Recognizing and Referring Children at Risk for Developmental Coordination Disorder: Role of the Speech-Language Pathologist

Reconnaître et envoyer en consultation des enfants à risque de trouble de l'acquisition de la coordination : le rôle de l'orthophoniste

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Abstract

Speech-language pathologists are in a unique position to assist families with the process of early identification of motor coordination disorders in children. While families and physicians may be focused primarily on the child's communication delay, a child's fine and gross motor abilities should also be progressing at a rapid rate during the preschool years. Research reviews indicate that a significant number of children with speech-language delays and disorders will demonstrate concomitant motor coordination difficulties which, when left untreated, may impact the child's later social and academic progress. Many of these children display the characteristics of Developmental Coordination Disorder. This article describes the clinical observations of motor development specialists and delineates some key child-behaviours and some clinician-helping behaviours to watch for when working with a preschool speech and language delayed child. This information may assist speech-language pathologists in identifying children who are at risk of having developmental coordination disorder and in facilitating referral to occupational therapists or physical therapists for assessment.

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Abrégé

Les orthophonistes sont éminemment bien placés pour aider les familles à effectuer le dépistage précoce de troubles de coordination motrice chez les enfants. Tandis que les familles et les médecins se préoccupent principalement de retards de l'enfant sur le plan de la communication, la motricité fine et globale de l'enfant doit elle aussi progresser rapidement pendant les années préscolaires. Les examens des recherches entreprises sur ce sujet portent à croire qu'un nombre significatif d'enfants ayant des retards ou des troubles de la parole et du langage feront état de difficultés de motricité associées qui, en l'absence de traitement, peuvent avoir des répercussions sur les progrès ultérieurs de l'enfant sur les plans social et scolaire. Plusieurs de ces enfants affichent des caractéristiques de trouble de l'acquisition de la coordination. Cet article décrit les observations cliniques de spécialistes du développement moteur et trace quelques comportements clés chez l'enfant et quelques comportements aidant le clinicien à surveiller lorsqu'on traite un enfant d'âge préscolaire présentant un retard de la parole et du langage. Cette information peut aider les orthophonistes à identifier les enfants qui sont à risque d'avoir un trouble de l'acquisition de la coordination et à faciliter l'envoi en consultation auprès d'ergothérapeutes ou de physiothérapeutes pour évaluation.

Key words: Developmental Coordination Disorder, early identification, preschool, specific language impairment

Children who are so clumsy that they are unable to perform age-appropriate academic and self-care tasks have a syndrome known as Developmental Coordination Disorder (DCD). It is well recognized that five to six percent of

children are born with DCD (American Psychiatric Association, 1994), yet health care and educational systems typically do not recognize and intervene with these children until well into the school years when academic and behavioural problems begin to emerge. Historically, one of the reasons that these children received so little attention was due to the belief that, if left alone, they would outgrow their problems (Fox & Lent, 1996). Recent evidence has shown that the motor problems persist and that most children with DCD go on to experience learning difficulties, emotional problems and social isolation in adolescence and adulthood (Cantell, Smyth, & Ahonen, 1994; Gillberg & Gillberg, 1989; Losse et al., 1991; Rasmussen & Gllberg, 2000). If children with DCD can be referred and identified at an earlier age, their health and educational outcomes may be significantly improved.

In order to identify children with DCD during the preschool years, the health care professionals who would typically see these children for reasons other than motor development, need to be aware of the diagnosis and manifestations of DCD. One health care professional who often sees preschool children with developmental difficulties is the speech-language pathologist. Speech-language pathologists receive referrals from early intervention initiatives that are designed to facilitate speech and language development in children who are demonstrating early delays. Recent research has shown that more than half of the children who present with "specific" language impairments may also have DCD (Hill, 1998; Hill, Bishop, & Nimmo-Smith, 1998; Robinson, 1991). There are strong theoretical reasons to believe that the underlying mechanism of both disorders may be difficulties with rule generalization (Hill, 1998; 2001; Kiernan & Snow, 1999), praxis (Hall, 2000; Hodge, 1998; Portwood, 2000) or a shared atypical brain development (Kaplan, Wilson, Dewey, & Crawford, 1998). It would seem that speech-language pathologists are an excellent group to educate about DCD to facilitate earlier referral of these children to pediatric occupational therapists and physical therapists.

