Human Movement Science xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Human Movement Science

journal homepage: www.elsevier.com/locate/humov

Developmental coordination disorder and its cause: The road less travelled

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This article is one that has important implications as it questions and offers alternatives to several current views on the condition of Developmental Coordination Disorder (DCD). A prediction is that this will be the start of, or the catalyst for, a number of articles that take existing theoretical accounts and provide empirical and professional evidence to develop the thinking around the condition. There are a number of fundamental issues and assertions that are addressed and can be reduced to three discussion points. The first surrounds causation currently being viewed through the lens of information processing using models that have been used to explain both adult and typical motor performance. The second, takes the concept or concepts of executive function as an explanatory variable. Both of these approaches are criticised. The third examines whether, and if so how, theoretical evidence can help with professional practice. The theme running through all of these three issues is that a more productive way to view DCD is through an ecological approach to skilled performance engaging concepts from the perception-action and dynamical systems literature.

A starting point is a comment that one can view this article being about coordination in general through the medium of examining DCD. One could almost take the arguments that are being used and apply them to coordinated movement in general. The debate about information systems and dynamic systems now have been made for almost 50 years, reverting back to the original writings of Bernstein (1967) and Gibson (1966) from whom many of these ideas emanated. This is made even more clear by the statement near the end of article where it states that DCD does not involve neural or intelligence deficits and is part of a normal distribution. It is not like Down Syndrome or Cerebral Palsy where atypical constitutional features are part of the condition. DCD as defined by DSM 5 (APA, 2013) does not involve these atypical underlying substrates. Thus, the conclusion is that the variables that help us understand the cause of typical coordinated movement must also apply to DCD. It is noted that the article rarely ventures into the realm of development, that is a third of the name of the condition. One can only assume that the authors would promote an explanation of the developmental part of DCD in the same way as typically developing children and therefore would involve ecological explanations including dynamical systems and perception action ideas.

Information processing systems are subjected to the now familiar criticisms in the adult literature that although they show some of the processes involved in movement, they have difficulty in accounting for the actual control and co-ordination of limbs. The authors refer to the original work of Bernstein (1967) and the problem he set as to how the many degrees of freedom are controlled to produce coordinated movement. They argue that this issue is difficult to address through information processing systems. The criticism is justly made that an information systems approach has problems with explaining how the mastery of the redundant degrees of freedom, can be coordinated into skilful actions (Bernstein, 1967). He noted that through the skill learning process, the degrees of freedom are frozen, then released and finally utilized and are task and context related. They are all emergent properties, self-organised and softly assembled according to the ecological context and task demands. Wade and Kazek concur with this and also argue against noise in the system being an important variable together with the issue of variability which they note can be beneficial or harmful according to context. High variability in a context that requires consistency can be seen as detrimental but in more open fluid situations where flexibility of response is required, high variability places the mover in an advantageous position.

A major part of the article addresses the concept of executive function (EF). This has been a major topic for those interested in DCD. However, it should be recalled that as the article notes, EF does not offer an adequate explanation of limb coordination. Executive Function is an all-embracing term for a number of processes such as working memory, reasoning, problem solving,

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http://dx.doi.org/10.1016/j.humov.2017.04.006

multitasking, planning and organization, and the inhibition of responses. It is seen as an overarching explanation for such developmental disorders as autism (ASD) and attention deficit disorder (AD/HD). The core features of these conditions do indeed contain those processes such as inhibition of responses in ADD. In addition, some of the features are also seen in DCD. However, they are seen as co-occurring separate characteristics and not as a primary cause of limb coordination problems. Probably the nearest that EF provides to any explanation is in the planning and organization of movement. Here there is also a confusion as to what we mean by planning and organization. For example, one could use the packing of a lunch box with a soft drink, sandwiches, crisps, chocolate bar as a planning exercise that involves movement. However, it involves only minimal coordination although paradoxically one could say that the lunch box and the fitting of the various food and drink components could be classed as a classic perception-action task with the box affording various shapes and sizes of the food and drink, and would be better explained by a more ecological viewpoint. A second type of planning could involve movements during the actual performance of an action; this is particularly true if the action involves a sequence of movements, with the performer having difficulty starting the movement or forgetting what to do next in the sequence. This is often seen in children with movement difficulties such as DCD; the question becomes whether this can be better explained by a processing account involving a central executive or whether an ecological account employing affordances and perception action concepts is a better explanation. The conclusion from the authors favours the latter explanation and the evidence appears to support this. There is a substantial amount of evidence to show that children with DCD have problems with a number of components of what has come to be called executive function. However, the fundamental question is, whether any of these components can explain the fundamental quality of DCD, that is poor movement quality and coordination and functional outcomes in everyday motor activities? The Wade and Kazek article clearly assert that this is not the case and they quote recent work by Rigoli, Piek, and Kane (2012) that notes that there is no causal relationship. They also note that many EF tasks seem to be unrelated to motor difficulties typically observed. Again, this is not clear cut as the boundaries between description and causation tend to be blurred and in reality are probably on some continuum rather than a straight dichotomy as is often portrayed. More general supporting work for the Wade and Kazek article comes from a recent paper by Logie (2016) who notes that a central executive involves aspects of cognition that are poorly understood and probably have several functions working together using different but overlapping brain functions. Logie concludes by proposing that the concept ought to be “offered a dignified retirement” (Logie, 2016, page 2093).

