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Analyzing Multimodal Biometric Data to Identify Profiles of Physiological States and Expressiveness in an ASD Context

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Introduction: Given the pervasiveness of socio-emotional difficulties in autism, many social skills intervention programs are designed to facilitate training in socially-relevant nonverbal cue usage, production, and understanding by means of in-person and technology-based paradigms. Emerging automated technology systems supported by machine learning have greatly facilitated administration and improved the accessibility of autism services like social skills interventions. Supervised and unsupervised machine learning approaches have promising utility in predicting outcomes and identifying subgroups based on symptom profiles. Anecdotal and empirical evidence suggest that autistic individuals find technology-assisted social skill interventions to be motivating and enjoyable and suggest that technology is a promising medium for intervention. By contrast, evidence on the efficacy of these programs as clinically useful has lagged behind the prolific advancements in computer science research. There appears, for example, to still be much room for improvement regarding the evidence-based real world applicability, longevity, and universality of skills improved upon and acquired through these systems. The heterogeneity observed across autism highlights with special importance the need for more adaptive and personalized social skill interventions programs.

Methods: We studied the physiological states and facial expressions of 53 participants completing a computer-based emotion-evoking empathy task. We collected multi-modal data on 27 autistic (ASD) and 26 neurotypical (NT) participants using different biosensors (skin conductance, heart rate, facial expressions), and applied a combination of unsupervised machine learning and statistical analyses to identify two distinct participant profiles with significant differences in emotional/physiological metrics like expressiveness, emotion valence and arousal.

Results: We found a small group of exaggerated emoters, consisting of 86% ASD individuals, and a larger and more heterogeneous group of consistent emoters, consisting of 62% NT individuals

Discussion: The findings from this paper showed that multimodal technologies allow us to collect different modes of non-verbal physiological/emotional data from a variety of embodied/non-embodied biometric sensors. By combining these data modes and analyzing them using exploratory data mining approaches, we were able to generate distinct behavioral profiles within our participants, and thereby, derive a more nuanced insight into the different types of ASD and NT groups who exist in our sample and differ from each other in their physiological responses to emotion-evoking images.

Keywords:

Social informatics, Autism spectrum disorders, Biometrics