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COMMENTARY

Ten Conferences on Developmental Coordination Disorder (DCD): A Brief Commentary on 20 Years of Research

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Awareness and understanding of Developmental Coordination Disorder (DCD) has increased steadily over the last two decades. A series of international conferences, begun in 1995, has offered a forum for researchers and practitioners to get together to discuss the theoretical and practical problems that arose as new findings emerged. The purpose of this brief commentary is to reflect on the contribution made by this series of meetings and to highlight the difficulties that continue to present themselves.

In June 2013, more than 150 researchers and practitioners gathered in Ouro Preto, Brazil to celebrate the 10th anniversary of a series of conferences devoted to the study of DCD. The series began in March 1995 at the University of London, where Sheila Henderson organized a meeting of 35 researchers and clinicians who shared an interest in movement disorders in children. The discussions were so stimulating that a follow-up meeting was immediately planned for later that year. Major players in the field then took up the baton. The conference moved from the United Kingdom to the Netherlands (1999), Canada (2002), Italy (2005), Australia (2007), the United States of America (2009), Switzerland (2011) and, most recently, Brazil (2013).

As a fun exercise, Sheila Henderson, in her opening address in Ouro Preto, plotted the distance between London and successive conference locations against the number of presentations made. The correlation between these two measures was 0.92, a somewhat meaningless statistic which nevertheless illustrated the growing international interest in the field since 1995! More seriously, Reint Geuze's DCD-X keynote address included an analysis of the number of articles on DCD published

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FIGURE 1. Number of citations and number of publications with DCD in the title for the period 1994–2013.

in international journals, along with associated citations, since 1995 (see Figure 1). In this period, 509 articles on DCD have appeared which were cited in 1953 articles (*excluding* self-citation). The average number of citations per article on DCD within other articles on DCD (including self-citation) is 13.8.

Although it might be presumptuous to claim that the DCD conferences and the Special Issues in journals which emerged from them have *caused* this steady rise in interest, we suggest that they have made a substantial contribution to awareness of the disorder as well as to our understanding of what causes it. In what follows, however, we draw attention to just a few of the problems still to be solved.

THE TERM DCD—HAS IT SERVED US WELL?

In some of the 18 countries represented at DCD-X, the use of the term DCD is not an issue; for others, it is still not the accepted term. When considering questions related to labeling it is important to keep in mind: (a) that the use of particular terms or labels in particular contexts influences the allocation of resources and (b) that terminology matters in relation to the collection of official statistics which inform policy-making, nationally and internationally. For example, in countries which have private insurance schemes, if a child is assessed and does not meet criteria for receipt of a diagnosis (or label) then funding for intervention is not forthcoming. Governments also require prevalence figures to decide how to allocate resources to medical and educational services.

Within the area of movement disorders, there has been great confusion about labels, and many attempts to reach consensus on terminology (e.g., Bax and MacKeith, 1963). However, it was not until 1987 that a major breakthrough occurred. The term “*Developmental Coordination Disorder*” was introduced by the American Psychological Association in DSM-III (APA, 1987). Thereafter, a steady stream of international meetings and papers have endorsed the term and discussed the diagnostic criteria. In 1994, a consensus meeting held in London, Ontario, addressed questions of description and definition, assessment and management of DCD (Polatajko et al., 1995). In 1998, Henderson and Barnett alerted the wider community to the term DCD and its diagnostic criteria at a meeting on “specific” developmental disorders (Henderson & Barnett, 1998). In 2006, in Leeds, a series of meetings extended previous discussions to build consensus on characteristics and definitions,

assessment, and intervention (Sugden, 2006). Most recently, a European group has produced a set of guidelines for clinical practice which is now being adopted by many countries within the European Union (Blank et al., 2012).

There are, of course, still disagreements about terminology and diagnosis, both theoretical and practical. For example, whether Dyspraxia is different from or a part of DCD still concerns many; practically, it is unfortunate that the DSM-5 (American Psychiatric Association (APA), 2013) and ICD-10 (World Health Organization, 1992) differ in terminology, using the labels Developmental Coordination Disorder and Specific Disorder of Motor Function, respectively. If only for consistency, we suggest that DCD has served us well and should continue to be the favored label of the future. With regard to diagnostic procedures, the changes to the criteria introduced in DSM-5 require careful consideration as some apparently minor changes have more major implications (APA, 2013). For example, the introduction of the phrase “opportunity for skill acquisition and use” in criterion A seems very reasonable, until one thinks of how it might be evaluated.

UNDERSTANDING DCD—SOME LONGSTANDING ISSUES

Understanding any developmental disorder, including DCD, is a multiphase process, involving scientists from different disciplines, including genetics, pediatrics, neurology, biomechanics, psychology and many others. In a nutshell, we might summarize the progress made over the last 20 years as follows: (a) What we know about DCD at a descriptive level has expanded considerably, including both motor and nonmotor features, and has extended to include adults; (b) the process of diagnosis has become more sophisticated and approaches to intervention are being more carefully evaluated; and (c) what we know about the underlying deficits which are thought to cause/contribute to the functional difficulties experienced by children with DCD is advancing (see Sugden and Wade, 2013; Wilson et al., 2013 for reviews). However, there continue to be gaps in our knowledge, which are very difficult to fill. We have space to mention only three.

