Ocular Dominance and Subjective Color Perception: A Study Using the Fechner-Benham Visual Illusion

Jessica M. Kellogg and Geoffrey O’Shea

Introduction

Past research has demonstrated differences in visual processing between the dominant, or preferred eye, and the non-dominant, or less preferred eye. Researchers have accounted for these differences according to either physiological mechanisms (Porac & Coren, 1976) or behavioral preferences (Mapp, Ono, & Barbeito, 2003).

The behavioral preferences account can be eliminated by examining how the eyes process visual illusions which are expected to be influenced by prior experiences. One particular illusion, the Fechner-Benham Color Illusion, involves disks featuring red and white designs which, when created, produce the illusion of various subjective colors within the disks (Rosembloom, Anderson, & Purdie, 1981).

It was hypothesized that when viewing the Fechner-Benham Illusion with the non-dominant eye, participants would exhibit longer latencies for the onset of color and would report fewer colors compared to viewing with the dominant eye and with binocular vision.

The underlying physiological mechanisms that are often regarded in subjective color perception are either described high in the visual information hierarchy, in a neurophysiological site, thus eliminating the inherent speed (Porac & Viénot, 1999; Robinson, 1998). Or, antagonistically, they are described as taking place within the retina in terms of an uneven distribution of photoreceptor cells (Janks, 1977).

General Method

Participants (n = 29) were verbally presented with a Questionnaire in order to identify normal vision corrected vision, any injury that may affect visual acuity, and handedness. Participants’ color vision was tested using the D-15 Panel Test for Color Perception. Participants’ ocular dominance was determined using the average of three tests: 1) a test of motion discrimination, 2) a test for visual acuity using an eye chart, and 3) a test of ocular preference in tasks.

Design

Participants were first presented with a control disk, in which objective colors could be observed. The disk was observed at ½ and ¾ full speed, under the three conditions, Non-Dominant, Dominant, and Binocular, which were randomized.

Participants then viewed the Fechner-Benham disks (2) at ½ and ¾ speeds, and a range of stimuli was presented, each under each of the three eye conditions.

Control Condition Results: Wavelength Detection at ¾ Speed

There were no significant differences in the number of colors reported across the eye conditions for the control disk.

Significantly more colors were reported under half-speed compared to three-quarter speed viewing conditions for the dominant and binocular conditions.

Significantly less colors were reported under non-dominant eye viewing conditions than binocular viewing conditions under half-speed conditions (t = 3.78, p < .05).

When viewing the Fechner-Benham Illusion, the performance of the non-dominant eye is near equal to that of binocular vision.

Conclusions

Overall, sensitivity to color is reduced when viewing the Fechner-Benham disks compared to the control disks.

The non-dominant eye is more sensitive to shorter wavelengths such as blue compared to the dominant eye.

The non-dominant eye condition is less sensitive to longer wavelengths such as orange compared to the dominant eye and binocular eye conditions.

References


