Classifying neural responses to familiar and unfamiliar people over viewing distances in face and body selective areas

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Background

Person recognition in the real world:
- people are seen, in motion, from a distance

Information from the face, body, and gait contributes to person recognition
- differential contribution as a function of distance (Hahn et al., 2015)

Neural responses to faces and bodies:
- Faces
  - OFA (Halgren et al., 1999; Puce et al., 1996)
  - FFA (Kanwisher et al., 1997)
- Bodies
  - FBA (Peelen & Downing, 2005)
  - EBA (Downing et al., 2001)
- Biological motion
  - pSTS (c.f., Allison et al., 2000)

Neural responses to familiarity in the brain leading up to a recognition decision
- Previous work - *still images* and most compared neural response magnitude
  - Faces (Gobbini & Haxby, 2006, 2007; Rossion et al., 2003; cf. review, Natu & O'Toole, 2011a)
  - Bodies (Hodzic et al., 2009)
- Natu & O'Toole (2015) – Decoded familiarity using static face images
  - *Accurate classification*: OFA + FFA; FG + precuneus; VTC + precuneus conjunctions

Goal

Investigate the neural time course of familiarity processing as person approaches
-Which brain regions code the familiarity of the person?
-When, in the time-course of the approach, do areas discriminate familiar vs. unfamiliar people?

Approach

Before scanning: familiarized participants with identities
In fMRI scanner: test with videos of unfamiliar & familiar people approaching
Analysis: determine discriminability of neural response to familiar vs. unfamiliar people using pattern-classification
- examine specified ROIs
- dissect discrimination across the timeline of the approach

ROIs

Classically defined

	Average number of voxels			
	ROI	Right	Left	Bilateral
Ventral	OFA	13.60 *(10/12)*	7.20 *(10/12)*	23.00 *(8/12)*
Ventral	FFA	11.00 *(11/12)*	7.92 *(12/12)*	19.27 *(10/12)*
Ventral	EBA	14.42 *(12/12)*	9.78 *(9/12)*	24.67 *(9/12)*
Ventral	FBA	7.27 *(11/12)*	5.82 *(11/12)*	13.70 *(10/12)*
Dorsal	pSTS	87.50 *(12/12)*	88.33 *(12/12)*	175.83 *(12/12)*

Distributed VT cortex

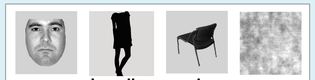
	Average number of voxels	
	ROI	# voxels
Ventral	Face selective	392.08
Ventral	Body selective	343.17

Method

Learning phase (before scanning)

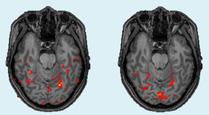
Familiarized with 30 identities • 4 motion-based actions • 120 videos total

Localizer

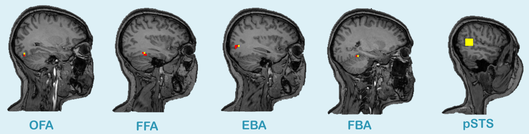


Localizer session (for voxel selection)

- 12 participants
- 3T Philips Scanner
- TR = 2000ms; TE = 30ms
- whole brain coverage (38 slices)
- voxel size: 3.44mm x 3.44mm x 4mm

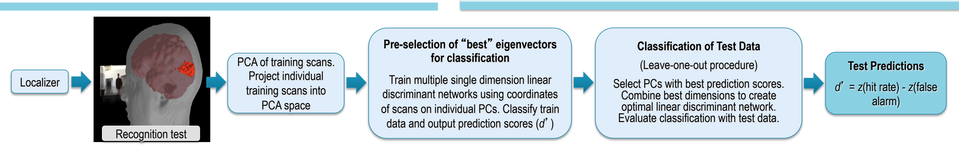


- Functionally localized *face & body selective VT cortex areas*
  - Face selective (faces > objects + scrambled, p < .00001)
  - Body selective (bodies > objects + scrambled, p < .00001)
- Anatomically localized pSTS