The first gap concerns the word *development*. All children, typically developing or not change with age, and these changes result from the complex interaction of a child with his environment, a process which can only be studied longitudinally. Broadly speaking, there are two types of longitudinal studies of children with DCD which have advanced our knowledge. The first type begins with school-age children with motor difficulties and describes their development over time (e.g., Losse et al., 1991; Cantell et al., 1994; Geuze and Börger, 1993). The second type involves much larger samples, starts with children born at risk (e.g., preterm) and also follows them over time (e.g., Jongmans et al., 1998; Lingham et al., 2009). The advantage of the first is that more variables can be measured in depth and individual differences can be highlighted. The advantage of the second is that they tell us more about etiology, and prevalence. Unfortunately, to date, none of the studies which focus on underlying perceptual, cognitive or motor deficits in DCD have adopted these designs. They tend to be cross-sectional in format, simply comparing children with difficulties and typically developing children of the same age or younger, on a single task. Although valuable to generate hypotheses, any study which simply shows that

two groups of children are different at a single point in time cannot contribute to our understanding of how that deficit affects performance over time.

The second problem requiring further study concerns the question of whether, and how a deficit in *learning* might affect children with DCD. Almost by definition, children with DCD are slower to acquire movement skills than their age-matched peers. It does not matter whether it is a skill that is generally acquired through implicit learning, such as hopping or skipping, or through explicit learning such as handwriting. It is surprising, therefore, that so few studies have attempted to study questions relating to learning in children with DCD and that those that have are inconsistent in outcome. For example, no learning deficits were found in pointing and sequence learning (Missiuna, 1994; Lejeune et al., 2013) but the tasks used had low motor demands and focused on short-term learning. In contrast, studies which have employed more realistic complex tasks, such as hockey shots (Marchiori et al., 1987) and balance control on a Wii-fit game, show that there are differences in rate of learning, and that the final outcome is often positive but more variable (Jelsma et al., 2015). From a quite different source, the literature on intervention, we also learn that, given time, it is possible to teach a child with DCD many everyday tasks (see Smits-Engelsman et al., 2013). However, the level of competence reached might not equal that of age-matched peers, transfer to new skills might have to be systematically taught, and generalization to other similar skills might be less good. If we try to put together data from learning studies with data from other studies focusing on underlying deficits, it is hard not to conclude that we really know very little about how these deficiencies interact over time in children with DCD. This makes it difficult to optimize intervention methods.

The third issue concerns the term *coordination* and what we mean by poor coordination. All of us feel—and look—uncoordinated at times, especially when learning a new skill, or when performing a familiar action under new circumstances. So what is it that is different about children who consistently fail to acquire everyday skills at an appropriate age and often continue to look awkward? Few studies have actually addressed this question. Wilson's comprehensive review of the possible deficits underlying DCD (Wilson et al., 2013), shows numerous studies of sensory, perceptual, or cognitive deficits but few which look directly at those aspects of our actions which lead to inaccuracy, poor timing, inconsistency, and/or variability in performance (see Wilmut et al., 2013 for an exception). Disagreement over the definition of coordination is one problem but it is of more concern that coordination at the muscular level does not simply translate into coordinated movement that is functional in daily life. It is even more difficult to understand how patterns of brain activation map onto patterns of coordinated movement within intentional action.

CONCLUSION

At present, DCD is a childhood condition, which in both DSM-5 and ICD-10 is still behaviorally and/or statistically defined. As the chair of the DSM-5 committee exclaimed:

It would have been great if we had been able to have a paradigmatic shift... basing the diagnosis of mental illness on biology... as the APA had hoped when it began the revision of DSM IV... but the science did not arrive in time!

While acknowledging the difficulties that this situation creates for diagnostic schemes in general, by focusing research efforts on the condition which has motor learning difficulties at its core, the last 20 years has seen remarkable progress. Understanding any developmental disorder, including DCD, is a multilevel and multistage process, involving scientists from disciplines including genetics, pediatrics, neurology, biomechanics, psychology, rehabilitation, education, and many others. In the 21st century, the study of DCD will require input from genetics and neuroscience if it is to keep pace with progress in other developmental disorders such as autism spectrum disorders and dyslexia.

Declaration of interest: The authors report no conflict of interest. The authors alone are responsible for the content and writing of this article.

ABOUT THE AUTHORS

Sheila E. Henderson, PhD, is an Emeritus Reader at University College Institute of Education, University of London. The main focus of her research is on movement difficulties in children. The topics covered range from the motor difficulties of children born prematurely to the psycho-social and educational concomitants of Developmental Coordination Disorder (DCD). The *Movement Assessment Battery for Children* (2nd edition), of which she is principal author, has been translated into 16 languages and has become one of the most widely used measures of developmental coordination disorders in the world. It has recently been nominated as the test of choice in the European Guidelines for the assessment of children with movement difficulties. Another publication, the *Detailed Assessment Speed of Handwriting* (DASH), is now the test of choice for teachers in the UK applying for special arrangements for children and students with specific learning difficulties. **Reint H. Geuze**, PhD, is an associate professor in Clinical and Developmental Psychology at the University of Groningen. Main topics of his research are motor development and developmental motor disorder, and lateralization of brain and behaviour. He contributed to the development of the European guideline for clinical practice for Developmental Coordination Disorder. He is a member of the board of the Society for Research on DCD.

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