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Role of visual–perceptual skills (non-motor) in children with developmental coordination disorder

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Abstract

The purposes of this study were to examine test–retest reliability of the Test of Visual–Perceptual Skills (Non-Motor)-Revised (TVPS-R), to explore motor-free visual–perceptual skills, and to categorize subtypes thereof in children with developmental coordination disorder (DCD). One hundred and seventy-eight children, aged 9 and 10 years, identified as having DCD with the Movement Assessment Battery for Children (M-ABC), were assessed, along with 200 typically developing children. The results showed good test–retest reliability for the total perceptual quotient scores of the TVPS-R, but not for all subtests. Children with DCD performed significantly poorer compared to typically developing children on the visual–perceptual test, but the deficits were not common to all children with DCD. This study supported the stance that we should consider the heterogeneous characteristics of children with DCD when designing experimental studies or developing educational interventions.

Keywords: Developmental coordination disorder; Visual perception; Subtype

1. Introduction

Developmental coordination disorder (DCD) in the diagnostic and statistical manual of mental health disorder (DSM-IV) is a term describing motor impairment in the absence of

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neurological disease, any known physical disorder, developmental delay, mental retardation, and low IQ (American Psychiatric Association., 1994). By definition, DCD interferes significantly with the child's academic achievement, daily living skills (like dressing, tying shoelaces, and brushing teeth), and ability to engage in sporting activities. Contrary to the belief shared by numerous physicians, teachers, and parents that most children with DCD will grow out of their motor clumsiness, DCD has been shown to often persist into adolescence and early adulthood, along with associated psycho-social problems (Cantell, Smyth, & Ahonen, 1994; Visser, Geuze, & Kalverboer, 1998). In some cases, the motor impairments exhibited by children with DCD may increase; however, this pattern is variable (Inder & Sullivan, 2005).

Many studies have demonstrated that children with DCD display deficits on perceptual-motor functioning (Bonifacci, 2004; Henderson, Barnett, & Henderson, 1994; Hulme, Biggerstaff, Moran, & McKinlay, 1982; Hulme, Smart, & Moran, 1982; Lord & Hulme, 1987, 1988; van Waelvelde, de Weerdt, de Cock, & Smits-Engelsman, 2004; Wilson & McKenzie, 1998). These visual–perceptual deficits can negatively impact children's ability to conduct simple, everyday activities which require fine manipulation of objects, such as writing or drawing (Parush, Yochman, Cohen, & Gershon, 1998; Rosenblum, 2006). However, in terms of motor-free visual–perceptual ability, some studies have found conflicting results. Sigmundsson, Hansen, and Talcott (2003) found that children with DCD showed impaired visual sensitivity, but Bonifacci (2004) did not.

Visual perception is an intricate system that is concerned with both object identity and localization in space, and is intimately connected with action systems (Jeannerod, 2006). Visual perception relies on the integrity of the posterior visual pathway and cortical networks emanating from the occipital lobe (Lieberman, 1984). The so-called dorsal stream radiates from occipital cortex to posterior parietal cortex and is intimately concerned with object localization and action planning, while the ventral stream, radiating toward the superior temporal cortex, is concerned mainly with object identity. The two streams of processing interact in a complex way to inform action planning in 3D space. The visual–perceptual system per se is regarded as the dominant modality for controlling goal-directed actions (Hudgins, 1977; Jeannerod, 2006). Deficits in processing visual signals at various points along this network can lead to problems in movement planning, on-line movement correction, and feedback control (Wilson & McKenzie, 1998).

In children, the ability of visual perception is a developing process. The visual discrimination of young children develops rapidly over childhood and approaches adult levels at around 11–12 years of age (Atkinson & Braddick, 1989; Birch, & Lefford, 1967). Indeed, by 9 years of age, visual–perceptual skills are quite well refined. For example, figure-ground perception improves rapidly between 3 and 5 years, and stabilizes between the ages of 8 and 10 years; the ability of position in space develops completely around ages 7 to 9; the ability of form constancy rapidly improves from 6 to 7 years old, and achieves a stable condition at about 8 to 9 years, while the ability to discern more complex spatial relations shows consistent improvement over childhood and is well developed by 10 years of age (Atkinson, & Braddick, 1989; Williams, 1983). Taken together, visual perception is very well developed in middle childhood and reaches adult levels at around 12 years.

Numerous studies suggest that children with DCD have deficits in their perceptual-motor and visual–perceptual skills (Wilson & McKenzie, 1998). However, we know little about individual profiles of performance across tasks in children with DCD, or the proportion of children who deviate from the norm (Schoemaker et al., 2001). Hence, by exam-