Differential spatial and temporal neural response patterns for own- and other-race faces

Vaidehi Natu[1], David Raboy[2], Alice O'Toole[1]

[1] The University of Texas at Dallas, [2] University of Pittsburgh

Contact: vsnatu@utdallas.edu

BACKGROUND

- other-race effect for face recognition (e.g., Malpass & Kravitz, 1969)
  - own-race recognition more accurate than other-race face recognition
  - perceptual component - other-race faces "*all look alike to me!*"
  - speed of processing
    - other-race faces *categorized* faster than own-race faces (Levin, 2000)
    - own-race *recognition* faster than other-race (Macon et al., in press)
- neural correlates of *own- vs. other*-race face perception
- fMRI studies
  - socio-affective differences
    - amygdala (Hart *et al.*, 2000; Phelps *et al.*, 2000; Cunningham *et al.*, 2004; Lieberman *et al.*, 2005)
      - results are inconsistent
  - visual processing differences (e.g., Golby *et al.*, 2001)
    - fusiform "face" area (own-race response > other-race response)
    - left fusiform gyrus, parahippocampal gyrus, hippocampal areas
  - visual codes underlying face ethnicity, gender, identity (Ng *et al.*, 2007)
    - distributed representations
      - fusiform gyrus, inferior occipital cortex

GOAL

- examine neural response patterns for own- *vs.* other-race faces
  - focus on spatio-temporal aspects
  - consider broader range of high-level visual and face-selective areas in ventral temporal (VT) cortex

APPROACH

- apply pattern-based classification analysis to discriminate
  - Caucasian and Asian faces in the brains of Caucasian and Asian participants
- examine time-course of neural activation for own- *vs.* other-race faces in Caucasians and Asians

STIMULI

- face stimuli
  - 4 Asian and 4 Caucasian facial identities
  - 4 different images per face

e.g., 4 different images of an Asian face

e.g., 4 different images of a Caucasian face

LOCALIZER

- Localizer scan was used to isolate high-level visual and face-selective regions of interest in the occipital and VT areas of the cortex.

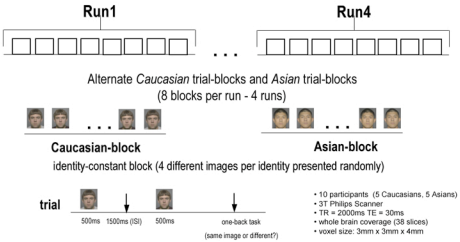
Caucasian Localizer

- ANOVA used to select voxels showing significant variation ($p < 0.0000001$) across three categories (**Caucasian** faces, objects, and scrambled images).
- **Localized *VT mask***
- Approximate number of voxels/subject: 300-1000

Asian Localizer

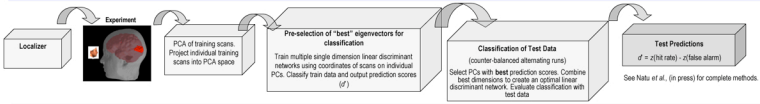
- ANOVA used to select voxels showing significant variation ($p < 0.00001$) across three categories (**Asian** faces, objects, and scrambled images).
- **Localized *VT mask***
- Approximate number of voxels/subject: 300-1000

EXPERIMENTAL DESIGN



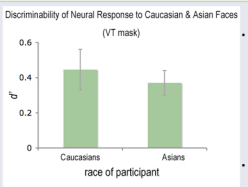
- 10 participants (5 Caucasians, 5 Asians)
- 3T Philips Scanner
- TR = 2000ms TE = 30ms
- whole brain coverage (38 slices)
- voxel size: 3mm x 3mm x 4mm

PATTERN-BASED CLASSIFICATION



See Natu *et al.*, (in press) for complete methods.

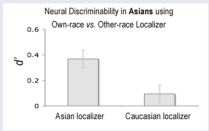
RESULTS



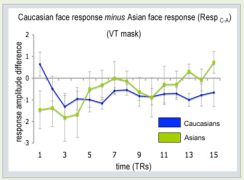
- VT mask
  - above chance discrimination in brains of both Caucasians and Asians
  - data from first 4 TRs of block most useful for classification
- FFA mask
  - no discrimination

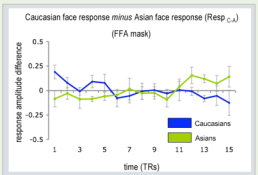
Importance of own-race localizer:

- to select high-level visual and face-selective areas
- data from a subset of Asian participants



TIME-COURSE of NEURAL RESPONSE to OWN- *vs.* OTHER-RACE FACES

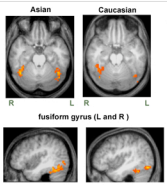




FFA and VT mask

- faster and stronger average neural response to own-race faces
  - **own-race > other-race**
  - result consistent with Golby *et al.* (2001)
- slow progressive increase in amplitude of neural response to other-race faces
  - **other-race > own-race**
  - (cf., Henson *et al.* 2000 for analogous temporal response to unfamiliar faces in face-selective areas)
- **interpretation**
  - neural adaptation of own-race response, continuously increasing other-race response
    - fast, automatic processing of own-race faces
    - dedication of additional neural resources for other-race faces

IMPORTANCE MAPS



- regions important for dissociating own- *vs.* other-race faces in Caucasian and Asian participants
  - fusiform gyrus
  - lateral occipital complex

Summary of importance map construction:

1. individual subject classifier:

   importance map = weighted sum of the dimensions (PCs) useful for discriminating neural response to Asian and Caucasian faces
2. MNI normalization of each participant's importance map
3. average MNI normalized maps for Caucasian and Asian participants
4. project thresholded voxels onto MNI normalized anatomical brain

RESULTS SUMMARY

- neural response to Asian and Caucasian faces
  - discriminable with pattern classification methods
  - high-level visual and face-selective areas in VT cortex
- importance of *own-race* face localizer
- time-course differences in neural activation for own-race *vs.* other-race
  - efficient own-race face processing
  - dedication of additional resources for other-race face processing
- use of areas beyond the FFA for categorization of faces by race

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