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# The impact of Wii Fit intervention on dynamic balance control in children with probable Developmental Coordination Disorder and balance problems

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ABSTRACT

The aim of this study was to examine differences in the performance of children with probable Developmental Coordination Disorder (p-DCD) and balance problems (BP) and typical developing children (TD) on a Wii Fit task and to measure the effect on balance skills after a Wii Fit intervention.

Twenty-eight children with BP and 20 TD-children participated in the study. Motor performance was assessed with the Movement Assessment Battery for Children (MABC2), three subtests of the Bruininks Oseretsky Test (BOT2): Bilateral Coordination, Balance and Running Speed & Agility, and a Wii Fit ski slalom test. The TD children and half of the children in the BP group were tested before and after a 6 weeks non-intervention period. All children with BP received 6 weeks of Wii Fit intervention (with games other than the ski game) and were tested before and afterwards.

Children with BP were less proficient than TD children in playing the Wii Fit ski slalom game. Training with the Wii Fit improved their motor performance. The improvement was significantly larger after intervention than after a period of non-intervention. Therefore the change cannot solely be attributed to spontaneous development or test–retest effect. Nearly all children enjoyed participation during the 6 weeks of intervention. Our study shows that

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Wii Fit intervention is effective and is potentially a method to support treatment of (dynamic) balance control problems in children.


## 1. Introduction

Most children enjoy physical activities, such as running, walking or jumping. Physical activity is not only important for the development of motor skills, coordination, but also for fitness and overall health (Cermak & Larkin, 2002). Children with Developmental Coordination Disorder (DCD), a disorder affecting approximately 2–7% of all children, find many of these activities difficult (American Psychiatric Association, 2013; Geuze, 2010, chap. 21; Rivilis et al., 2011). Therefore they tend to withdraw from participating and may not develop adequate levels of motor skills and physical fitness. The disorder is usually not noticed until primary school, and diagnosed between six and twelve years of age (Geuze, Jongmans, Schoemaker, & Smits-Engelsman, 2001). In addition to general health issues due to sedentary life style, affected children are vulnerable to poor social competence (Bar-Or, 2005; Kalverboer, de Vries, & van Dellen, 1990), poor motivation, low self-esteem (Shaw, Levine, & Belfer, 1982; Strauss, 2000), and feelings of unhappiness (Schoemaker, Hijlkema, & Kalverboer, 1994). It is therefore important to find ways to engage these children more in physical activities in a way they enjoy, both during intervention and in daily life.

One main characteristic of children with DCD is poor postural control (Geuze, 2003). These children are less capable of controlling their balance during variable circumstances due to the fact that they respond more slowly to balance disturbances compared with their peers (Geuze, 2005; Johnston, Burns, Brauer, & Richardson, 2002). For postural control two mechanisms can be distinguished; feedback control to correct perturbed balance and feedforward (anticipatory) control. The start of well-coordinated movement is characterized by postural adaptations that anticipate loss of balance by the effects of the action itself. This process of feedforward control input prior to movement, attributed to the cerebellum, seems to be diminished in most children with DCD (Wilson, Ruddock, Smits-Engelsman, Polatajko, & Blanks, 2012), resulting in the more frequent use of feedback based strategies with longer response times, poorer timing and larger within-child variability over learning trials (Geuze & Wilson, 2008, chap. 11; Hadders-Algra, 2002).

In most of the current therapeutic approaches for children with DCD balance training is included in the treatment and has shown to be effective (Smits-Engelsman et al., 2012; Wilson, 2005). One of the important motor learning principles is practicing the task in variable, gradually more challenging circumstances (Niemeijer, Smits-Engelsman, & Schoemaker, 2007). With the development of interactive computer games, which require whole body movement and weight transfer to control the game, the so called exergames, a potential tool emerged for training dynamic balance with variability of practice. To play such games successfully a child needs adequate dynamic balance skills which enable the child to control his or her center of gravity within the base of support while moving.

Interactive computer games, such as Wii Fit or Kinect seem to offer a new and joyful tool to encourage children to participate in physical activity that can be extended for intervention purposes. Exergames connect to the everyday world of the youngsters, and satisfy the internal drive for motivation while playing the games (Sandlund, Waterworth, & Häger, 2011).

The games are dynamic tasks that require timing within and between limbs and programming weight shifts. Children can interact naturally with the game by motion that controls the virtual character on the screen, for example by shifting weight without losing balance to cause that character to pass through gates or avoid obstacles. The exergames thus provide instant visual feedback to the child about the unconscious regulation of her or his center of gravity. The Wii Fit games promote the development of sufficient postural adjustments required for controlling dynamic balance. The task is scaled to the child's level of competence by a baseline measure. While playing, the children learn to adjust their balance in anticipation of or in reaction to visual information on the screen and may reach a higher level in the game.