Self-Adjusting Biofeedback with a Dynamic Feedback Signal Set (DyFSS)

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Abstract

Autonomic dysregulation with anxiety presents major challenges for many children with Autism Spectrum Disorder (ASD). Peripherally Autonomic Biofeedback Training (PABT) is a promising treatment for managing both anxiety and ASD symptoms. Diversity in ASD may also be reflected in the autonomic profile of individuals, yet there is a paucity of normative data for how the autonomic functioning may differ. Our Dynamic Feedback Signal Set (DyFSS) is a strength-based, self-customizing algorithm that addresses autonomic heterogeneity in youth with ASD. The DyFSS may ease learning of PABT by tuning sensitivity of the feedback to those inputs that are most discernible and controllable for a specific user. Feasibility was tested for youth with ASD in using this algorithm during 5-session PABT protocols. Improvement in ASD symptoms was assessed. Initial results show that youth with ASD are readily engaged through technological interventions such as autonomic biofeedback and improve problem behaviors. By creating individualized and intuitive software, PABT can be refined to address the autonomic heterogeneity of youth with ASD, ease reliance on the clinician, and create the potential for integration of PABT into interactive games and media.

What’s a DyFSS?

Customarily, PABT uses inputs such as Skin Conductance Level (SCL), skin temperature (TMP), low frequency heart rate variability (HRV), respiratory rate (RR) and feeds these signals to the user who learns how to (1) change them in adaptive directions, (2) control them, and then (3) generalize that skill to daily life. People with ASD are autonomically diverse so it is difficult to tell which sensors are best at any given time. To optimize PABT for people with ASD we took a four sensor Signal Set (SCL, TMP, HRV, RR) and displayed them as addends. We dynamically weighted the weight of each addend as it moved in stress-reducing directions at the rate of 32 Hz, summing them to create the Dynamic Feedback Signal Set.

Feasibility testing of DyFSS in teens (ages 12-18) with ASD, n = 8. Change in Daily Observation Scale for Autism (DOSA), following a self-regulation training protocol. Lower scores indicate better behavior. A one-tailed, paired t-test indicates a trend toward lower DOSA scores, t(7) = 1.7, p < .10.

Comparison of DyFSS in youth (ages 8-15) with ASD to a non-customizing display of the four signals (Graphs) individually, n = 10. Change in DOSA, Aberrant Behavior Checklist (ABC), and physiological control following a self-regulation training protocol.

Future Directions

DyFSS in ASD

Develop GUIs and presentation media

Efficacy study with behavioral, biological measures

Follow-up: Tracking symptom change, multi-site trials longer training period.

DyFSS in Other Conditions

Anxiety Disorders, PTSD

Performance improvement

Psychophysiological disorders

Integrated DyFSS

Integrate into interactive games

Portable DyFSS: glove, belt and transmitter

References