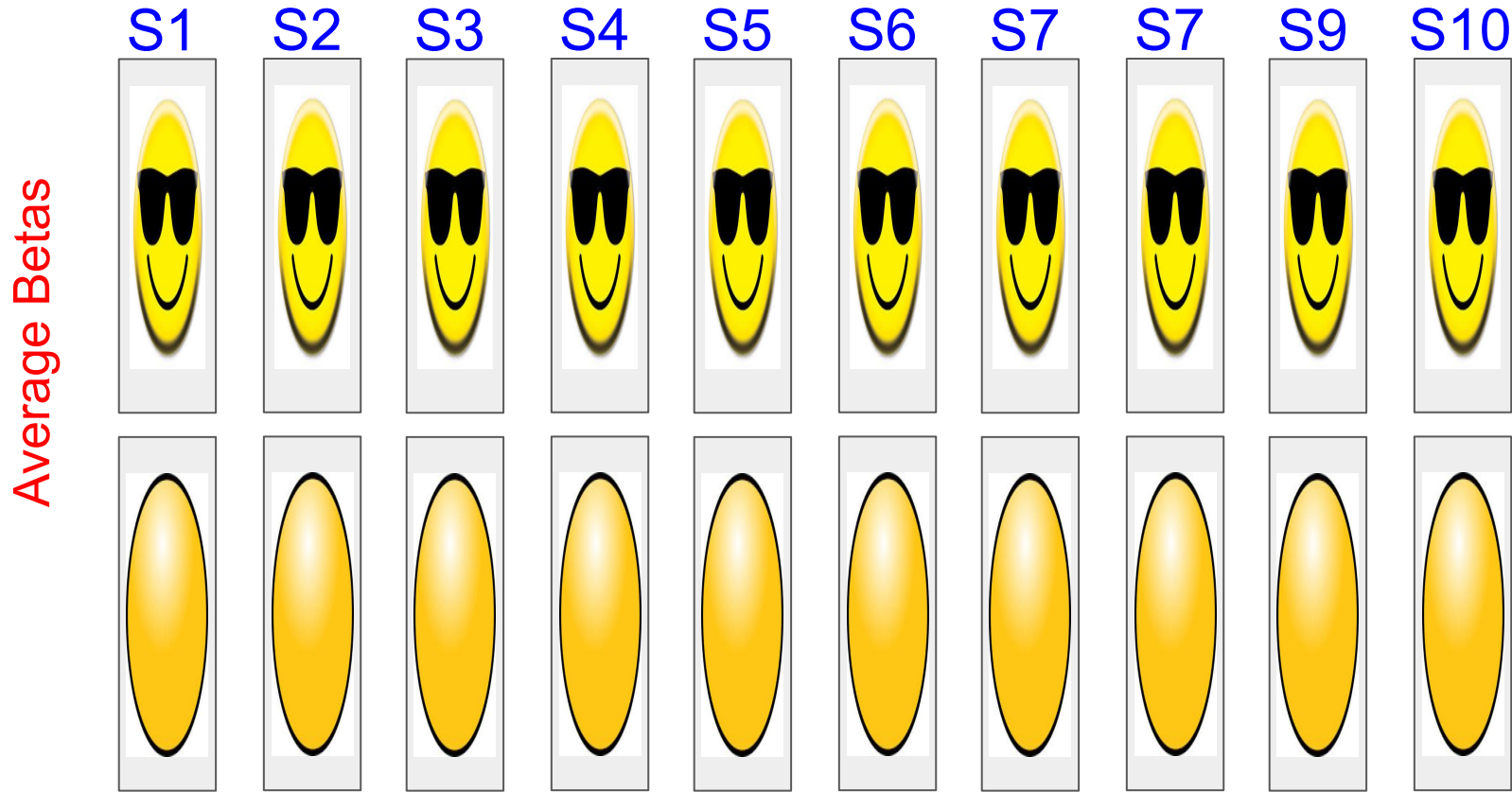
Methods: Study 1 Paradigm - Face vs. NoFace

- Only moderate agreement with regards to whether memes were classified as Face/NoFace

