

Chapter 1

A System to Measure Physiological Response During Social Interaction in VR for Children With ASD

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ABSTRACT

This chapter presents work aimed at investigating interactions between virtual reality (VR) and children with autism spectrum disorder (ASD) using physiological sensing of affective cues. The research objectives are two-fold: 1) develop VR-based social communication tasks and integrate them into the physiological signal acquisition module to enable the capture of one's physiological responses in a time-synchronized manner during participation in the task and 2) conduct a pilot usability study to evaluate a VR-based social interaction system that induces an affective response in ASD and typically developing (TD) individuals by using a physiology-based approach. Physiological results suggest there is a different physiological response in the body in relation to the reported level of the affective states. The preliminary results from a matched pair of participants could provide valuable information about specific affect-eliciting aspects of social communication, and this feedback could drive individualized interventions that scaffold skills and improve social wellbeing.

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INTRODUCTION

Autism is a neurodevelopmental disorder characterized by core deficits in social interaction and communication accompanied by restricted patterns of interest and behavior (American Psychiatric Association, 2000). Currently, with Centers for Disease Control and Prevention (CDC) prevalence estimates for the broad autism spectrum as high as 1 in 59 children (Baio et al., 2018), identification and effective treatment of autism spectrum disorder (ASD) is often characterized as a public health emergency (Interagency Autism Coordinating Committee, 2009). While there is at present no single accepted intervention, treatment, or known cure for ASD, there is growing consensus that intensive behavioral and educational intervention programs can significantly improve short and long term outcomes for individuals with ASD and their families (Cohen, Amerine-Dickens, & Smith, 2006; National Research Council, 2001; Rogers, 1998). While such intervention paradigms have demonstrated significant effect in addressing basic early deficits in young children (i.e., preschool children), traditional interventions designed to address higher level social and adaptive impairments (i.e., communicating with others, processing and integrating information from the environment, establishing and sustaining social relationships, participating in new environments, learning skills related to functional independence) have been demonstrated to be minimally effective for school-aged children and adolescents with ASD. Specifically, low treatment effects and low generalization effects are typical for social and adaptive skill interventions and are thought to be a result of a failure of traditional methodologies to systematically match intervention strategies to specific skill deficits within and across naturalistic settings in appropriately intensive dosages (Bellini, Peters, Benner, & Hopf, 2007). With a lack of widely available efficacious treatment modes for addressing these complex skills at later points in childhood, adolescence, and early adulthood, it is not surprising that evidence suggests a majority of individuals with ASD (i.e., >70%) fail to achieve adaptive independence as adults (Billstedt, Gillberg, & Gillberg, 2005; Cederlund et al., 2007). Current intervention limitations are compounded by the lack of available resources in many areas and the fact that many children are not identified with ASD until later ages (Christensen et al., 2016; Croen, Grether, & Selvin, 2002; Mandell, Listerud, Levy, & Pinto-Martin, 2002; Yeargin-Allsopp et al., 2003). Thus, despite the urgent need and societal import of intensive treatment of social and adaptive impairment at later ages, effective and appropriate intervention resources for children,

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