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REVIEW/MISE AU POINT

# Developmental coordination disorders: State of art



## *Troubles de l'acquisition de la coordination : état de la question*

L. Vaivre-Douret <sup>a,b,c,d,e,f,\*</sup>

<sup>a</sup> Paris Descartes University, 75006 Paris, France

<sup>b</sup> Sorbonne Paris City, 75006 Paris, France

<sup>c</sup> Inserm, UMR-S0669 Paris, 75014 Paris, France

<sup>d</sup> University of Paris-Sud and Paris Descartes University, 75006 Paris, France

<sup>e</sup> Cochin-Port Royal Hospital Paris Center, Department of Pediatrics, 75015 Paris, France

<sup>f</sup> Department of Child Psychiatry, Necker-Enfants Malades Hospital, 149, rue de Sèvres, 75015 Paris, France

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Diagnostic criteria

**Summary** In the literature, descriptions of children with motor coordination difficulties and clumsy movements have been discussed since the early 1900s. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), it is a marked impairment in the development of fine or global motor coordination, affecting 6% of school-age children. All these children are characterized for developmental coordination disorder (DCD) in motor learning and new motor skill acquisition, in contrast to adult apraxia which is a disorder in the execution of already learned movements. No consensus has been established about etiology of DCD. Intra-group approach through factor and cluster analysis highlights that motor impairment in DCD children varies both in severity and nature. Indeed, most studies have used screening measures of performance on some developmental milestones derived from global motor tests. A few studies have investigated different functions together with standardized assessments, such as neuromuscular tone and soft signs, qualitative and quantitative measures related to gross and fine motor coordination and the specific difficulties – academic, language, gnosis, visual motor/visual-perceptual, and attentional/executive – in order to allow a better identification of DCD subtypes with diagnostic criteria and to provide an understanding of the mechanisms and of the cerebral involvement.

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\* Correspondence. Tel.: +33 1 44 49 40 14; fax: +33 1 44 49 45 63.  
E-mail address: [laurence.vaivre-douret@inserm.fr](mailto:laurence.vaivre-douret@inserm.fr)

**MOTS CLÉS**

Trouble de l'acquisition de la coordination ;  
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 Évaluation ;  
 Critères diagnostiques

**Résumé** À partir d'une revue de la littérature, les descriptions des enfants ayant des difficultés de coordination motrice et des mouvements maladroits ont été discutées depuis le début du 19<sup>e</sup> siècle. Selon le manuel diagnostique et statistique des troubles mentaux (DSM-IV), il s'agit d'un trouble avéré au niveau du développement de la coordination motrice fine et globale, touchant 6% des enfants scolarisés. Tous ces enfants sont caractérisés par un trouble de l'acquisition de la coordination motrice (TAC) au niveau de l'apprentissage moteur et des nouvelles acquisitions d'habileté motrice, contrairement à l'apraxie chez l'adulte pour lequel il s'agit d'un trouble de l'exécution des mouvements déjà appris. Aucun consensus n'a été établi à propos de l'étiologie du TAC. L'approche intragroupe par une analyse factorielle et de classification souligne qu'un trouble moteur chez des enfants porteurs d'un TAC varie à la fois au niveau de la sévérité et de la nature du trouble. En effet, la plupart des études ont utilisé des mesures de *screening* de la performance sur quelques items développementaux basés sur des tests moteurs globaux. Peu d'études ont investigué un ensemble de différentes fonctions avec des évaluations standardisées, telles que le tonus musculaire et les signes neurologiques doux, sur des mesures quantitatives et qualitatives de la coordination motrice globale et fine, et sur des difficultés spécifiques – académique, langage, gnosique, visuo-motrice/visuo-perceptive et attentionnelle/exécutive – afin de permettre une meilleure identification des sous-groupes de TAC avec des critères diagnostiques et de fournir une compréhension des mécanismes et des zones cérébrales en jeu.

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## Introduction

Children with developmental coordination disorder (DCD) are characterized by difficulties in the acquisition and performance of motor skills affecting approximately 6% of them between 5 and 11 years of age, with higher prevalence among boys than girls [4], difficulties which persist into adolescence and adulthood [14,21]. Motor impairments include marked delays in achieving motor milestones, clumsiness, poor sensorimotor coordination, poor balance and handwriting [16], poor postural control and difficulties in motor learning (new skills, planning of movement, automatization), strategic planning, timing, sequencing of movement [42]. They also have deficits in processing visual-spatial information [141].

In the literature, descriptions of children with motor coordination difficulties and clumsy movements have been discussed since the early 1900s. Collier referred to "congenital clumsiness" according to Ford [37] and by Dupré [31] who described as "motor debility" children with clumsiness in voluntary movements. Orton [100] referred to "abnormal clumsiness" and Strauss and Lehtinen [124] to "clumsiness or psychomotor syndrome". Ford [38] used the term of "congenital awkwardness". "Developmental dyspraxia" was also briefly used by Brain [11]. Thereafter, other authors used the term of "developmental apraxia" [47,137].

In 1964, a French child psychiatrist and psychologist Ajuriaguerra (de) [2] and Stambak, L'héritau, Auzias, Bergès, & Ajuriaguerra (de) [121], described "child dyspraxia" by reference to "constructional apraxia" in adults, and defined it as a body integration disorder interfering with spatial organization. In 1968, Reuben and Bakwin [110] used the term of "developmental clumsiness" and in the 1970s, Benson and Geschwind [8], Denkla [25] and PeBenito [103] described the disorder as a "developmental

Gerstmann's syndrome". Gubbay [49,50] at first used the term "developmental apraxia" and later preferred the term "dyspraxia".

However, around 1980, new terms emerged, such as "apracto-gnosia" for De Quiros and Schragar [23], Miller [92] and "developmental dyspraxia-dysgnosia" for Lesny [79]. "Developmental dyspraxia" also appeared in the literature with the work of Denkla [24], Cermak [15], Iloje [62] and Njioiktjien [97]. Thus, the term "developmental dyspraxia" was applied to children falling into the category described as "clumsy" [15,20,71,79,91].

## Dyspraxia is not a simple version of adult apraxia

Apraxia is an acquired disorder that leads to the loss in the ability to accomplish previously learned skills whereas dyspraxia is presented as a constitutional developmental disorder involving an impairment in learning or in performing non-habitual motor tasks typically identified in children, defined as a failure to have ever acquired the ability to perform given age-appropriate complex motor actions or voluntary motor activities. Thus, dyspraxia is not a simple version of adult apraxia, which is most commonly observed in difficulties in planning and execution of complex movement sequences in adults with brain damage, where the cortical lesion is often located in the left parietal lobe, in the pre-motor cortex, in the supplementary motor area [18,22,45,60,102,114,115] or in the frontal cortex in association with language impairments such as aphasia [26,116]. Ideational, ideomotor, and constructional types of apraxia in adults are described in the literature [12,51,52,83].

In contrast, in children, the etiology of developmental dyspraxia is unknown and seems to be connected with maturational processes in the central nervous system. However, no consensus has been established, while heterogeneous

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