Cicadas: A Clinician-assisted, Closed-loop Technology, Mobile App for Adolescents with Autism Spectrum Disorders

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Abstract : Background: ASD is characterized by pervasive Sensory Processing Abnormalities (SPA) and social cognitive deficits that persist throughout the course of the illness and have been linked to functional abnormalities in specific neural systems that underlie the perception, processing, and representation of sensory information. SPA and social cognitive deficits are associated with difficulties in interpersonal relationships, poor development of social skills, reduced social interactions and lower academic performance. Importantly, they can hamper the effects of established evidence-based psychological treatments—including PEERS (Program for the Education and Enrichment of Relationship Skills), a parent/caregiver-assisted, 16-weeks social skills intervention—which nonetheless requires a functional brain capable of assimilating and retaining information and skills. As a matter of fact, some adolescents benefit from PEERS more than others, calling for strategies to increase treatment response rates. Objective: We will present interim data on CICADAS (Care Improving Cognition for ADolescents on the Autism Spectrum)—a clinician-assisted, closed-loop technology mobile application for adolescents with ASD. Via ten mobile assessments, CICADAS captures data on sensory processing abnormalities and associated cognitive deficits. These data populate a machine learning algorithm that tailors the delivery of ten neuroplasticity-based social cognitive training (NB-SCT) exercises targeting sensory processing abnormalities. Methods: In collaboration with the Autism Spectrum and Neurodevelopmental Disorders Clinic at the University of Minnesota, we conducted a fully remote, three-arm, randomized crossover trial with adolescents with ASD to document the acceptability of CICADAS and evaluate its potential as a stand-alone treatment or as a treatment enhancer of PEERS. Twenty-four adolescents with ASD (ages 11-18) have been initially randomized to 16 weeks of PEERS + CICADAS (Arm A) vs. 16 weeks of PEERS + computer games vs. 16 weeks of CICADAS alone (Arm C). After 16 weeks, the full battery of assessments has been remotely administered. Results: We have evaluated the acceptability of CICADAS by examining adherence rates, engagement patterns, and exit survey data. We found that: 1) CICADAS is able to serve as a treatment enhancer for PEERS, inducing greater improvements in sensory processing, cognition, symptom reduction, social skills and behaviors, as well as the quality of life compared to computer games; 2) the concurrent delivery of PEERS and CICADAS induces greater improvements in study outcomes compared to CICADAS only. Conclusion: While preliminary, our results indicate that the individualized assessment and treatment approach designed in CICADAS seems effective in inducing adaptive long-term learning about social-emotional events. CICADAS-induced enhancement of processing and cognition facilitates the application of PEERS skills in the environment of adolescents with ASD, thus improving their real-world functioning.

Keywords : ASD, social skills, cognitive training, mobile app

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