The Influence of Affect on 2D Pattern Perception

Michelle L. Fowler[1], Elliot Lockerman[2], Andrea Li[1,2]

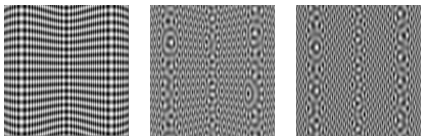
[1]Neuropsychology Doctoral Subprogram, Graduate Center, City University of New York

[2]Department of Psychology, Queens College, City University of New York

1. INTRODUCTION

The ability to detect changes in orientation is critical for 2D and 3D form perception. For example, previous work in our lab has shown that accurate perception of textured 3D surfaces depends on the presence of specific patterns of orientation flows in the image. Recent research has shown that affective state may influence the visual perception of oriented patterns. For example, Bocanegra and Zeelenberg (2009) found that relative to neutral face stimuli, fearful face stimuli can augment sensitivity to orientation of low spatial frequency gratings and decrease sensitivity to orientation of high spatial frequency gratings. The authors thus suggest that fear may facilitate processing in the magnocelluler ("where" / "how") pathway at a cost of impairing function in the parvocellular ("what") pathway. The current study aims to extend these results by investigating 1) how the effects of affect on orientation perception might generalize across face databases, 2) how affect might alter the perception of orientation in not only vertically oriented stimuli, but also horizontally oriented stimuli, and 3) how affect might alter the perception of orientation of more complex patterns containing horizontal and vertical orientations. Using the Radboud face database, we presented affective fear versus neutral face primes before grating and plaid stimuli and measured orientation sensitivity to both low (2cpd) and high (4cpd) spatial frequency patterns. Preliminary results suggest that fearful primes, relative to neutral primes, may increase orientation sensitivity to low frequency stimuli and reduce orientation sensitivity to high frequency stimuli, as was found in Bocanegra and Zeelenberg (2009), and that these results appear to generalize to the Radboud face database. However, this pattern of results appears to occur only for vertically oriented stimuli. Fearful primes do not appear to affect orientation sensitivity to horizontally oriented stimuli or stimuli containing both horizontal and vertical components.

An example of how changes in orientation are critical for form perception is illustrated here. Correct 3D perception depends on the visibility of specific orientation flows (Li & Zaidi, 2000, 2004):



Recent studies suggest that the visual perception of oriented patterns can be altered by affective state:

1. Fear (vs. neutral) face stimuli prior to a target stimulus (Gabor patch) **enhanced** sensitivity to the **contrast** of the stimulus (Phelps, Ling, and Carrasco, 2006).
2. Fear (vs. neutral) face stimuli prior to a target stimulus (Gabor patch) **enhanced** sensitivity to the **orientation** of the stimulus for low spatial frequency stimuli. However, fearful (vs. neutral) face stimuli **reduced** sensitivity to orientation if it was high spatial frequency. (Bocanegra & Zeelenberg, 2009).

LO SF - Vertical | LO SF - Tilted | HI SF - Vertical | HI SF - Tilted

Gabor patches

2. SPECIFIC QUESTIONS

The current series of experiments seek to examine:

1. Whether the effects of affect on orientation perception generalize across face databases

2. Whether the effects of affect on vertically oriented stimuli generalize to horizontally oriented stimuli

3. The influence of affect on the perception of orientation for more complex patterns containing both horizontal and vertical components

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Phelps E.A., Ling S., & M. Carrasco (2006) Emotion facilitates perception and potentiates the perceptual benefits of attention. *Psychological Science*, Apr.17(4):292-9. doi: 10.1111/j.1467-9280.2006.01701.x.

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3. METHODS

To measure sensitivity to orientation, we measured tilt threshold per participant in a baseline condition. In the experimental condition, gratings oriented at tilt thresholds were then individually generated per participant and effects of affective primes on these gratings were compared to effects of the same primes on non-tilted gratings. D-primes (d') were then derived and compared across participants.

For both the baseline and experimental trials, viewing parameters were driven by a ViSaGe Visual Stimulus Generator on a 22" CRT monitor at 100Hz at a distance of 100cm from the screen (mean luminance = 54 cd/m², all stimuli = 6.5 degrees). Stimuli were randomized across trials. All stimuli were viewed binocularly.

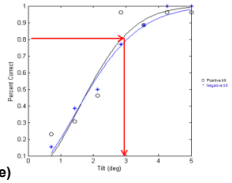
3.1 Measuring Sensitivity to Tilt (Baseline thresholds)

Task: While fixating centrally, does the stimulus in periphery appear tilted or not? (2AFC)

Procedure: Used the Method of Constant Stimuli to determine tilt thresholds for 2cpd and 4cpd frequency gratings. Following a 60s fixation period, gratings tilted at angles ranging from -10*deg* to +10*deg* were presented randomly 5*deg* to the right or left of the point of fixation for 40ms. Participants were blocked to run both 2cpd and 4cpd for either the Vertical, Horizontal, or Plaid conditions.

