

## **Long-lasting Sensitization to Color Induced by a Search Task**

Chia-Huei Tseng, Joetta L. Gobell, \*Zhong-lin Lu, and George Sperling.

University of California, Irvine, CA 92697; \*University of Southern California, LA, CA 92697

A novel motion paradigm (third-order chromatic motion with amplification by texture) offers a delicate measurement of attention. We here apply this paradigm to measuring the degree to which searching for a color in a search task sensitizes observers to that color. Using this method, we were able to determine the following: (1) that observers do become significantly sensitized to the attended color; (2) the sensitization can persist for a month after the last search session; (3) the sensitization is attenuated by asking observers to switch attention to another color.

### **Stimuli**

All the experiments utilize a third-order chromatic motion paradigm and a serial search task. The stimuli in each task are described as below.

Our third-order motion paradigm uses stimuli in which first-order (luminance) and second-order (texture/contrast) components have been cancelled. All motion stimuli consist of five frames with a 90 degree phase shift between each successive frames. The odd-number frames are red-green isoluminant sinewave gratings. On each trial, one of ten different saturation ratios ( $|R|/|G|$  ranging from 0 to  $\infty$ ) was chosen. The even frames consist of alternating stripes of high- and low-contrast textures. Even frames serve as "amplifiers" in the motion computation. The direction of motion is completely ambiguous when the saturations of green and red are such that they appear equally salient to the third-order motion system. When red-green salience is unequal, apparent movement is perceived in a "red" direction or in the opposite "green" direction according to whether the red or green stripes are more salient. By varying the relative saturation of the two colors, a psychometric function describing motion-direction judgments is obtained.

In the serial search task, observers search for a target letter among distractors (letter and numbers) in ten successive frames. Each frame is each composed of 4X4 squares with a black letter or digit in each square. Every trial has one target; the task of the observer is to report its location in the array. Each square is painted in one of four different colors (red, green, blue, yellow). Observers are informed before a trial on which colored square the target will be shown (only red or green are tested).

Observers' benefit from the color cue because it reduces the number of possible target locations to one quarter of the possible 16 X 10 (frames) locations in each trial. Thereby, the color precue is an important aid, and observers become sensitized to the target color after several hours of practice.

### **Methods & Results**

#### **Exp.1**

- (1) Observers performed the direction discrimination task in an isoluminant chromatic third-order motion display. A psychometric curve (baseline) depicting the perceived motion direction as a function of the relative saturation between two colors ( $|R|/|G|$ ) is obtained for each observer.
- (2) Then, each observer moves to another room to conduct the search task. Each observer is randomly

assigned to either search for targets on a red or on a green background. As observers improve, the task is made more difficult by shortening the duration of the search frames. Search training takes from 3 to 7 hours.

(3) After finishing the search task, the same motion task as in (1) is conducted again, and a new psychometric curve is obtained.

For all observers, the sensitization to the attended color in the search task generates a lateral shift in the psychometric function of the motion task, as if the attended color had become more saturated for a factor of 1.4 ~3.

### **Exp. 2**

Observers are perform the same tasks (1), (2), and (3) as in the previous experiment except they now attend to an opposite color. Observers' psychometric functions in the motion paradigm are obtained and compared with the baseline.

For all observers, the new psychometric functions show the same lateral shifts relative to the original control conditions as in Exp. 1 but in the opposite direction.

### **Exp. 3**

Observers return every day after the completion of Exp. 2 to run a session of motion judgments in which a new psychometric function is generated, which can then be compared with the original baseline.

Sensitization to an attended color produces data that, as far as salience is concerned, are equivalent to an increase in color saturation of that color. This increased equivalent color saturation can last for weeks, and in one (of four) observers it survived for a month.