The purpose of this paper is to summarize the research literature concerning children with DCD, highlighting the way in which these children may be recognized by speech-language pathologists. Key developmental milestones in the areas of self-care and fine motor skills are outlined and tips are provided concerning the observations that are most likely to be made during speech-language intervention. Results of a pilot study that delineated the helping behaviours that speech-language pathologists use clinically when working with these children are also described.

Review of the Literature

Children with DCD are estimated to represent at least five to six percent of the school-aged population (American Psychiatric Association, 1994; Iloeje, 1987; Kadesjo & Gillberg, 1998; Missiuna, 1994; Roussounis, Gaussen, & Stratton, 1987; Sugden & Keogh, 1990). This figure corresponds to approximately 470,000 Canadian children, of whom 129,000 are currently in elementary school (Statistics Canada, 1997). "The essential feature of Developmental Coordination Disorder is a marked impairment in the development of motor coordination ... that significantly interferes with academic achievement or activities of daily living" (American Psychiatric Association, 2000, p. 56-57). DCD is recognized as frequently coexisting with other developmental disorders including, most commonly, phonological disorder, expressive language disorder and mixed receptive-expressive language disorder (American Psychiatric Association).

Since this disorder was first described by Orton in 1937, DCD has been known under a variety of labels (Missiuna & Polatajko, 1995; Peters, Barnett, & Henderson, 2001) including developmental dyspraxia (Ayres, Mailloux, & Wendler, 1987; Cermak, 1985; Denckla, 1984; Goodgold-Edwards & Cermak, 1990; Portwood, 2000), minimal brain dysfunction (Gillberg, 1985; Gillberg & Gillberg, 1989; Gillberg, Gillberg, & Groth, 1989), perceptuo-motor dysfunction (Laszlo, Bairstow, Bartrip, & Rolfe, 1988), physical awkwardness (Marchiori, Wall, & Bedingfield, 1987; Wall, McClements, Bouffard, Findlay, & Taylor, 1985) and, most commonly, the "clumsy child syndrome" (Cratty, 1994; Gubbay, 1975a; 1975b; Gubbay, Ellis, Walton, & Court, 1965; Henderson & Hall, 1982; Losse et al., 1991: Walton, Ellis, & Court, 1962). A whole spectrum of terminology has been used over the years by different health care disciplines which has made diagnostic criteria confusing and prevalence estimates difficult to obtain. It is only in the past few years that there has been any consensus about the term "Developmental Coordination Disorder" and about its legitimacy as a health problem (American Psychiatric Association, 1994; Polatajko, Fox, & Missiuna, 1995). Despite the prevalence of this condition and the poor outcome of children who are untreated, we have no systematic approach anywhere in Canada to either identify or intervene with these children.

The aetiology of DCD has yet to be identified, but there is recognition that it is a multifaceted disorder that is frequently associated with other conditions such as learning disabilities (Kaplan, Wilson, Dewey, & Crawford, 1998), attention-deficit/hyperactivity disorder (Kadesjo & Gillberg, 1998; Rasmussen &

Gillberg, 2000) and specific language impairment (Hill, 1998; 2001; Rintala, Pienimaki, Ahonen, & Cantell, 1998; Robinson, 1991). In a recent comprehensive review of the literature, Hill (2001) illustrated that well-designed studies investigating children with specific language impairment find that from 40-90% of the children also have motor impairments. While many physicians now acknowledge the link between speech delays and negative academic outcomes, they are likely to tell parents not to worry about motor delays or children's clumsiness (Polatajko, 1999). The extent of the physical impairment is often not as severe in children with DCD as it is with many other neurodevelopmental disabilities so, when parents raise concerns, it is not uncommon for physicians to tell them that their children will "grow out of" the problems that they describe (Fox & Lent, 1996; Losse et al., 1991).