- Include memes with >90% Agreement
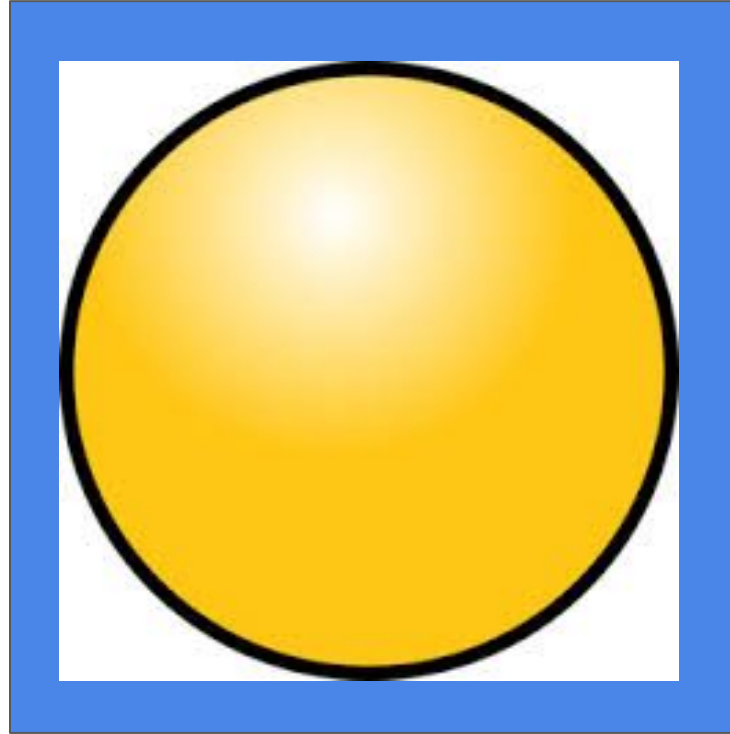
- Repeat Analysis → 0.05 Threshold

Agreement in 'Face' vs 'No Face' Memes

Number of Memes

Agreement (0, 1) vs. Disagreement (≠ 0, 1)

Methods: Overview

- Objectives:
  - 1) Face vs. No Face FFA Univariate Contrast

  - **2) Face vs. No Face FFA Multivariate Prediction**

  - 3) Face vs. Unsure Univariate Contrast
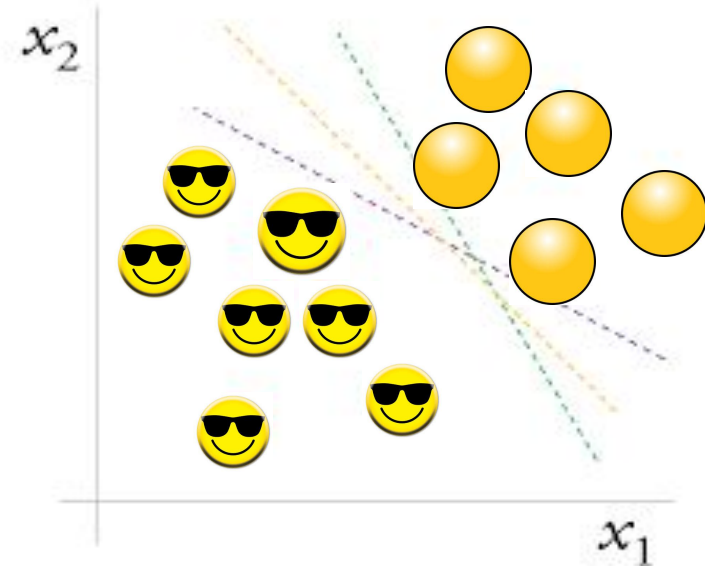
# Methods: Study 2 - Face v. NoFace Prediction

