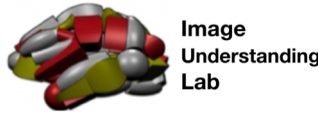# Matching Depth-Rotated Faces at Varying Degrees of Physical Similarity

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Image Understanding Lab

Measuring perceptual rotation costs on face matching

The **Orientation Face Perception Test (OFPT)** is a simple match-to-sample task designed to provide an assessment of the perceptual cost of differences in orientation on face matching. Surprisingly, prior studies assessing orientation costs have not isolated the perceptual component of the cost, typically confounding it with familiarity/memory.

Correct Answer: left   Correct Answer: left   Correct Answer: left
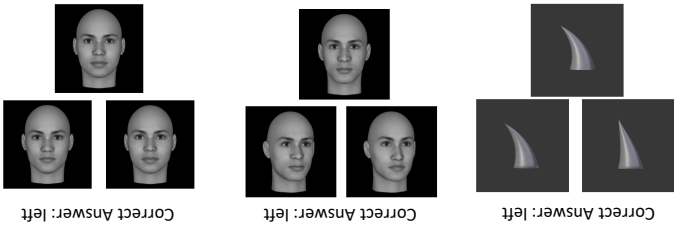
Faces were presented in a triangular array (max duration = 5 s). One of the two lower (test) faces was an exact identity match to the top (sample) face, and the other was a foil (distractor) that differed metrically from the sample. Faces could be all at the same orientation, or the **test** faces could be rotated 13 or 20 degrees from the sample viewing angle. The same task was run with geons.

Face and Geon Stimuli

FACES: Sample and foil faces differed metrically in the height of the cheekbones and vertical and horizontal separation between eyes, nose, and mouth, along with slight variations in the shape of the face parts themselves. This variation was largely ineffable during the maximum display duration.
GEONS: Varied in the curvature of their axis or the angle of convergence of their sides.
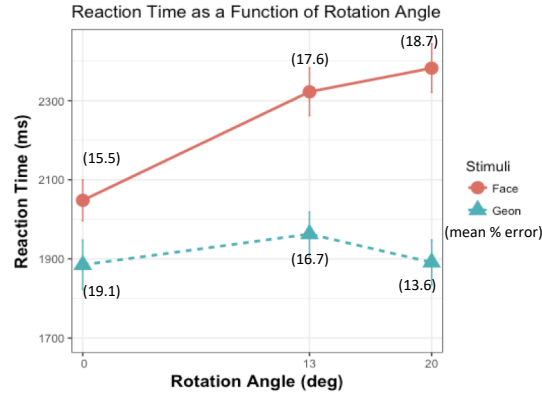
Subjects

65 USC students (age 18-25) were run on both the OFPT and a battery of face recognition proficiency tests.

Effect of Rotation-in-depth

Reaction Time as a Function of Rotation Angle

For face matching, there was a 350 ms increase in mean RTs and a 3.2% increase in error rates from 0 to 20° rotation.

No costs of rotation were observed when matching geons.

## Scaling Stimulus Similarity with the Gabor-Jet Model

The similarity of the matching test stimulus to a) the sample and b) the foil were assessed with the Gabor Jet Model, a model based on V1 hypercolumn filtering which predicts psychophysical discrimination of metrically varying faces/objects almost perfectly (Yue et al., 2012).

Dissimilarity (Distance) || G - F ||
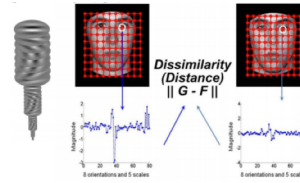
What drives the cost of orientation?

The massive cost of orientation differences in matching faces could be due to a) the decreased similarity of the matching test face to the sample, b) an increase in the similarity in the matching test face to the foil, or c) both a and b.

All the cost can be attributed to a) the decreased similarity of the matching test face to the sample. Rotation in depth has no effect on the similarity of the matching test face to the foil.
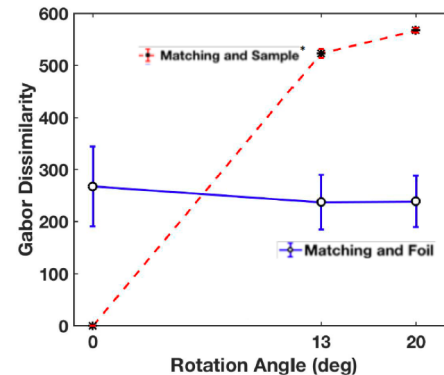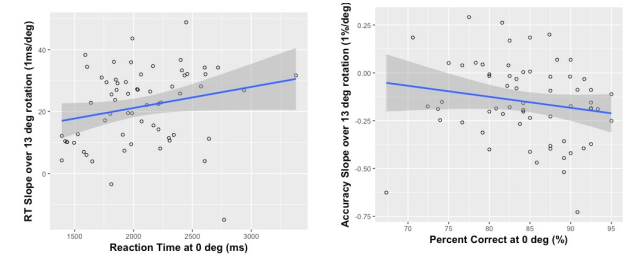
*Error bars encompassed within the data points

Individual Differences

Q: Do subjects who have greater difficulty in discriminating faces when they are at the same orientation show larger costs when the faces are at different orientations?

A: Only minimally, r = .23, p = .06

Does performance on the OFPT correlate with other measures of prosopagnosia? Yes

Correlations of Error Rates on the OFPT with:

FPT:	.721***
PI20:	-.183***
CFMT:	.387***
Doppelgänger Discrimination:	.218***

df = 64, *** = p < .001

Conclusions

1: There is a massive 350 msec cost on face matching RTs when the faces differ by as little as 20º. Geon matching shows no cost of orientation differences.

2: The effect of orientation differences on face matching is **solely** a function of the decreased similarity of the matching test face to the sample; there is no effect of rotation on the similarity of matching test and foil faces.

3: Across subjects, the cost of rotation in face matching is only moderately correlated with performance when sample and test faces are at the same orientation.

4: Performance on the OFPT is significantly correlated with other measures of face recognition proficiency.

References
Yue, X., Biederman, I., Mangini, M. C., von der Malsburg, C., & Amir, O. (2012). Predicting the Psychophysical Similarity of Faces and Non-Face Complex Shapes by Image-Based Measures. Vision Research. 55,41-46.
Margalit, E., Biederman, I., Herald, S. B., Yue, X., & von der Malsburg, C. (2016). An applet for the Gabor scaling of the differences between complex stimuli. Attention, Perception, & Psychophysics. 78(8), 2298-2306. doi:10.3758/s13414-016-1191-7.