Research in Developmental Disabilities 34 (2013) 687–694

Contents lists available at SciVerse ScienceDirect

Research in Developmental Disabilities

Everyday memory in children with developmental coordination disorder

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ARTICLE INFO

Article history:
Received 17 May 2012
Received in revised form 17 September 2012
Accepted 18 September 2012
Available online 1 November 2012

Keywords:
Developmental coordination disorder
Everyday memory
Cognition
Verbal intelligence

ABSTRACT

Children with developmental coordination disorder (DCD) have deficits in working memory, but little is known about the everyday memory of these children in real-life situations. We investigated the everyday memory function in children with DCD, and explored the specific profile of everyday memory across different domains. Nineteen children with DCD and 19 typically developing (TD) children participated in the study. Their everyday memory performance was evaluated using the Rivermead Behavioral Memory Test for Children, which showed that 52.6% of the children with DCD had everyday memory deficits. The overall everyday memory scores of the DCD group were significantly lower than those of the controls, particularly in the verbal and visual memory domains. Pearson correlation analysis indicated significant associations between verbal intelligence and memory scores. Analysis of covariance with verbal intelligence as a covariate showed no significant differences between groups in memory scores. Mediator analysis supported the notion that everyday memory deficits in children with DCD were fully mediated through verbal intelligence. We provide evidence of everyday memory deficits in most of the children with DCD, and hypothesize that language abilities are their underlying cause. The clinical implications of these findings and recommendations for additional research are discussed.

1. Introduction

Children with developmental coordination disorder (DCD) are characterized by significant impairment in the development of motor coordination, which substantially impedes academic achievement and daily functioning, but not because of neurological diseases or an intellectual deficiency (American Psychiatric Association, 2000). The estimated prevalence of DCD is between 1.8% and 19%, depending on the severity criteria used (Lingam, Hunt, Golding, Jongmans, & Emond, 2009; Zwicker, Missiuna, Harris, & Boyd, 2012). Because motor coordination is the product of a complex process of cognitive and physical operation, children with DCD may manifest deficits not only in motor abilities, but also in perceptual and cognitive function (Alloway, 2007; Van Waelvelde, De Weerdt, De Cock, & Smits-Engelsman, 2004), including reading disabilities, general learning disabilities, and attention and executive function deficits (Dewey, Kaplan, Crawford, & Wilson, 2002; Green, Baird, & Sugden, 2006; Wuang, Su, & Su, 2011; Zwicker et al., 2012). However, little is known about memory function in children with DCD.

Memory involves mental processes that encode, store, and retrieve information. Memory is composed of multiple and distinct systems, and can be categorized in different ways (Budson, 2009; Squire, 2004). According to the duration of information retention, memory is divided into sensory memory, short-term or working memory, and long-term memory.

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http://dx.doi.org/10.1016/j.ridd.2012.09.012

Moreover, based on the nature of the information being stored, long-term memory has been classified into several different types: semantic memory, episodic memory, and procedural memory. A distinction has also been made between retrospective memory and prospective memory. Given the multidimensional nature of memory, memory is not only required to support daily activities but is also crucial for learning (Gillen, 2008). It is, therefore, important to analyze the memory profiles of children with DCD.

Only a handful of recent studies (Alloway, 2011; Alloway, Rajendran, & Archibald, 2009; Alloway & Temple, 2007; Crawford & Dewey, 2008; Piek, Dyck, & Francis, 2007) have investigated the memory skills of children with DCD; most of them focus on working memory. Working memory, which is the ability to actively store and manipulate information for brief periods, is needed for complex tasks such as reasoning, comprehending, and learning (Baddeley, 2000). Working memory comprises an attentional control system aided by two subsidiary slave systems, which are responsible for the temporal storage of linguistic information and visuospatial structures (Baddeley, 2000). Tests that measure working memory generally require children to store and manipulate verbal (such as digits) or visuospatial (such as dot location and figure structures) information and then recall it. Studies (Alloway, 2011; Crawford & Dewey, 2008; Piek et al., 2007) have reported that children with DCD were less proficient in working memory than are typically developing children, especially in the visuospatial domain.

