

Attentional Sensitization to Specific Colors

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Last year, we demonstrated that a novel third-order motion paradigm was a sensitive measure of attentional sensitization to specific colors (Tseng et al, 2002). This year, we utilize this paradigm to investigate the dynamic characteristics in attention shifts. We were able to determine that (1) instructions to attend to a color produce significant sensitization to the color, (2) the magnitude is smaller than that the sensitization produced in a color search task; (3) instruction to switch attention is effective even when observers have to alternate attention between red and green on successive trials.

Stimuli

In these experiments, all motion stimuli consist of five frames with a 90 degree phase shift between each successive frame. The odd-number frames are red-green isoluminant square-wave gratings. On each trial, one of ten different saturation ratios is chosen. The even frames consist of alternating stripes of achromatic 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 motion is perceived in either of two opposite directions. If red is more salient, movement is seen in the "red" direction otherwise it is seen in the "green" direction. From previous research it is known that red-green salience can be influenced either by varying the physical saturation of the colors or by changing the observer's attentional state. A psychometric function describing motion-direction judgments at different relative saturation is obtained.

Procedures

1. Observers participate in a neutral third-order motion paradigm (without any instruction) and psychometric functions are obtained as a baseline.
2. With instruction to attend to one color, each observer runs the same motion task again. During the motion task consisting of 400 trials, every N trials, $N = 1, 50, 100, 200$, observers are instructed to shift attention from red to green or vice versa. A visual or auditory cue is presented prior to each trial to indicate the to-be-attended color in the coming trial. Two different visual cues (letter or color patch) and two auditory cues (spoken color names or high/low pitch) are used.
3. Trials in which subjects attend to red are averaged separately from attend-to-green trials. The

data are plotted as psychometric functions.

Results

1. All observers produced very similar results. Instructions to attend to a color produced lateral shifts in the observers' psychometric functions. These shifts are equivalent to increasing the relative physical saturation of the attended color by 10 to 20% .
2. Lateral shifts in the psychometric functions were observed in all conditions, even when observers had to shift attention every other trial (N=1). This indicates the instruction to switch attention is effective in changing the perceived salience even on the first trial of each block.
3. No difference is found in visual or auditory cues, so these data were averaged.

Conclusion and Discussion

1. The effect of "fast" voluntary attention to a color in altering the direction of perceived movement, while highly significant, is half that obtained by prolonged attention to the same color.
2. Third-order isoluminant motion paradigms are an effective way to measure the increase in sensitization to color that results from protracted search or within one sec in response to an attentional cue.
3. We explain this change in performance in terms of a hypothesized third-order computation of salience. Apparent motion is determined by the visual system's assignment of salience values. In an iso-luminant motion display, salience of an area is determined by the difference of the area from the uniform gray background--areas of high contrast texture or of high color saturation have greater salience. Attention to a color produces a change in motion-direction perception that is equivalent to an increase in saturation, i.e., an increase in salience.