Thesis Project Portfolio

Algorithm-based Troubleshooting for Improving Skill Acquisition in Toothbrushing Among Children with Autism Spectrum Disorder (ASD)

(Technical Report)

Holistic Methods of Diagnosis for Mental Health Conditions

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

While engineering solutions can improve global health and quality of life, the long-term effects of many of these solutions are unknown. As a biomedical engineer, I set out in my career to understand health problems and to design solutions to solve these problems. The area of health that I have conducted my STS thesis on is in mental health and disability diagnosis, and for my technical thesis, I have created a troubleshooting algorithm that is designed to help children with Autism Spectrum Disorder (ASD) succeed in trials for an application designed to improve toothbrushing skills among children with ASD.

The purpose of my technical thesis was to create an algorithm to guide users to additional online support for skillSTAR (developed by the team participating in UVA's STAR initiative), an application that uses evidence-based behavioral practices to improve skill acquisition in tooth brushing in children with ASD. Even with embedded support, the skillSTAR team anticipates that there will be users who require additional support to address common barriers to instruction (e.g., challenging behavior, lack of attending, sensory issues). Hence, I have created an algorithm that will guide users to troubleshooting resources based on identified barriers to instruction that they are experiencing while using the app. The algorithm was tested for validity manually and via an automated test function. I also have conducted a user experience survey, in which potential end-users were asked to reflect on the usefulness of the algorithm. Success rate was 100% for both the automated test function and manual testing. According to the survey results, end users felt that troubleshooting resources would be useful and helpful (to varying degrees).

My STS thesis investigates the ways that the diagnostic process in the US (using the Diagnostic Standards Manual (DSM)) can be diagnose patients based on symptoms/behaviors alone, but also on outside factors. The clinician also observes the patient's behavior while talking to the patient about aforementioned factors. For mental health conditions, the DSM-V, produced by the American Psychological Association, is currently the document used for

diagnosis. When outlining the criteria for diagnosis of disease in the DSM, the main considerations were objective criteria based on the patients' symptoms, behaviors, health conditions, etc. However, there are external factors that determine a patient's mental health status such as work and home life, relationships, etc. Potential solutions to this include using V-codes in the DSM that code for external factors, and/or using a more inclusive framework like the ICD.

My STS and Capstone project focus on different aspects of mental health (diagnosis and treatment respectively). The reason I chose to focus on mental health diagnosis for my STS is due to the rising MH crisis (exacerbated by the pandemic) along with increased awareness of mental health issues.

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