Methods: Study 2 - Face v. NoFace Prediction

- Divide into 2 groups: 1) Face and 2) NoFace

- Trained using SVM

- Feature Selection: FFA Mask

- Test → Cross Validation → ROC and Efficacy %

Methods: Overview

- Objectives:
- 1) Face vs. No Face FFA Univariate Contrast

  - 2) Face vs. No Face FFA Multivariate Prediction

  - **3) Face vs. Unsure Univariate Contrast**

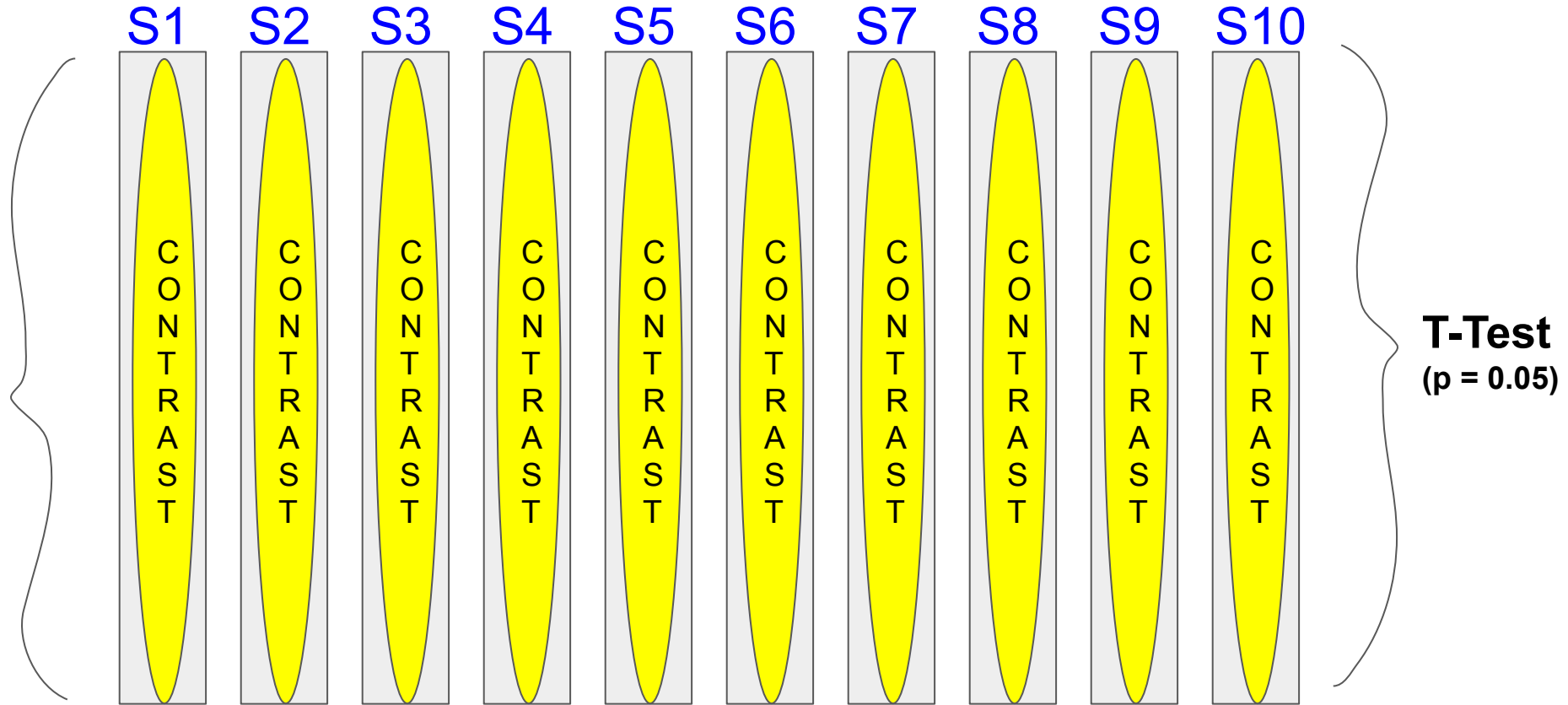   - **Similar to Study 1**
    - **Thresholded at p = 0.032**