A number of longitudinal studies have now provided strong empirical evidence that the motor problems of children with DCD persist, at least into adolescence (e.g., Cantell, Smyth, & Ahonen, 1994; Gillberg & Gillberg, 1989; Gillberg, Gillberg, & Groth, 1989; Hellgren, Gillberg, Gillberg, & Ennerskog, 1993; Losse et al., 1991). Perhaps of greater significance, findings indicate that the motor impairment leads to the development of secondary physical health, mental health and educational issues including poor physical fitness, poor social competence, academic problems, behavioural problems, and low self-esteem (Bouffard, Watkinson, Thompson, Causgrove-Dunn, & Romanow, 1996; Cantell, Smyth, & Ahonen, 1994; Geuze & Borger, 1993; Hay & Missiuna, 1998; Schoemaker & Kalverboer, 1994; Shafer et al., 1985; Watkinson, et al., 2001). Children as young as six years of age have been shown to lack confidence in their physical competence, to judge themselves to be less competent socially, and to be more introverted and anxious than their peers (Schoemaker & Kalverboer, 1994). Children with DCD have also been shown to differ in their participation in structured and unstructured physical activities which puts their social interactions, motor skill development, fitness, and health at risk (Bouffard, Watkinson, Thompson, Causgrove-Dunn, & Romanow, 1996; Hay & Missiuna, 1998; Larkin & Parker, 1998).

The evidence provided by the literature suggests that early identification is required to favour a more optimistic prognosis (Henderson, 1994; Polatajko, Fox, & Missiuna, 1995); yet, throughout North America, children with DCD are only rarely identified and diagnosed. What we have learned from the attempts of other countries to identify these children early is discouraging. Large-scale neurodevelopmental screening, used in many countries in Europe, for example, has been ineffective and costly since most developmental milestones of children with DCD are still achieved within normal limits (Haines et al, 1985; Roussounis, Gaussen, & Stratton, 1987). Specific medical testing is not helpful since our knowledge about the evolution of any particular signs, developmental or neurological, is incomplete and the significance of their presence/absence in children with DCD is not known (Henderson & Barnett, 1998). The usage of arbitrary cutoff points on motor proficiency tests does not work as it fails to address the relationship between the child's motor impairment and the resulting interference with daily activities and/or academic achievement (Wright & Sugden, 1996). Teacher-initiated referrals, while usually accurate (Dussart, 1994; Missiuna, 1994), tend to occur too late, after the onset of academic, social and behavioural problems in the classroom. Clearly, the screening methods that are used to identify many other types of health-related conditions are ineffective for children with DCD. Another method is required to facilitate earlier identification of this population.

One group of health service providers who see children with developmental difficulties during the preschool years is speech-language pathologists (SLPs). An estimated 7-10% of preschool children in Canada have a specific speech and language disorder which is not due to any secondary sensory, cognitive, neurological, or structural impairment (Beitchman, Nair, Clegg, & Patel, 1986). In recent years, early identification programs and other healthy child initiatives have promoted referrals of children who demonstrate early delays in speech and language to SLPs for assessment and possible inter-vention. As described earlier, studies of children with identified speech-language disorders (Cermak, Ward & Ward, 1986; Hill, 1998; Hill, Bishop, & Nimmo-Smith, 1998; Preis, Schittler, & Lenard, 1997; Powell & Bishop, 1992; Rintala, Pienimaki, Ahonen, & Canteli, 1998; Reeves, 1998; Robinson, 1991) have repeatedly demonstrated that between 40% and 90% of these children also have comorbid motor coordination difficulties (Hill, 2001). The overlap of these two disabilities has led clinicians and researchers to speculate whether there are underlying mechanisms of both motor and speech-language disorders which may be common to both conditions (Portwood, 2000).

