CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

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Project Number
22641

Project Title
Do You Believe What You See? The Effect of Lateral Adaptation on the Human Visual System

Abstract

Objectives/Goals
Is the effect of object size (field-of-view) on lateral adaptation in the human visual system the same or different for monochrome (grey scale) and color vision? My objective is to develop a better understanding of the contrast enhancement mechanisms of the human eye and brain, and in particular to understand the differences in behavior that occur in the color and grey-scale vision systems with respect to the size of the perceived objects within the field of view. Hypothesis: Lateral adaptation occurs in the human visual system, and results in contrast enhancement for same-brightness objects placed in different brightness backgrounds. Since the brain processes grey-scale and color information differently, and since the corresponding visual acuities are also different, we hypothesize that the minimum fields-of-view for grey-scale and color lateral adaptation may be different as well.

Methods/Materials
Several sets of visual test targets, generated in Matlab, and printed out in both grey-scale and color were used.
A. We made up patterns of various sizes both in grey-scale and in color, with different relative contrasts and colors between the square objects and their backgrounds.
B. The patterns were shown to 22 different human subjects, placed at different distances from each subject.
C. Each person#s observations were recorded as to how they perceived the brightness or color of each square when the patterns were presented at various distances from the observer.
D. The data were analyzed to determine the similarities and differences between the grey-scale and color image cases. Control patterns were used to eliminate observer bias.

Results
The grey-scale lateral brightness adaptation effect was observed over the entire range of object sizes and distances tested, right to the limit of human visual acuity. The chromatic adaptation (color) effect was observed over a nearly identical range of object sizes and distances tested.

Conclusions/Discussion
The minimum fields-of-view for grey-scale and color lateral adaptation are more similar than different, with both grey-scale and color adaptation working essentially all the way to the limits of human vision. This result is unexpected due to the traditional view of the specific mechanisms by which the brain processes grey-scale and color information, and where in the eye and the brain grey-scale and color information are extracted.

Summary Statement
In this project, we demonstrated that lateral brightness adaptation and chromatic adaptation can be observed to almost the limits of human visual acuity, contrary to the currently accepted models of the human eye and brain.

Help Received
Father guided student through project, offered suggestions and answered questions, and helped with the Matlab and PowerPoint programs to develop test targets and charts. Mother solicited volunteers to be experimental subjects, and helped with editing.