User-Centered Design of Technology for Just-In-Time, In-Situ Exploration of Facial Affect for Persons on the Autism Spectrum

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Background: Many people on the autism spectrum understand the semantics involved in social interaction, however, embodied information such as facial expressions, gestures, and voice often prove elusive. First-hand accounts from people with autism highlight the challenges inherent in processing these complex and unpredictable social cues. These challenges can be debilitating, complicating social interaction and making integration with society difficult. While many intervention methods have been developed to provide help, the majority fail to include rich, real-world social interactions in their methodology.

Objectives: Our goal is to develop technology-based interventions that help people with autism capture, analyze, systemize, and reflect on social-emotional signals communicated by facial and head movements in natural social interactions that occur within everyday environments. Our approach utilizes an ultra-mobile computer customized with video and pattern analysis algorithms capable of interpreting facial expressions and head movements. In an effort to make our system robust to real-world conditions, and usable by individuals with cognitive, motor, and sensory impairments, we have engaged in a number of user-centered design sessions with people on the autism spectrum and their caregivers.

Methods: We conducted five usability sessions with seven verbal adolescents on the autism spectrum and their teachers to address various hardware and software functionality issues related to our system.

Results: In terms of form-factor, we found that the keyboard and track pad were distracting to several participants. To overcome this, we made custom covers that shield exterior input controls. We also utilized the ultra-mobile computer's touch screen for navigation and input. Each session also resulted in significant changes to the software's interface. Our initial design proved to be cluttered with response graphs and face-tracking information, and lacked interactive tagging components. Based on this input, we modified the interface to allow for interactive tagging of facial expressions, and simplified the real-time graphs and visualizations. Also, at the suggestion of teachers, we made the interface customizable to suit each participant's interests and difficulties recognizing particular facial expressions. Finally, we adjusted the placement and size of touch screen buttons to facilitate use by participants with fine-motor difficulties and/or poor eyesight.

Conclusion: The user-centered design sessions provided significant usability insights and were critical to the overall development of our technology. The iterations made to our system underscore the importance of including people with autism and their caregivers in the design process of new technologies. For these technologies to be effective, they need to accommodate for the perceptual, motor, and cognitive disabilities of their users. An experimental evaluation of our redesigned system is forthcoming to determine if just-in-time, *in-situ* assistance can help facilitate learning of facial expressions and underlying emotions in people with autism.