Methods: Study 1 Paradigm - Face vs. NoFace
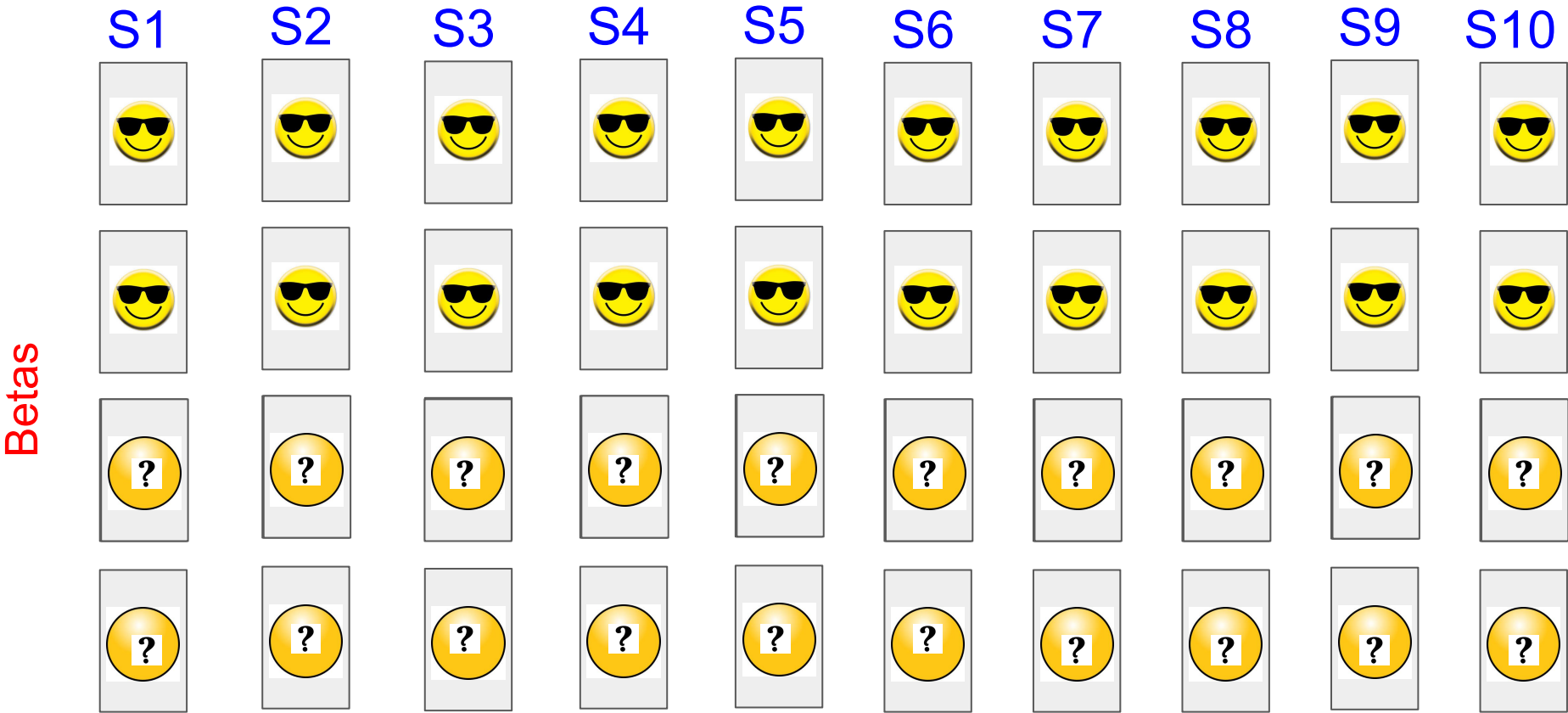
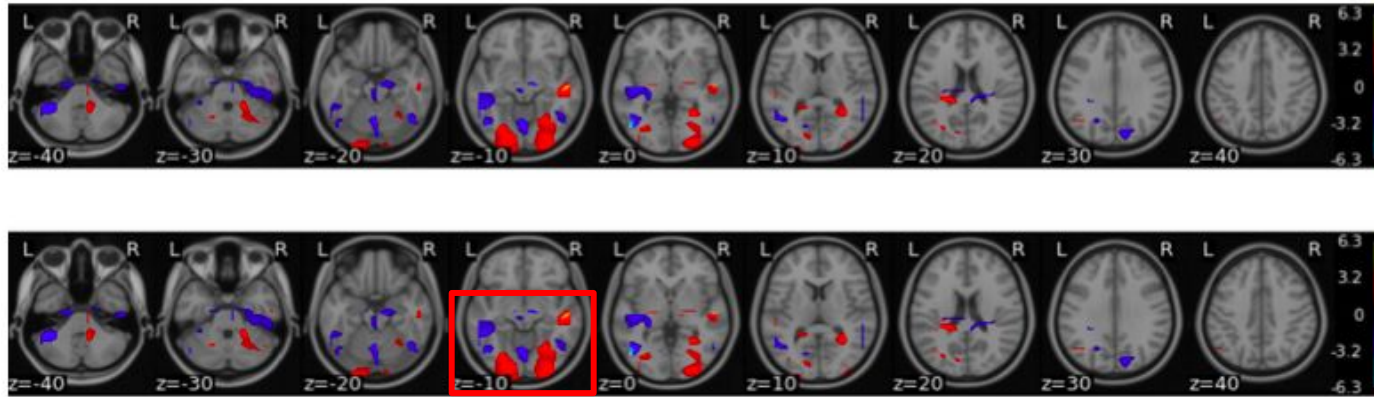Methods: Study 1 Paradigm - Face vs. NoFace

