SL-CN: Project LENS: Leveraging Expertise in Neurotechnologies to Study Individual Differences in Multimedia Learning

The use of multimedia in STEM education is undergoing a remarkable growth. Such growth has been so rapid that it has far outstripped the abilities of research to keep pace with its application. Project LENS is designed to establish a Science of Learning Collaborative Network (SL-CN) consisting of the Educational Neuroscience Laboratory and Center for the Study of Emotion and Attention at the University of Florida, the Laboratory for Visual Learning at the University of Massachusetts Boston, and the Educational Neuropsychology Laboratory at Washington State University to use new methods to investigate multimedia learning in order to address the gap in knowledge developing in this field. The network brings together scholars from the following disciplines: STEM Education, Cognitive and Developmental Psychology, Neuroscience, Educational Technology, Computer Science, and Educational Measurement. The purpose of our collaborative network is to capitalize on the strengths of each node leveraging our expertise in cognitive neurotechnologies (Electroencephalography, functional Near Infrared Spectroscopy, and eye tracking) to enable a rigorous interdisciplinary research ecosystem. Project LENS will advance fundamental research about learning through integrative neurocognitive conceptual and empirical approaches. Given our interdisciplinary expertise, the **shared goals** of Project LENS include:

1. Establish an effective collaborative network that will build on the strengths of each node of expertise to advance the science of learning through integrated research employing diverse research strategies, shared resources, and a focus on individual differences.
2. Contribute to the translation and integration of conceptual frameworks, methodological approaches, and salient findings from cognitive neuroscience for the science of learning research community.
3. Design and carry out a compelling demonstration project on visuospatial thinking in multimedia learning to illustrate the added value of an individual differences approach to study multimedia learning and the use of non-invasive neuroimaging methods.

Intellectual Merit. Our experienced and interdisciplinary team will advance the science of learning in several ways:

- Most existing multimedia learning research that focuses on cognitive load and learning without much consideration of individual learner characteristics. Here, we propose a paradigm shift that will put the diversity of learners and their individual differences in the center of multimedia learning research.
- While the few existing studies that use the individual differences paradigm focus exclusively on the role of working memory capacity, we take a broader approach and study individual differences at a more precise level, exploring the role of such variables as visual attention span, inhibitory control etc.
- The integrative, interdisciplinary, neurocognitive research proposed here will reduce learning scientists' reliance on self-reports in the study of cognition and promote the use of relevant cognitive neuroscience frameworks and neurotechnologies to improve the science of learning.
- Our work will help accumulate data on individual differences and lay initial groundwork for the construction of comprehensive computational models that can be used to personalize and adapt multimedia learning. Such computational modeling is a natural outgrowth of this line of inquiry.

Broader Impacts. In addition to advancing our understanding of designing cognitively appropriate multimedia, our project's webinars, guest presentations, and composite mentorship of graduate students will **enhance learning, teaching, and student advisement** within and across our network nodes. We will **broaden participation** of underrepresented groups by focusing on the diverse community college population with a wide range of demographic, attentional, and cognitive differences, and by recruiting research assistants from groups that are currently underrepresented in STEM. The entire purpose of Project LENS is to **enhance infrastructure for research and education**, which we accomplish by establishing and furthering collaborations and partnerships to contribute to the science of learning. Our work addresses at least three national initiatives: a) the BRAIN initiative (2014), b) American Graduation Initiative (2015), and c) US House Resolution on Dyslexia (#456, 113th Congress). Our work will enhance, and possibly transform, our understanding of effective designs of 21st century learning accounting for the diversity of individual differences among learners to enhance access to education, which will result in **benefits to the society** in general, and to underserved populations in particular.