

Summer Student Research Program

Project Description

FACULTY SPONSOR'S NAME AND DEGREE: *Eric L. Altschuler, M.D., Ph.D.*

PHONE: (973) 972 - 5439

DEPARTMENT AND INTERNAL MAILING ADDRESS: *Physical Medicine & Rehabilitation, University Hospital, 150 Bergen Street, B-403*

E-MAIL: *eric.altschuler@umdnj.edu*

PROJECT TITLE (200 Characters max):

Psychophysics of the Visual Perceptual Binding and Color and Brightness Contrast Problems in Normal Subjects with Potential Applications to Neurologic Patients

HYPOTHESIS:

One of the biggest unsolved problems in neuroscience, psychology, neurology or even in all of science is the perceptual binding problem: How does the brain bind stimuli disparate in time and space into a single, coherent perceptual whole. Recent work has found a number of time scales for binding of visual perceptual stimuli---20Hz for characteristics such as color and orientation for stimuli at a single spatial location, and ~4Hz for most stimuli separated even slightly in space. The time scales have been studied and established in normal subjects but little work has been done in neurologic subjects. We will now (1) design, test and catalog perceptual stimuli with binding frequencies in a range intermediate between 4 and 20 Hz or close to 20 Hz to try to definitively establish if there are multiple binding mechanisms, and also to have a test paradigm that can rapidly test normal subjects and thus be useful in testing neurologic patients. (2) Another equally significant problem is that of color and brightness contrast--how the brain maintains the color or brightness of objects in the face of constantly changing ambient lightings and scenes. We have been studying, and designing and testing new visual illusions and effects that probe this remarkable property of the brain. The faculty sponsor and medical students as part of the ORSP program have already published and presented (Huang, Ghosh, Hon, Goris-Rosales & Altschuler, 2009; Huang, Hon & Altschuler 2008; Altschuler, Huang, Hon, Goris-Rosales & Tyler 2008; Altschuler, Huang & Hon 2008) some results on these topics and now we will be studying such effects more closely and designing and studying new effects.

PROJECT DESCRIPTION (Include design, methodology, data collection, techniques, data analysis to be employed and evaluation and interpretation methodology)

The Faculty Sponsor has been working with his colleague V.S. Ramachandran, M.D., Ph.D. (UCSD) on perception and perceptual binding, and the student will benefit from this collaboration. The student will first learn how to test normal subjects on visual psychophysics experiments. The student will then test normal subjects on previous and recent stimuli sets, ascertain cutoff frequencies for individual subjects and compute statistical norms. The student will also design stimuli appropriate for neurologic subjects, test these stimuli in controls age-matched to neurologic subjects and plan for and ideally test neurologic subjects. The student will learn about designing stimuli. The student may also run subjects on a new paradigm/method to immediately improve reading speed and comprehension in dyslexic individuals and work on studies on color contrast and modern understanding of Gestalt grouping principles. The Faculty Sponsor also works with Prof. Alan Gilchrist (Rutgers) a world leader in the brightness contrast problem.

SPONSOR'S MOST RECENT PUBLICATIONS RELEVANT TO THIS RESEARCH:

Altschuler E, Hon A, Huang A. Case 19-2007: a college student with fever and joint pain. N Engl J Med. 2007; 357: 1780.

Altschuler EL, Altschuler BM, Altschuler DL, Samber D & Ramachandran VS. "Stroop concordant" coloring of letters for remediation of dyslexia. Medical Hypotheses 2007 69: 381-2.

Altschuler EL. Interaction of vision and movement via a mirror. Perception 2005; 34: 1153-5.

Altschuler EL, Huang AE, Hon AJ, Goris-Rosales J, Tyler C. Simultaneous color contrast, afterimages and metameric intransitivity: Novel effects and explanation of previously enigmatic results. Vision Sciences Society, May, 2008, Naples, Fla. Journal of Vision 2008; 8 (6) 562a.

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Altschuler EL, Huang AE, Hon AJ. Simultaneous color contrast subtracts from the test patch the color in common with the surround, and does not add the complement of the surround to the test patch. *Society for Neurosciences (Washington DC, November, 2008)* 86.17.

Foster C & Altschuler EL. The bulging grid. *Perception* 2001; 30: 393-5

Huang AE, Ghosh S, Hon AJ, Goris-Rosales J & Altschuler EL. The Wertheimer-Benary effect does not invert, and a nulled Wertheimer-Benary effect. *Perception* 2009; 38: 1728-1730.

Huang AE, Hon AJ, Altschuler EL. Thickness and the Koffka ring effect. *Perception*. 2008; 37: 1458-60.

Holcombe AO & Judson J. Visual binding of English and Chinese word parts is limited to low temporal frequencies. *Perception* 2007 36: 49-74.

Eagleman DM, et al., & Holcombe AO. Time and the brain: how subjective time relates to neural time. *J Neurosci* 2005; 25: 10369-71.

Economou E, Zdravkovic S, Gilchrist A. Anchoring versus spatial filtering accounts of simultaneous lightness contrast. *J Vis.* 2007; 7: 2.1-15.

IS THIS PROJECT SUPPORTED BY EXTRAMURAL FUNDS?

Yes or No

THIS PROJECT IS: Clinical Laboratory Behavioral Other

THIS PROJECT IS CANCER-RELATED

THIS PROJECT IS HEART, LUNG & BLOOD- RELATED

THIS PROJECT EMPLOYS RADIOISOTOPES

THIS PROJECT INVOLVES THE USE OF ANIMALS

PENDING APPROVED IACUC PROTOCOL #

THIS PROJECT INVOLVES THE USE OF HUMAN SUBJECTS x

PENDING APPROVED IRB PROTOCOL # 0120060078

THIS PROJECT IS SUITABLE FOR:

UNDERGRADUATE STUDENTS ENTERING FRESHMAN
SOPHOMORES ALL STUDENTS

THIS PROJECT IS WORK-STUDY: Yes or No

WHAT WILL THE STUDENT LEARN FROM THIS EXPERIENCE?

The student will learn about the psychophysics and cognitive neuroscience of visual perceptual binding. The student will learn how to test subjects in a rigorous manner. The student will learn about experimental design. The student will learn about the organization of perceptual information in the human brain. This project is ideal for the student interested in clinical or research aspects of modern neurology, neuroscience and cognitive psychology. The Faculty Sponsor and his collaborators have significant publication records. The faculty sponsor has published papers and made presentations with ORSP students (e.g., Huang, Ghosh, Hon, Goris-Rosales & Altschuler, 2009; Huang, Hon & Altschuler 2008; Altschuler, Hon & Huang 2007; Altschuler, Huang, Hon, Goris-Rosales & Tyler 2008; Altschuler, Huang, Hon 2008) The student will learn about the process of publishing scientific papers, with the goal of this project being publication in a high impact journal. The students from previous summers along with the Faculty Sponsor also have other papers at review or in preparation. This project is ideal for students interesting in publishing in the scientific literature.