Methods: Study 1 Paradigm - Face vs. NoFace

S1 S2 S3 S4 S5 S6 S7 S8 S9 S10

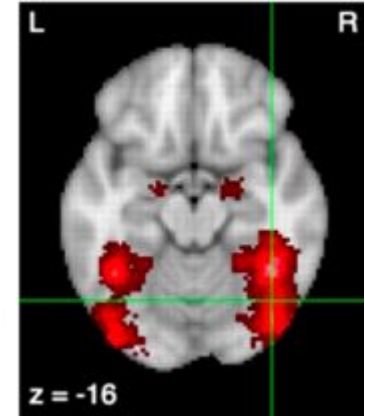CONTRAST

T-Test
(p = 0.05)
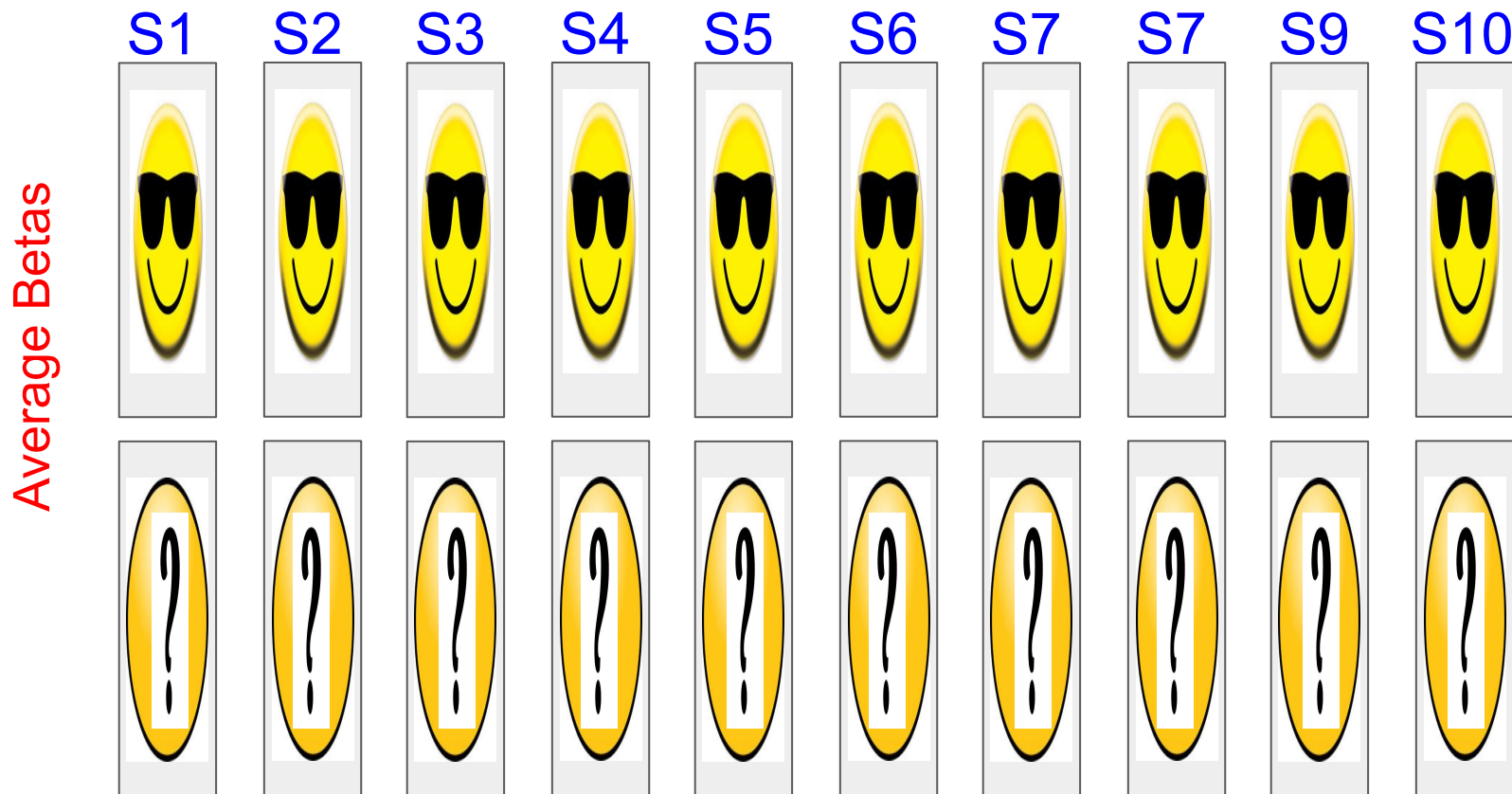
Results

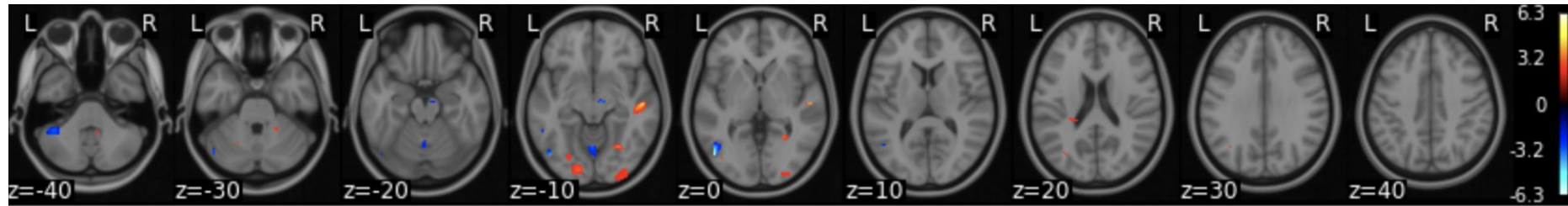Analysis 1: Contrast between 'Face' and 'No Face' memes

