Poster

Wearable Stress Sensors for Children With Autism Spectrum Disorder With In Situ Alerts to Caregivers via a Mobile Phone

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Abstract

Background: Children with autism spectrum disorder (ASD) often exhibit unexpected and difficult to manage self-injurious, aggressive, and/or disruptive and challenging behaviors. These behaviors can lead to restrictive care settings including hospitalizations and lifelong residential care placement. Because children with ASD have significant impairments in social communication skills including lack of facial expression, an inability to clearly articulate feelings, and atypical body language, caregivers could benefit tremendously by knowing when a child is becoming stressed.

Objective: To develop a set of customized features in a wearable sensor and mobile app that monitors stress reactivity of children with autism in real time and automatically triggers in situ alerts to a caregiver via a mobile handheld device.

Methods: The Center for Discovery (CFD) is a not-for-profit internationally recognized service provider for people with complex developmental disabilities, including a large population of children and adults with autism. Neumitra Inc., is a start-up technology vendor specializing in wearable stress monitoring. Neumitra's wearable sensor called neuma featured an embedded system with automated scoring of electrodermal activity, a well-established method for recording physiological stress responses. The sensor was accompanied by a mobile app for users to self-monitor their own stress levels. The app provided a 10-point color gradient scale as an interpretation of real-time stress and arousal levels. CFD collaborated with Neumitra's development team to develop a set of customized features amenable to the use case presented by caring for children with autism. The research team at CFD trialed the neuma system extensively, developed use case scenarios, and identified the features necessary to successfully implement in situ alerts to caregivers and track stress events to review for patterns of stress.

Results: The resulting system is neuma-CFD, a coordinated technological system for in situ monitoring of stress levels to identify correlations in the user's stress increases and contextual events. The system delivers in situ alerts to caregivers via a smartphone or similar handheld devices. A new interface for the mobile app was customized to minimize user burden. The home screen now allows users to create high-frequency calendar events in only two taps. These events include common challenging behaviors and common intervention techniques. Thus, upon review, stress responses can be viewed relevant to both challenging behavioral episodes and intervention techniques. To enhance clinical review, the app now logs the detection of stress events into the calendar. Users can also access an increased granular review of electrodermal activity within a calendar event, such as behavior episodes or classroom routines.

Conclusions: In field testing, in situ alerts were reported by caregivers to be beneficial. Furthermore, the integration of color-coding calendar events and routines in an intuitive interface allows multiple users to review the contextual events correlated to stress responses with minimal training. Wear tolerance, a challenging human factor common in ASD, can be addressed through behavioral shaping protocols. The hardware form factor was not amenable to this population due impulsive behaviors including pulling on the device to remove it, causing hardware damage. Exposure to water during handwashing was another challenge in hardware. These concerns are being revised in future versions of hardware. This system can also benefit other healthcare populations, such as patients with anxiety, posttraumatic stress disorder or any other condition for which understanding patterns of stress offers improved health outcomes.

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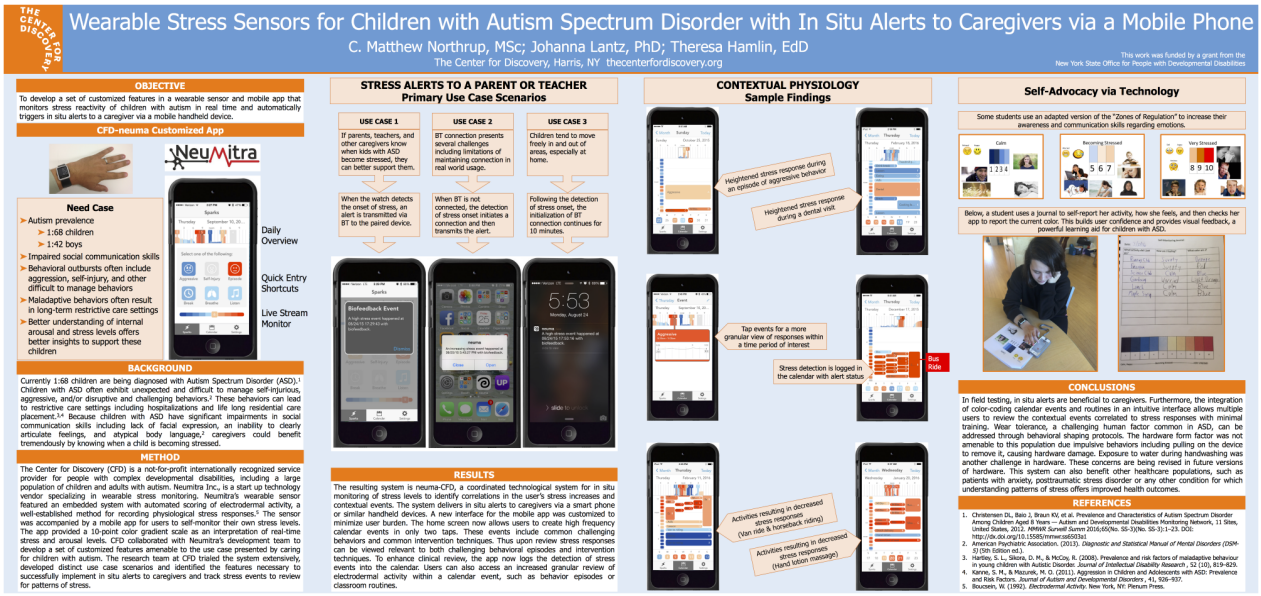
KEYWORDS

mHealth; wearable sensor; stress; autism; app; design

This poster was presented at the Connected Health Symposium 2016, October 20-21, Boston, MA, United States. The poster is displayed as an image in Figure 1 and as a PDF in Multimedia Appendix 1.

Figure 1. Poster.



Multimedia Appendix 1

Poster.

[PDF File (Adobe PDF File), 11MB-Multimedia Appendix 1]

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