The Integration of Eye-Tracking and Psychophysiology Methodology in the Study of Psychopathology

CIS-Kodak Innovative Research Grant - New Collaboration Proposal

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Abstract

Rochester Institute of Technology (RIT) places an emphasis on research that is innovative, interdisciplinary, and conducive to student learning and scholarship. This proposal seeks funding for an interdepartmental collaborative research project within the Multidisciplinary Vision Research Laboratory (MVRL) to integrate psychophysiological and eye tracking techniques in the study of clinical psychopathology, specifically research on addiction disorders and bipolar disorder. The goals of this project are to: 1) develop a paradigm to combine mobile eye-tracking data with psychophysiological measures (i.e. heart rate and skin conductance), and 2) to apply this new methodology to investigate visual attention and psychophysiological arousal as it applies to emotion processing and cue-reactivity in nicotine addiction and pediatric bipolar disorder. Funding will be used to collect important pilot data for a future National Institutes of Health (NIH) R01 application, while also supporting undergraduate student research assistants to work on the project. This project is an important first step in the development of a unique multidisciplinary research program that combines methodologies from imaging science, cognitive science, and psychophysiology with clinical psychology to investigate abnormalities in visual attention and emotional reactivity in nicotine addiction and pediatric bipolar disorder.

Dollar Request: $6500

Desired Funding Dates: 1/09 – 12/09
Scientific Justification: This proposal is in response to the call for interdisciplinary research collaborations between imaging science researchers and other disciplines. The proposed collaboration described here entails creating a synergistic research group that will apply eye-tracking methodology developed in the Multidisciplinary Vision Research Laboratory (MVRL) and the tools of cognitive science to the assessment of clinical research problems (specific projects described below) in the field of Clinical Psychology (Drs. Baschnagel & Schenkel) from the Department of Psychology at RIT. This collaboration will combine cutting-edge research methodologies from multiple fields including psychophysiology, cognitive science, and clinical psychology with the use of state-of-the-art imaging systems, and will allow for the development of new and innovative clinical research applications.

The proposed collaboration will focus on building a research team that will 1) combine eye-tracking and psychophysiological methodology in the study of clinical disorders (specifically addictions and pediatric psychopathology), 2) be competitive for external funding and 3) provide research training opportunities for students in both CIS and the Department of Psychology. Dr. Baschnagel is an expert on addiction research and the use of psychophysiological measures, while Dr. Schenkel’s expertise is in research on serious mental illness and pediatric psychopathology. Drs. Pelz and Herbert will provide expertise in eye-tracking methodology, cognitive science, and attentional processing. The group will begin by focusing on two concurrent pilot projects that utilize eye-tracking and psychophysiology methodologies to study emotional and attentional processing in two specific clinical areas: the study of nicotine addiction and pediatric bipolar disorder. The three main goals of this project and the overall rational for each study are provided below.

Part 1: The development of a paradigm to link eye-tracking with psychophysiological measures.

The specific aim of Part 1 is to develop a paradigm to combine mobile eye-tracking data with psychophysiological measures. Psychophysiological measures (i.e. heart rate and skin conductance) allow for the measure of arousal which is linked to attentional orienting (shifting attention to novel stimuli) and emotional reactivity (arousal increases when attending to emotional stimuli). Linking data from mobile eye-tracking systems developed at RIT [1,2], which give us information on where individuals are allocating visual attention in the environment, to psychophysiological data will allow for the increased specificity of the psychophysiological measures. This would allow for these psychophysiological measures to be utilized in more dynamic, real-world settings, which is important for Parts 2 and 3 of this proposal.

Part 2: Examination of attentional and emotional processes in nicotine addiction.

The specific aim of Part 2 is to use the combined paradigm to study attentional and emotional processes in nicotine addiction. Current smokers who wish to quit smoking often relapse soon after quitting due to cravings elicited by smoking cues in their environment [3,4]. This cue-reactivity is a phenomenon whereby objects in one’s environment become associated with drug use and the drug’s effects, and thus come to elicit physiological reactivity and craving responses in addicted individuals [3]. Researchers have attempted to study this cue-reactivity to better understand its potential to lead to relapse. Many studies have assessed cue-reactivity in the laboratory [3,5]. The findings show large effects for self-report craving but contrary to theory, only small effects for physiological responding [3]. Furthermore, the generalizability of laboratory based reactivity is limited. The reduced physiological reactivity may result from the constraints of conducting studies in a typical research lab, where the artificialness of the setting and the use of cues that may not be
powerful enough to elicit strong reactivity (e.g. using pictures or videos of drug paraphernalia and drug use). Designing a research paradigm that can assess a participant’s reaction to drug cues in a more natural environment would increase our understanding of cue-reactivity and provide knowledge to improve current smoking cessation treatments. Research on cue-reactivity is now beginning to focus on more realistic environments (such as virtual reality) [5,6]. Using mobile eye-tracking technology may allow for the study of cue-reactivity in more naturalistic environments. Surprisingly, to date no study has utilized mobile eye-tracking to study cue-reactivity. This study is the necessary first step in using mobile eye-tracking data to study cue-reactivity in a realistic environment; an advancement that would drastically change the field of cue-reactivity research.