- fMRI contrast between 'face' (red) and 'no face' (blue) memes indicates greater activation of FFA (boxed) for 'face' conditions after thresholding at p=0.15

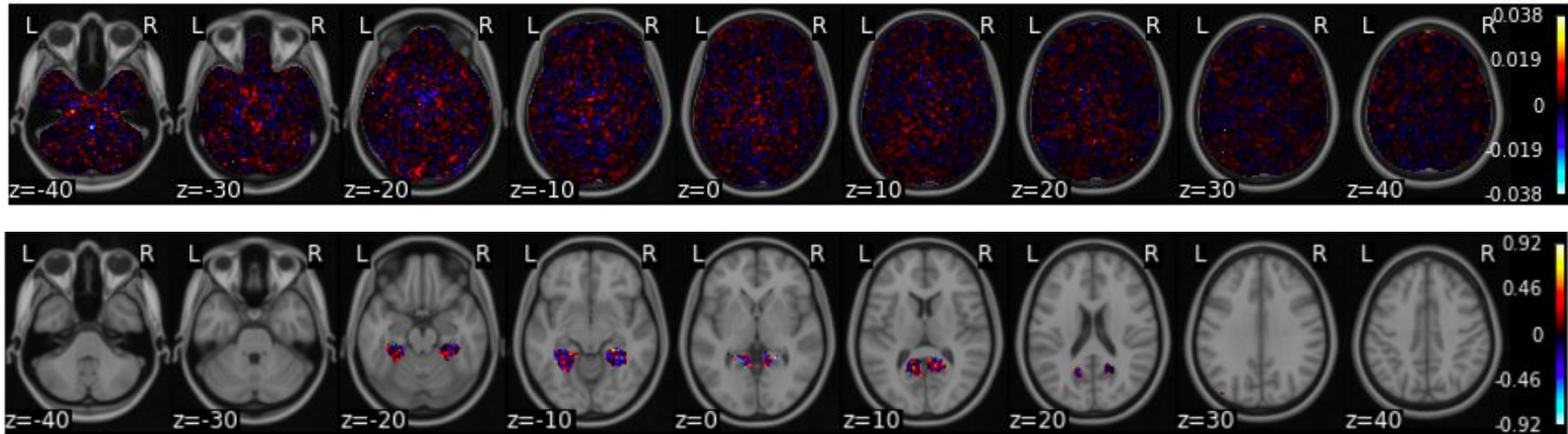Activation of FFA
(Neuro-Synth)

