IMFAR 2016 ABSTRACT

Customizable, Interactive Toy Platform to Enable Motivation-Driven Cognitive and Physical Development in Children Diagnosed with Autism or Developmental Disorders

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Background:
Most typically-developing children are motivated to learn and explore intrinsically, often driven by curiosity or pursuits of mastery and independence (Ryan & Deci, 2000). For many children with neuro-differences, however, this intrinsic motivation may be insufficient to overcome environmental distractions, sensory demands, or motor challenges required to focus, learn, or complete a task. Yet, children diagnosed with Autism Spectrum Disorder (ASD) and/or other developmental disorders often show intense, specific affinities for particular items or topics that can be leveraged to teach skills or ideas (Mancil & Pearl, 2008). Indeed, well-established therapy techniques utilize highly-motivating personal rewards to achieve ambitious therapeutic goals, including increased attention, physiological regulation, and social engagement (Vismara & Lyons, 2007). Ideally, these goals can extend beyond the therapy setting, integrating seamlessly within daily play activities. Technology has the capability to bridge this divide; yet, current devices lack the individualization and dynamic adaptation necessary to teach and engage many atypical learners.

Objectives:
To enable independently-initiated play experiences with therapeutic benefits – including increased engagement, learning, and psychophysiological regulation – while simultaneously collecting quantitative measures of this progress during play.

Methods:
We have developed a customizable, interactive toy platform that can be rapidly tuned to align with a child's intrinsic interests and potential sensitivities, enabling new opportunities for regulation, social engagement, and comprehensive data collection. This self-contained physical smart toy has a removable, modular center piece that allows us to adapt the challenge of the task to the needs of the child by inserting different modules, including shape sorting, ring stacking, and pincer grasp development activities. In addition, embedded digital sensors capture data quantifying a child's engagement and behavior while interacting with the toy. An integrated smartphone allows user-friendly customization of the motivating reinforcement mechanism, such as favorite video clips, music samples, or light displays. In this way, the toy can also become a vehicle to provide controlled stimuli capable of presenting other experimental paradigms in a flexible, ambulatory, and ecologically valid environment.

Results:
Preliminary data from three children (age 2-4) with ASD using an early prototype of the toy indicated that individualized reinforcement was highly motivating, increasing the children's abilities to attend to and achieve challenging tasks. We also found a correlation between the challenge level of the task and the necessary preference level of the reward, confirming a need for a tunable device that can match the "just right challenge" to the "just right reward." Our IMFAR demonstration will include opportunities to interact with our next-generation prototype, as well as to discuss additional data from neuro-diverse children engaging with the toy platform.

Conclusions:

We have created a new customizable toy platform designed to elicit increased cognition, self-regulation, and social engagement for children with complex neurological needs through a highly-motivating, self-driven play environment. Early results suggest that the toy's personalized reinforcement can help a child achieve ambitious cognitive and motor goals at an accelerated pace, underscoring the promise of innovative technologies for ASD research and intervention and warranting the need for further studies.