Tilt thresholds = the degree of tilt needed to correctly identify that the stimulus appeared tilted 80% of the time for each spatial frequency (2cpd and 4cpd) and pattern type (vertical grating, horizontal grating, and plaid grating) at 5*deg* from the point of fixation. Data for both positive and negative tilts were fit using a Weibull function (graph).

Sensitivity = 1/Tilt Threshold"



3.2 Measuring Tilt Sensitivity as a Function of Affect (D-prime)

Task: While fixating centrally, does the stimulus in periphery appear tilted or not? (2AFC)

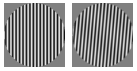
Procedure: Used the Method of Constant Stimuli to determine tilt sensitivity for one of the six pattern conditions – Vertical, Horizontal, or Plaid for 2cpd and 4cpd. Following a 60s fixation period, fearful and neutral face primes were simultaneously presented for 70ms before either a grating at baseline tilt threshold or a non-tilted grating, which were presented randomly 5*deg* to the right or left of the point of fixation. Response feedback was given per trial as two different tones.

D-primes = sensitivity to tilt was measured and compared by calculating the d-prime (d') for each tilt condition per face cue, where d-prime is the difference between the z-transformation of correctly identifying a test as being tilted when the stimulus is actually tilted (or, a hit) and the z-transformation of the incorrectly identifying a test as being tilted when the stimulus is actually not tilted (or, a false alarm).

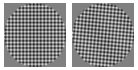
d' = z(hits) – z(false alarms!"

Stimuli

1-Dimensional - Grating

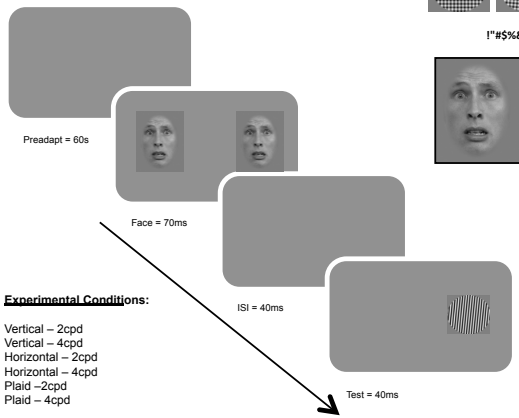


2-Dimensional - Plaid



!"#$%&#'faces

Per trial:

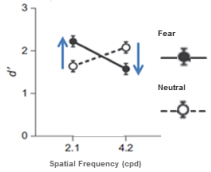


Experimental Conditions:

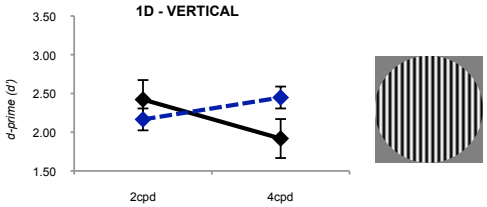
Vertical – 2cpd
Vertical – 4cpd
Horizontal – 2cpd
Horizontal – 4cpd
Plaid –2cpd
Plaid – 4cpd

Prediction:

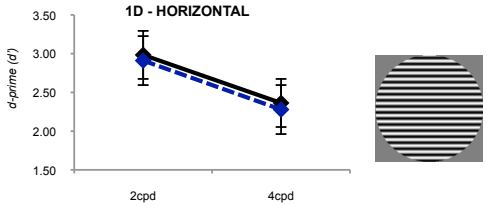
from Bocanegra & Zeelenberg (2009)



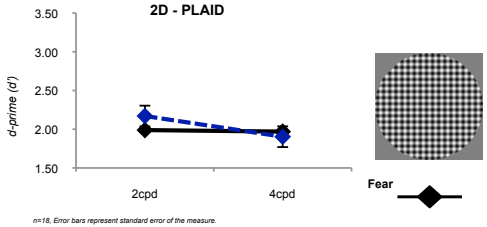
4. RESULTS



n=18, Error bars represent standard error of the measure.



n=18, Error bars represent standard error of the measure.



n=18, Error bars represent standard error of the measure.

5. CONCLUSIONS

Consistent with previous finding by Bocanegra and Zeelenberg (2009), we found a significant interaction (F(1, 17)=7.376, *p*=.015) between spatial frequency and the presentation of facial cues for vertically oriented stimuli using faces from the Radboud face database. **Therefore, sensitivity to orientation of a vertical stimulus is enhanced for lower spatial frequencies, whereas, sensitivity to orientation is reduced for higher spatial frequencies, and these effects appear to generalize to a different face database.**

However, we found significant overall effects (F(2, 204)=5.299, *p*=.006) between the experimental vertical and horizontal conditions (Bonferroni, *p*=.039) as well as the plaid and horizontal conditions (Bonferroni, *p*=.008). Given that there was not a significant interaction, the effects of fear do not seem generalizable to horizontal orientations. **Therefore, the effect of fear primes appears to affect orientation sensitivity differently for vertical stimuli, horizontal stimuli, and stimuli containing both orientations.**