Chapter 6
New Technologies to Support Adaptive Responding in Children and Adolescents With Neurodevelopmental Disorders

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ABSTRACT

The chapter provides the reader with a narrative overview on the newest empirical evidence available on the use of new technologies to help individuals with neurodevelopmental disorders. Three main categories of studies were identified, namely (1) virtual reality, (2) mobile technologies, and (3) wearable technologies. Results were satisfactory although failures occurred. Findings were critically discussed, and different technological solutions were emphasized. Some useful insights for both future and practice were critically discussed.

INTRODUCTION

Individuals with neurodevelopmental disorders (NDD) and severe to profound and multiple disabilities (i.e., intellectual, motor, and communication impairments) may pose serious challenges to daily life contexts, due to their clinical conditions (e.g., medical, breath, postural abnormalities, lack of speech, challenging behaviors, isolation, passivity) and may consequently pose serious problems to parents, staff, teachers, and caregivers (Edwards, Rudaizky, Toner, & Chen, 2021; Gardiner,Miller, & Lach, 2020). Next to physiotherapeutic and pharmacological strategies, those children and adolescents may need specific help to: (a) engage positively and independently with surrounding preferred items, (b) improve favor-

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able opportunities for communication, occupation and leisure, and (c) redirect challenging behaviors. Furthermore, people with NDD may be unable to develop request and choice responses autonomously, although they are capable of learning skills (Neville, Draper, Cooper, Adullah, & Lakes, 2021; Koly et al., 2021; Pastorino et al., 2021). The aforementioned conditions may have deleterious outcomes on their quality of life (Lopez-Sastre et al., 2021; Remmele et al., 2021; Ueda et al., 2021).

One way to promote self-determination, constructive engagement, and positive participation among children and adolescents with NDD is to resort on the use of assistive technology (AT)-based interventions combined to motivational strategies and learning principles (Manta et al., 2020). Among AT, new technologies (i.e., virtual reality, augmented reality, mobile technologies, and wearable technologies) have been recently and growingly developed (Bailey, Bryant, & Hemsley, 2021; Banta Lavenex & Lavenex, 2021; Valentine et al., 2020). Augmented reality (AR) includes digital environments, people, objects, and materials into the user's real word surroundings. Virtual reality (VR) refers to technologies which generate a three-dimensional environment that incorporates the users, enabling interactions with digital people, objects, and/or materials (Dellazizzo, Potvin, Luigi, & Dumais, 2020; Mesa-Gresa, Gil-Gomez, Lozano-Quillis, & Gil-Gomez, 2018). Mobile technologies (MT) include transportable devices or tools capable of automatically deliver self-directed interventions, foster the access to therapies, entitle the therapies to be distantly administrated, enhance clinical effectiveness, and customize treatment strategies (Hermes, Lyon, Schueller, & Glass, 2019: Kellstedt, Spengler, Foster, Lee, & Maddock, 2021). Wearable technologies (WT) have rapidly been developed in recent years as crucial means of human-computer interaction with the growing complexity of information and communication technology. WT comprise the features of mobility and connectivity ensuring users with the online information and communication while moving (Lee, Kim, Ryoo, & Shin, 2016).

Banta Lavenex and Lavenex (2021) carried out a critical review, through a VR-based setup, on spatial abilities in Down and Williams syndromes and evidenced that most individuals with Down syndrome exhibited low-resolution egocentric and allocentric spatial learning memory abilities similarly to typically developed children. Conversely, children with Down syndrome exhibited impaired high-resolution allocentric spatial and facilitated response learning as compared to typically developed children. Individuals with Williams syndrome also demonstrated facilitated response learning but their low-resolution allocentric spatial learning and memory abilities were significantly compromised, if compared to both Down syndrome and typically developed children.

Colombini, Duradoni, Carpi, Vagnoli, and Guazzini (2021) conducted a systematic mini-review on hand-movements sensing in individuals with NDD and neurodegenerative diseases. Results showed that protocols for attention deficits hyperactivity disorders (ADHD) and autism spectrum disorders (ASD) successfully promoted psychomotor and psychosocial rehabilitation in setting that stimulated learning. VR seemed to be encouraging for assessment and screening of executive functions in individuals with NDD, mild cognitive impairments, and dementia.

Bioulac, Taillard, Philip, and Sagaspe (2020) proposed a narrative review on the excessive daytime sleeping (EDS) in the context of ADHD with first a summary of the objective and subjective tools to evaluate it. Furthermore, perspectives in terms of electroencephalogram (EEG) markers and neurofeedback were suggested. Additionally, the possibilities of new kinds of assessment were critically discussed (i.e., VR and ecological momentary evaluation). Finally, the authors constructively argued on specific clinical conditions with EDS in an ADHD framework as links with narcolepsy and the comorbidity with other psychiatric disorders.