Recognition test with 8 second approach video (in fMRI scanner)

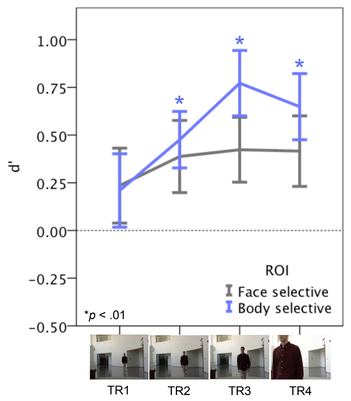
- 60 Identities (30 familiar & 30 unfamiliar)
- when familiar: different clothes, appearance, hair, etc.
- video shows person walking toward camera from 13.6 meters away



See Natu *et al.*, (2010, 2011b, 2015) & O'Toole et al. (2014) for complete methods.

Results: Discrimination of Neural Responses to Familiar and Unfamiliar People

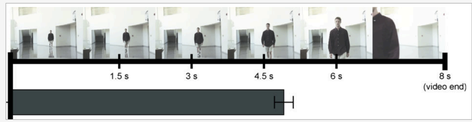
Distributed VT Cortex



- *Distributed **body-selective***, not distributed face-selective, voxels achieved accurate classification
- Peak accuracy in TR3 at moderately close view

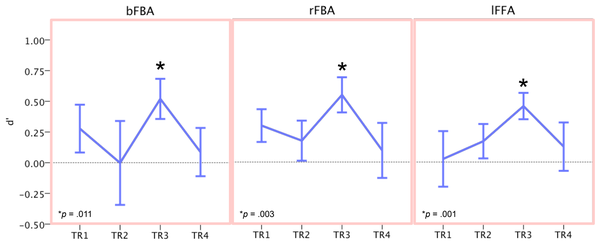
Neural decoding timing corresponds to *behavioral results* in scanner:
- Average RT: 4.86 s (within TR3)
- *d'* = 1.97 (+/- 0.18)

Reaction time for accurate trials from Hahn et al. (2015)

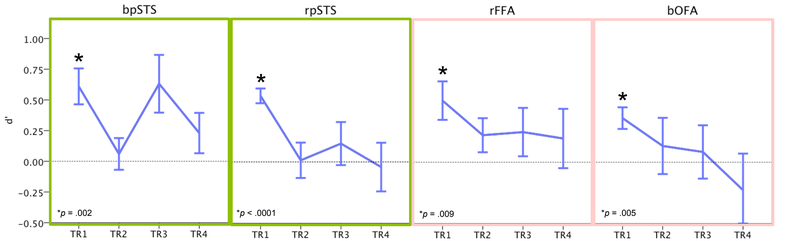


Classically defined ROIs

ROIs with peak classifier accuracy at a moderately close view



ROIs with peak classifier accuracy at a distant view



Conclusions

- First study examining neural correlates of familiarity using naturalistic videos of *whole people* in *motion*
- Accurate classification of familiar and unfamiliar people in both dorsal and ventral stream areas
- Highest classification using distributed ***body selective*** voxels in VT cortex
  - distributed face-selective voxels in VT cortex did not yield accurate classification

Classically defined ROIs:
- *At a distance*: Accurate classification in both ventral and dorsal regions
- *Close-up views*: Accurate classification in ventral regions
- Correspondence between timing of highest neural decoding accuracy and timing of behavioral responses

- Familiarity decoding with *people in motion*:
  - extends previous work that used static images (for review cf., Natu & O'Toole, 2011a; Natu & O'Toole, 2015)
  - when viewing people in motion: multiple time-points where discrimination is possible
  - classification accuracy possible in multiple, individual ROIs using naturalistic stimuli
    - previous study in our lab used static face images (Natu & O'Toole, 2015)
- Future directions:
  - combinations of ROIs to examine *network* of regions involved in person familiarity processing
  - incorporating parietal regions (e.g., precuneus) and anterior temporal lobe to examine core and extended network (Haxby et al., 2000; Gobbini & Haxby, 2007)

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