Behavior Imaging: Enabling a Quantitative Science of Behavior through Computational Sensing

Project Summary

Rationale and unique opportunity: We propose an Expedition to define and explore a new research area of Behavior Imaging—integrated technologies for multi-modal computational sensing and modeling to capture, measure, and understand human behaviors. Our motivating goal is to revolutionize the diagnosis and treatment of behavioral and developmental disorders. Our thesis is that emerging sensing and interpretation capabilities in vision, audition, and wearable computing, when developed and properly integrated, have the potential to transform this vision into reality.

Overarching goal: We aim to revolutionize the diagnosis and treatment of behavioral and developmental disorders by focusing on three research thrusts: Capturing Behavioral Signals, Measuring Behavioral Variables, and Understanding Dyadic Behaviors. These thrusts describe the systematic progression of our proposed work, from the synchronized capture of multimodal data, such as video and audio, to the measurement of behavioral variables such as eye gaze and level of arousal, culminating in the integrated understanding of complex dyadic behaviors.

Collaborative team: Georgia Tech is the lead institution on this proposal and provides expertise and leadership in computer vision, audition and deployment of applications for screening and interventions for autism. MIT provides unique expertise in wearable sensing of the autonomic nervous system, and will lead on integrating that internal behavior characteristic to deployment studies. CMU provides expertise in computer vision, with a focus on facial analysis, and the human-centered aspects of data collection in everyday environments. Boston University will provide expertise in computer vision as it relates to the analysis of gesture and sign language. Illinois provides expertise in computer vision for activity recognition, and support for visualizing cross-modal information in language-based interventions. USC provides leadership in speech analysis supporting language development in children.

Intellectual merit: The problem of modeling, analyzing, and understanding human behavior from sensor data is a fundamental computational challenge. Progress in this area would impact many disciplines, including speech and language processing, computer vision, and ubiquitous computing. Computational modeling and analysis of children’s behavior is under-developed, and yet of great value in the identification and treatment of many childhood disorders. The behavior of young children is dyadic in nature, inherently multimodal, exhibits a great range of temporal scales, and occurs in a wide range of environments. These sources of complexity and variability pose significant computational challenges, which we propose to overcome through an integrated research program. Our success would help catalyze the creation of a new discipline of computational behavioral science.

Broader Impacts: Our work will impact the diagnosis, and treatment of a broad range of related developmental disorders, with autism as a primary focus. The methods we develop, including an extensive educational plan, will impact the needs of a broad cross-section of stakeholders, including individuals, caretakers, therapists, clinicians, and researchers. Our outreach activities include significant and on-going collaborations with major research centers focused on autism in Atlanta, Boston, Pittsburgh, Illinois and Los Angeles.

Keywords: computer vision, computer audition, autonomic sensing, behavioral science, autism