Spatial and temporal characteristics of the neural representations of face familiarity

Vaidehi Natu1, Alice O'Toole1
1 The University of Texas at Dallas
Contact: vnnatu@utdallas.edu

BACKGROUND
- endpoints of familiarity with faces
  - behavioral studies
    - familiar face recognition (Johnson & Emans, 2000)
    - accurate and robust over various photometric changes
  - unfamiliar face recognition (Rossion, Droit-Volet, & Burton, 2008)
- fMRI and PET studies
  - famous, personally familiar (Sandin & Hadjikhani, 2017; Natu & O'Toole, 2018)
  - differential neural magnitude in multiple brain regions
  - complexity of familiarity
    - semantic and autobiographic information, emotion, episodic memories
- visual information - core component, drives familiarity
  - visually familiar faces - participants learn in lab settings
  - activate early visual areas, high-level visual areas, prefrontal areas
(Dolan et al., 1999; Rossion et al., 2003; Sandin & Hadjikhani, 2017)
- progression of familiarity with faces
  - behavioral studies
    - improvement in matching and recognition abilities
(Koch et al., 2002; 2004, 2005; Hemsley et al., 2008)
  - single fMRI study
    - neural magnitude changes (Rosen et al., 2007)
  - fEAR, amygdala, posterior cingulate gyrus

QUESTION
- how neural patterns elicited in response to faces varying in familiarity differ from each other?
  - neural patterns most separable

APPROACH
- apply pattern-based classification analysis to discriminate
  - spatial patterns elicited in response to faces varying in levels of visual familiarity
  - examine temporal characteristics of the spatial patterns
  - examine differences in average response activation to faces varying in familiarity

BEHAVIORAL FACE FAMILIARIZATION EXPERIMENT
- test to see if participants can achieve different levels of robustness with faces
- learn faces using different exposure levels
- test for recognition using novel, naturalistic images of learned faces

METHODS
- fMRI and PET studies
- famous, personally familiar faces
  - prefrontal areas, hippocampal areas
  - core visual and parietal areas

EXPERIMENTAL DESIGN
- fMRI and PET studies
- famous, personally familiar faces
  - prefrontal areas, hippocampal areas
  - core visual and parietal areas

REGIONS OF INTEREST
- Functional Localizations
- Anatomical Localization (MEGBrain)

VT task
- ANOVA used to select trials surviving significant variance across faces, objects, and neutral images (p < 0.05)
- average number of trials: 333
- FFA-OFa rash
  - trials + 1 block
  - average number of trials: 24

PATTERN-BASED CLASSIFICATION
- apply pattern-based classification analysis to discriminate
- spatial patterns elicited in response to faces varying in levels of visual familiarity
- examine temporal characteristics of the spatial patterns
- examine differences in average response activation to faces varying in familiarity

RESULTS SUMMARY
- spatial
  - high-level visual and parietal areas (HF and UF)
    - twofold classification results
      - FFA-OFa
        - known vs. unknown faces
          - greater discrimination - reflects behavioral generalization data
      - prefrontal areas, hippocampal areas
        - known vs. unknown faces
          - non-parametric significance - mirrors familiarity
      - neural patterns better predictors of face familiarity than average magnitude

Spatio-temporal
- larger differences in familiarization levels of conditions, easier classification success
  - UF vs. HF: difficult

CONCLUSIONS
- gradual changes in neural representations of faces varying in visual familiarity
- spatial and temporal characteristics
- accord with behavioral recognition measures
- importance of parietal areas
- stimulus independent familiarity trace
- importance of neural patterns
- familiarity coded in the globally distributed patterns

REFERENCES