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Impact of task difficulty and motor ability on visual-motor task performance of children with and without developmental coordination disorder



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ABSTRACT

Introduction: Given the well-acknowledged visual-motor difficulties of children with developmental coordination disorder (DCD), it is surprising to find few research studies systematically exploring their visual-motor task performance.

Objective: To describe the impact of task difficulty and motor ability on visual-motor task performance in children with and without DCD.

Methods: Twenty-four children (8 years 11 months to 12 years 11 months) were recruited: 12 children with DCD, 12 children developing typically with regards to their motor skills. A computer-based aiming task completed with three different cursor controls of increasing levels of difficulty was designed for this study. Mixed-effect modeling analyses were performed to describe the influence of motor ability and task difficulty on visual-motor task performance.

Results: Motor ability modulated the impact of task difficulty on visual-motor task performance. Children with DCD were as fast and as accurate as their peers in their initial performance of the simple task. However, they were slower and less accurate when performing the complex and novel visual-motor task.

Conclusion: While children with DCD can generally be characterized as less accurate and slower than their peers, this characterization

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needs to be specified and qualified; it is probably best not applied to a well-learned, simple task.

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1. Introduction

The motor abilities of children with developmental coordination disorder (DCD) have been described at length in the literature. Regardless of the motor-based activity under scrutiny, as a group, children with DCD are typically reported to be less accurate and more variable in their trial-to-trial performance when compared to their typically developing peers (e.g., Elders et al., 2010; Johnston, Burns, Brauer, & Richardson, 2002; Smits-Engelsman, Bloem-van der Wel, & Duysens, 2006). With regards to their movement speed, two characterizations seem to emerge. The first one indicates that children with DCD have difficulty meeting accuracy demands of tasks and move slower than their peers (e.g., Elders et al., 2010; Johnston et al., 2002; Maruff, Wilson, Trebilcock, & Currie, 1999; Smits-Engelsman et al., 2006). The second one suggests that children with DCD do not have an efficient strategy emphasizing terminal accuracy and move faster than their peers (e.g., Elders et al., 2010; Smits-Engelsman, Niemeijer, & van Galen, 2001; Smits-Engelsman, Wilson, Westenberg, & Duysens, 2003).

The poor motor abilities of children with DCD affect their performance of many motor-based childhood tasks and activities (APA, 2000; Fox & Lent, 1996; Geuze, Jongmans, Schoemaker, & Smits-Engelsman, 2001; Magalhães, Cardoso, & Missiuna, 2011). The most frequently reported issue in the literature is their difficulty with handwriting, which is also reported to be the primary reason for their referral to health care professionals (Miller, Missiuna, Macnab, Malloy-Miller, & Polatajko, 2001; Missiuna, Moll, King, Stewart, & MacDonald 2008). Together, the poor motor abilities and the motor-based performance difficulties of children with DCD are the main defining characteristics differentiating them from typically developing children (APA, 2000).

More specifically, their difficulty in performing visual-motor tasks and activities is a predominant characteristic widely recognized by clinicians and frequently reported in the literature (e.g., Dunford, Missiuna, Street, & Sibert, 2005; Magalhães et al., 2011; Summers, Larkin, & Dewey, 2008). In 1998, a now frequently cited meta-analysis by Wilson and McKenzie was the first comprehensive synthesis of the DCD literature to suggest the possibility of a visual-motor deficit in children with DCD. Since the study by Wilson and McKenzie (1998), a number of researchers have explored the performance of children with DCD for fine motor tasks requiring the interaction of the visual and motor systems, more specifically for writing (Chang & Yu, 2010; Di Brina, Niels, Overvelde, Levi, & Hulstijn, 2008; Rosenblum & Livneh-Zirinski, 2008; Tseng, Howe, Chuang, & Hsieh, 2007) and for drawing tasks (Kagerer, Bo, Contreras-Vidal, & Clark, 2004; Kagerer, Contreras-Vidal, Bo, & Clark, 2006; Smits-Engelsman et al., 2001, 2003, 2006; Zwicker, Missiuna, Harris, & Boyd, 2011). These studies bring to light the accumulating evidence supporting the findings of Wilson and McKenzie (1998), suggesting the presence of a specific visual-motor deficit in children with DCD.

However, upon reviewing the evidence from these studies, it is also clear that the current literature on visual-motor task performance in children with DCD provides a rather incomplete and inconsistent picture. First, it is mostly descriptive and explanatory mechanisms are scarcely proposed. Second, while results from most studies support the clinical observation that the visual-motor task performance of children with DCD differs from that of their peers and is characterized by poor end-point or ongoing accuracy (Chang & Yu, 2010; Di Brina et al., 2008; Rosenblum & Livneh-Zirinski, 2008; Smits-Engelsman et al., 2001, 2003; Tseng et al., 2007), divergent characterizations emerge with regards to their movement times. For some tasks, children with DCD moved slower than their peers (Chang & Yu, 2010; Rosenblum & Livneh-Zirinski, 2008; Smits-Engelsman et al., 2006), while for others they moved faster (Chang & Yu, 2010; Di Brina et al., 2008; Smits-Engelsman et al., 2001, 2003), and for others they moved as fast as their peers (Zwicker et al., 2011). Such varied findings point to the need for further investigation of the visual-motor abilities of children with DCD.

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