A Neurofeedback Protocol Using a Sophisticated Interactive Video Game to Improve Social Responsiveness in Children with Autism Spectrum Disorder

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Children with Autism Spectrum Disorder (ASD) have deficits in social and communicative skills such as imitation and empathy. These deficits impair social interactions substantially and may have a basis in motor, emotion, and/or cognitive deficits. The aim of this project is to elicit, enhance, and train appropriate motor behavior and cognition as the basis for emotional reactions in social situations for children with ASD. This project is based on 1) the use of a specifically-designed interactive video game; and 2) Neurofeedback training (NFT), an operant conditioning methodology to gain control of specific brain dynamics. The assumption is that modulation of these dynamics, which can be trained with NFT, will reengage the mirror neuron system (MNS). The MNS provides the neurophysiological basis for imitation and has been found to be dysfunctional in individuals with ASD. Furthermore, a linkage between the regulation of heart rate and the social engagement system has been proposed. Therefore, we also recorded peripheral physiological reactions to emotions in social situations.

Children with high functioning ASD played the video game while electroencephalography (EEG) and peripheral physiological measurements (i.e. muscle activity, skin conductance, heart rate, respiration) were recorded. The children were trained to allow a series of social interactions to take place in the game. Specifically, the child's game character engaged in imitation behavior of facial emotions. During this social interaction game, children were rewarded if they showed a specific neurophysiological reaction (i.e. modulation of the mu rhythm). This connects the neurophysiological basis for imitation learning- the MNS- with appropriate imitation behavior in social situations. Therefore, we expect significant improvements in behavior and cognition in the children with ASD, which were evaluated with various tests before and after the NFT. While data are currently being analyzed, the ultimate goal of this project is to teach children with ASD to appropriately respond to social situations. As social interactions build the fundamentals of our lives, an improvement in social interactions could strengthen relationships with family, facilitate social relationships as well as academic interactions and profoundly improve the health and well-being of individuals with ASD across their lifespan.