The research on memory deficits in DCD cited above has all been based on laboratory work. Memory is usually assessed using computer-based or paper-and-pencil tests in controlled experimental conditions. Although the evidence indicates that visuospatial working memory is closely related to academic achievement in children with DCD (Alloway, 2007, 2011; Alloway & Archibald, 2008; Alloway & Temple, 2007), such laboratory-based measures of memory may not resemble the memory performance in a real-life environment; therefore, it may lack adequate ecological validity. Even though it is clear that everyday activities need the mediation of working memory, it is still necessary to obtain a comprehensive profile of how their memory functions in the natural context of the real world to capture ecologically valid instances of their memory.

Everyday memory refers to the day-to-day application of memory skills to meet the challenges of daily life (Magnussen & Helstrup, 2007). It involves many fractionated components of memory and reflects a functional role of memory, typically in social contexts (Cohen, 2008). Examples of everyday memory in children include recalling names and telephone numbers, remembering the instructions of teachers, and remembering to do homework. Compared with conventional laboratory-based tasks, measurements of everyday memory often use tasks simulating what people do every day and involving more complex and practical materials (Cornish, 2000). Furthermore, according to the child and youth version of the International Classification of Functioning, Disability and Health (ICF-CY), everyday memory abilities are not just one of the basic mental functions, but are more related to activity domains, such as completing a complex task (World Health Organization, 2007). As to neurodevelopmental disorders, everyday memory deficits have been found in adolescents with a very low birth weight (Narberhaus et al., 2007) and with autism spectrum disorders (ASD) (Jones et al., 2011). There is also an increased risk of everyday memory difficulties in 5-year-old children born preterm (Briscoe, Gathercole, & Marlow, 2001). However, little is known about how everyday memory functions in children with DCD.

We investigated everyday memory function in a sample of children with DCD, and explored the specific profile of everyday memory across different domains. The reliable and valid standardized Rivermead Behavioral Memory Test for Children (RBMT-C) (Wilson, Ivani-Chalian, & Aldrich, 1991) was used to evaluate everyday memory. The RBMT-C has been widely used as an assessment tool in different clinical populations (Briscoe et al., 2001; Chevignard et al., 2009; Jones et al., 2011; Kihara et al., 2009). We hypothesized that children with DCD would show everyday memory deficits, especially in the verbal, visual, and spatial domains.

2. Methods

2.1. Participants

2.1.1. Children with DCD

The DCD group consisted of 19 children with DCD (Table 1). They were recruited by occupational therapists and identified as having motor difficulties based on their Movement Assessment Battery for Children-Second Edition (MABC-2) scores (Henderson, Sugden, & Barnett, 2007). Children with MABC-2 total scores below the 15th percentile were classified as having DCD (Henderson et al., 2007). Children comorbid with neuromotor or significant medical problems, autism, attention-deficit/hyperactivity disorder (ADHD), or intellectual disabilities (IQ < 85) were excluded. Intelligence was measured using the Peabody Picture Vocabulary Test-Revised (PPVT-R) (Dunn & Dunn, 1981) and the Test of Nonverbal Intelligence-Third Edition (TONI-3) (Brown, Sherbenou, & Johnsen, 1997). Scores of both tests provided an index of general intelligence for verbal and nonverbal intelligence.

2.1.2. Typically developing (TD) children

The TD group comprised 19 typically developing children (Table 1). They were recruited from several kindergartens and schools, and were age-matched with the DCD group. All the MABC-2 scores of the TD-group children were above the 15th percentile. Children with any neurodevelopmental disorder, medical disorder, or intellectual disabilities (IQ < 85) based on the PPVT-R and the TONI-3 were excluded.