Part 3: Visual eye-tracking and emotional reactivity to facial stimuli in pediatric bipolar disorder.

The specific aim of Part 3 will be to investigate eye-tracking as it relates to emotion processing and psychophysiological reactivity for positive, negative, and neutral facial stimuli in children and adolescents with pediatric bipolar disorder (PBD).

PBD is a debilitating illness characterized by rapid mood swings, significant functional impairment, and chronic morbidity. Deficits in social cognitive and interpersonal functioning are core features of the illness [7,8,9], and are thought to reflect disturbances in emotion processing circuitry. However, the specific mechanisms associated with emotion processing deficits in PBD are currently unknown. Past studies have demonstrated deficits in the ability to identify and discriminate facial emotional expressions among youth with PBD [10]. Studies have also shown that youth with PBD display increased psychophysiological reactivity when placed in emotionally challenging contexts [11]. One candidate probe for investigating both affect processing and emotional reactivity in PBD is the application of eye-tracking methodology along with measures of psychophysiological arousal.

Visual attention to salient facial features, such as the eye region, is vital for accurate emotion identification and discrimination [12]. Attention to the eye region is also associated with an increased state of arousal [13]. Past studies have documented a reduction in attention to the eye region of faces in other psychiatric disorders such as autism and schizophrenia [14,15]. There has been only one study of visual scanning for faces among adult mood disorder patients, and results indicate that these patients display a reduced number and duration of fixations to both the eye and mouth regions [16]. To date, there have been no studies of visual eye tracking in PBD. Moreover, there have been no investigations that have combined eye-tracking with psychophysiological measures to examine emotion processing in this population. Therefore, it is unclear whether or not attention to the eye region of emotional faces is associated with exaggerated psychophysiological reactivity, and whether or not this is associated with abnormal visual scanning patterns and poorer emotion identification in PBD. The proposed study would be the first to explore the relationship between visual eye tracking and emotional reactivity for facial stimuli in PBD, and it would explore this issue using state-of-the-art eye-tracking and psychophysiological methodology applied to realistic, life-sized stimuli. This project will lay the groundwork for future studies of visual scanning for broader aspects of social stimuli in PBD (i.e., complex social scenes, real-world social interactions, etc.), as well as studies that examine potential changes in visual scanning patterns with variations in clinical state and following treatment.
**Collaboration Benefits:** The proposed collaboration will provide the following benefits:

1.) This collaboration will allow the involved PI’s to be competitive for external grant funding from the National Institutes of Health and its sub-agencies: the National Institute of Mental Health (NIMH), and the National Institute of Drug Addiction (NIDA). These government funding agencies have recently released multiple requests for applications that call for the specific types of collaborative research groups we are proposing in this application. The proposed projects will provide pilot data that demonstrates the group’s ability to work together and generate data with the eye-tracking assessments.

2.) This collaboration will allow for the advancement of the field of addiction research and pediatric psychopathology research, putting eye-tracking methodology at the forefront of these fields. This will expand the audience of imaging science research and possibly instigate the increased use of eye-tracking methodology in these psychological fields of study.

3.) This collaboration will provide opportunities for undergraduate students from CIS and the Department of Psychology to work in a state-of-the-art research lab. This will allow students from both areas to learn valuable research and collaborative skills which will enrich their training here at RIT and make these students more competitive in the job market and graduate school admissions.

4.) On a more general scale, the work of this collaboration may help improve the human condition by bettering our understanding of addictive processes and dysregulated emotion and attention in children with psychological disorders by allowing for better treatments to be developed for these patient populations.

**Budget Request:** We request funds in the amount of $6500. This funding will be solely used to pay undergraduate students to work as research assistants on this collaborative work. The funding would pay for part-time salaries of 3 students, one CIS student and two psychology students, at $9-12/hour. Students will learn the methodology and concepts related to the studies and assist with scheduling and running participants through the studies. Over $12K in Funding for equipment and participant costs for the above-mentioned studies has already been secured by Drs. Baschnagel and Schenkel in a competitive-proposal process through the Office of the Vice President for Research. Additionally, Dr. Schenkel recently submitted a National Alliance for Research in Schizophrenia and Depression (NARSAD) Young Investigator Award (with Drs. Jeff Pelz in CIS and Andrew Herbert in Psychology) for related research.

**Project Plan:**

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References