In the final section of the article the authors address the question as to whether theory can contribute to professional practice. When evaluating the contribution of information processing systems to explanations of DCD there is little in the article of how theoretically the proponents of IPS link this to intervention. Indeed, one could say there is a paradox between IPS explanations of the underlying causes and how they propose to rectify the difficulties. During the last 20 years, there has been much discussion about the type of intervention that should be pursued with children showing movement disorders. Numerous categories of intervention approaches have been identified, ranging from popular ones to others that are more idiosyncratic and rare. We have taken a view, used by many, that the approaches can be drilled down into the two large categories of task approaches and process approaches. These are the usual two that have been commonly used in the literature when examining the effectiveness of intervention as we have noted in our discussion on systematic reviews and meta analyses. (Pless & Carlsson, 2000; Wilson, 2005: Polatajko & Mandich, 2004; Schoemaker, Niemeijer, Reynders, & Smits-Englesman, 2003; Sugden, 2007; Smits-Engelsman et al., 2013).

However, caution is advised on this as they clearly are not discrete categories as often they are portrayed. A simplistic look says that task approaches are simply that; one teaches the task that needs to be learned such as riding a bicycle or forming letters. Similarly process approaches aim to teach processes that underlie the tasks such as visual perception or kinaesthesis and aim for improvement in these. However, this is not the total answer and rather than portraying them as discrete categories as is usually the case, it could be said that not only do they form a continuum but also that each one contains characteristics of the other. For example, in task approaches, many of the intervention schemes will also involve some underlying processes. For example in both a Cognitive Motor approach (Henderson & Sugden 1992; Sugden & Henderson, 2007) and COOP (Polatajko & Mandich, 2004), there would be an inclusion of some processes involving cognition and perception but all are task based approaches. How detailed and how conscious this is variable but all would state they are task based and involve cognitive processes. Thus, one can teach a task that is an activity of everyday living yet involves such cognitive processes as self-goal selection and setting, self monitoring and problem solving. Similarly, in more process oriented approaches such as Sensory Integration Therapy (SIT), although the emphasis is on processes particularly sensory one, they obviously do use tasks in their intervention schedules. In addition, SIT for example has also changed to include more task oriented approaches over the last few years and a modification from the original programme as started by Jean Ayres in the early 1970s. (Ayres, 1979).

The point to be made is that if IPS systems are good explanations of the problems and difficulties by children with DCD, why are nearly all of the proponents of IPS and EF systems recommending that tasks oriented approaches rather than processing approaches are the ones to be used. There appears at first analysis to be a contradiction in these recommendations. It is recognized that this is a simplistic and probably reductionist statement to be used. However, there does appear to be a kind of paradox in that the explanation or causation does not link with what is recommended to remedy the problem. It would have been useful for the Wade and Kasek article to note this and indeed use the recommendations that all seem to be making for task oriented approaches to link this to their dynamic systems perception action functional tasks that they are recommending as explanations.

Much general work in the professional arena has been conducted with information processing systems as the foundation for the work on such topics as amount of practice, on scheduling, variability of practice and these are well established in the traditional motor learning literature (Schmidt & Lee, 2011). More recently, there is work coming through that examines what dynamical systems can offer with many researchers and practitioners adding to this work drawing on the work of Bernstein (1967) and Gibson (1966) and moved into the practical domain by others such as Davids, Button, and Bennett (2008) who use the term non linear pedagogies (NLP) to describe an approach that draws heavily on the ideas as advocated in the article by Wade and Kazek. The ideas of NLP are