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Fostering locomotor behavior of children with developmental disabilities: An overview of studies using treadmills and walkers with microswitches

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ABSTRACT

This paper provides an overview of studies using programs with treadmills or walkers with microswitches and contingent stimulation to foster locomotor behavior of children with developmental disabilities. Twenty-six studies were identified in the period 2000–2008 (i.e., the period in which research in this area has actually taken shape). Twenty-one of the studies involved the use of treadmills (i.e., 13 were aimed at children with cerebral palsy, 6 at children with Down syndrome, and 2 at children with Rett syndrome or cerebellar ataxia). The remaining five studies concerned the use of walkers with microswitches and contingent stimulation with children with multiple disabilities. The outcomes of the studies tended to be positive but occasional failures also occurred. The outcomes were analyzed considering the characteristics of the approaches employed, the implications of the approaches for the participants' overall functioning situation (development), as well as methodological and practical aspects related to those approaches. Issues for future research were also examined.

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1. Introduction

The most common intervention approach employed for fostering the locomotor behavior of children with cerebral palsy or motor and intellectual disabilities in general has relied on the neuro-developmental method (Bar-Haim et al., 2006; Begnoche & Pitetti, 2007; Day, Fox, Lowe, Swales, & Behrman, 2004; Ketelaar, Vermeer, Hart, Van Petegem-van Beek, & Helders, 2001; Tsorlakis, Evaggelinou, Grouios, & Tsorbatzoudis, 2004). The neuro-developmental method is largely based on the conceptual model devised by the Bobaths (see Bobath, 1980; Bobath & Bobath, 1984). Such model emphasizes the importance of inhibiting abnormal movements and facilitating postural adjustments, and involves the therapist-directed practice of preparatory maneuvers and motor tasks while the child is lying, sitting or standing (Cherng, Liu, Lau, & Hong, 2007; Ketelaar et al., 2001; Tsorlakis et al., 2004).

In contrast with this model, current views on intervention for children with developmental disabilities have emphasized an active (child-centered), task-specific practice as the basis for improving the targeted motor function. According to this view, the way to improve a child's locomotor behavior is to allow the child to successfully practice such behavior (Begnoche & Pitetti, 2007). The most popular approach developed within this new perspective to promote locomotion concerns the use of treadmills generally combined with partial body weight support (Accivatti, Harro, & Bothner, 2006; Dannemiller, Heriza, Burtner, & Gutierrez, 2005; DeJong, Stuber, & Spady, 2005; Sanders, Begnoche, & Pitetti, 2005). The strategy of supporting the child's body weight (e.g., through a harness) may be essential to facilitate his or her stepping responses particularly when the level of motor impairment is more severe or the child's motor condition is largely immature (Angulo-Barroso, Burghardt, Lloyd, & Ulrich, 2008; Beard, Harro, & Bothner, 2005; Provost et al., 2007; Schindl, Forstner, Kern, & Hesse, 2000). A second, still preliminary, approach emerging from the same perspective concerns the use of walker devices combined with microswitches. The walkers are equipped with supporting features ensuring postural control and partial weight lifting. The microswitches allow the monitoring of the child's stepping responses and the automatic delivery of brief periods of preferred environmental stimulation contingent on those responses (Lancioni, Singh, O'Reilly, Campodonico, Oliva, et al., 2005; Lancioni et al., 2007a).

This paper is directed at examining the aforementioned approaches and their implications to present a functional picture of the situation available and its possible developments. This objective is pursued by (a) providing an overview of the studies using those approaches to deal with locomotor behavior of children with developmental disabilities and of the results so far obtained, (b) discussing the results in relation to the practicality and suitability of the approaches as well as their education (rehabilitation) and general human impact, and (c) pointing out some relevant issues for future research in the area.

2. Method

Studies using the aforementioned two approaches with children were primarily identified through computerized searches of PsycINFO and PubMed databases. The searches were focused on journal articles published from 2000 to 2008 (i.e., the time period in which research in this area has actually taken shape). Manual searches of the reference sections of the articles identified through the computerized process were also carried out to supplement the computerized process. In total, 26 studies were included in this overview (with one of them being still in press). For practical reasons, the studies using treadmills were divided into three groups concerning children with cerebral palsy, children with Down syndrome, and children with Rett syndrome and cerebellar ataxia, respectively.

Table 1 lists the 26 studies included in the overview (i.e., the three groups dealing with the use of treadmills and the group involving walkers with microswitches). For each study, the table reports the number of participants involved, their ages and characteristics (i.e., locomotor functioning) at the start of the study, the general intervention conditions, and the outcome. With regard to the outcome, the table summarizes the evidence available (i.e., intervention or follow-up data) concerning improvements in the participants' locomotor behavior and related functions.

The first of the following three sections of the paper (i.e., Section 3: Summary of studies and related outcomes), presents illustrative summaries for nine (about 35%) of the studies listed in Table 1. The

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