Results

Contrast between 'Face' and 'No Face' Memes with >90% Agreement

- Significant difference in activation at p= 0.05
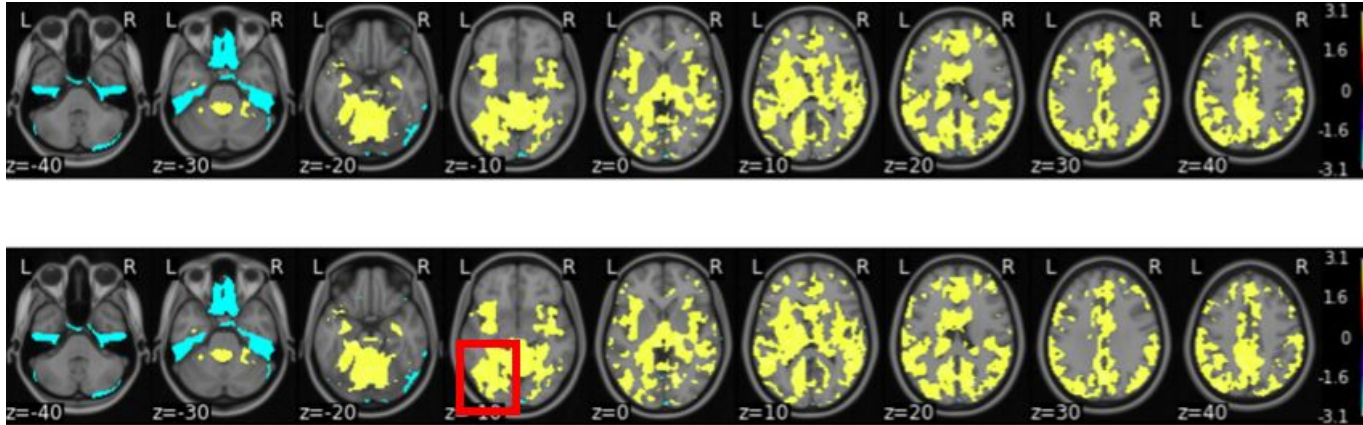
Results

Analysis 2: Prediction analysis for 'Face' vs 'No Face' memes

- Did not establish clear pattern of activation for 'Face' vs 'No Face' memes
- Cross Validation: whole brain: CV accuracy= 0.68
- Cross Validation: FFA mask: CV accuracy= 0.64

Results

Analysis 3: Contrast between 'Face' and 'Not Sure' memes

Activation of FFA
(Neuro-Synth)

- fMRI contrast between 'face' (yellow) and 'not sure' (blue) memes indicates significantly greater activation in the left FFA (boxed) for 'face' conditions after thresholding at p=0.038.
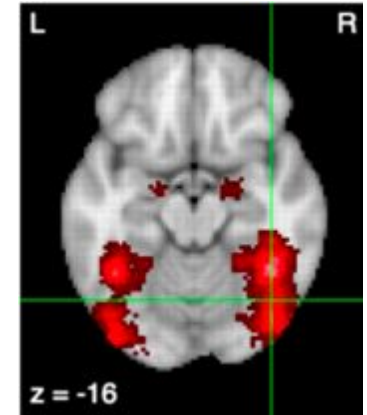
Discussion:

1. We found greater activation in the FFA in response to memes with faces in it compared to memes without faces in it.
   a. This result became more robust when we focused on memes with >90% agreement.
2. We calculated a pattern of activation with and without a FFA mask that predicted facial perception with 64% and 68% accuracy respectively.
3. We found greater activation in the FFA in response to memes participants were sure of containing a face compared to memes they were unsure of.
   a. This suggests a relationship between certainty/judgment and FFA activity.

Future Directions

- Statistics:
    - Increase the sample size to increase statistical power.
    - Recruit participants other than students in this class to have a representative sample group.
    - Re-run experiment again in MRI machine to avoid acquisition errors.
- Methodology:
    - Explicitly tell participants that cartoon, anthropomorphic, non-human, etc… faces count.
    - Ask participants right after the presentation of memes if they saw a face or not.
        - Avoids possible discrepancies between facial perception during scanning and later evaluation of memes in the questionnaire.
        - Can correlate FFA activity with brain activity during the judgment.
    - Increase size of meme presented on the screen to promote readability.

Thank you!