Theoretical proposals have suggested that specific language impairment and DCD may share common underpinnings. Some authors have theorized that the common underpinnings between speech and motor impairments may be quite specific. Reflecting upon the numerous studies that demonstrate difficulties in praxis with many of the children who have DCD, Hodge (1998) and Hall (2000) have proposed that problems with

praxis may be a shared factor with some children who have motor and speech-language impairments. It would appear that these authors may be focusing on the subgroup of children who would be considered to have developmental apraxia of speech. It is suggested that these children have difficulty with premotor organization and sequencing abilities (Hall, 2000). These children probably represent a subset of children with DCD (Missiuna, Pollock, & Gaines, 2000).

Other authors who have suggested a single, underlying etiology have presumed a more diffuse neurodevelopmental abnormality. Kaplan, Wilson, Dewey, & Crawford (1998) proposed that the co-morbid presentation of childhood developmental disorders is so common that there must be a shared factor; they referred to this as Atypical Brain Development. Speech-language difficulties and motor coordination difficulties are viewed as variable expressions of one common factor. A slightly different line of thinking is reflected in the studies that have investigated a theory of a common "maturational lag". Studies have refuted the idea, however, that children with language impairment and/or children with motor impairments are simply delayed. Rather, it appears that, as children grow older, the gap between their development and the development of typical children actually widens (e.g., Bishop & Edmundson, 1987; Lord & Hulme, 1988). Most recently, Hill (1998, 2001) concluded that concomitance of speech and motor problems "is the rule rather than the exception" (2001, p. 166) and stressed the fact that we must be aware of the substantial risk that language delay has for additional motor impairments.

Throughout the remainder of this paper, information will be provided concerning the types of observations of motor development that speech-language pathologists may note throughout their speech-language sessions.

Increasing Awareness of Speech-Language Pathologists

What is typical and what is not?

Occupational and physical therapists who observe preschool children can typically identify children who show evidence of mild coordination difficulties and motor delays. Observation of motor skill development is not the emphasis of training for speech-language pathologists; however, they can learn to make specific observations that are appropriate to their clinical settings. The motor coordination difficulties that are present in children with DCD impact their ability to perform everyday tasks such as reaching to pick up an object, putting on clothing, managing zippers and snaps, using crayons and scissors, and manipulating toys. To observe delays or difficulties with these types of activities, one must first become familiar with the abilities of preschool aged children who are developing in a typical manner. Table 1 outlines some of the skills that would be expected of typically developing children who are two to three years, three to four years, four to five years, and five to six years of age in the performance of self-care and fine motor activities. These particular areas are highlighted as the SLP often has the opportunity to observe the child doing these activities within a preschool setting or in group or individual therapy. It is important to observe the child from the moment he or she arrives, as many of the activities that can indicate the presence of DCD happen prior to the initiation of, or at the end of, the therapy itself (e.g., undoing zippers, hanging up coats, putting on shoes, moving to the table, getting seated, picking up crayons or pencils).

In Table 1, the overlap of ages across categories reflects the fact that, depending on their experiences, children may achieve specific skills at different times. If a child does not demonstrate nearly all of the skills expected within this age range, however, further assessment by an occupational therapist may be warranted.

What might be observed in a preschool child who has DCD?

Observations of preschool children with DCD were compiled from characteristics outlined in the literature, from stories and descriptions provided by parents of children with DCD, and from clinical experience. Descriptions of characteristics that may be observed in a classroom or small group setting in a preschool child with DCD are summarized in Table 2. The observations have been grouped into general categories that reflect features that are commonly described in children with DCD: awkward posture, difficulty moving between tasks, difficulty using both hands together in an effective manner, "squirms" around when seated due to inability to maintain stable position, avoidance of tasks that require fine or gross motor skill, frustration with tasks that require motor skills. While the presence of some of these behaviours may arguably be attributable to something other than DCD, they are nonetheless present in children with DCD and need to be included as part of the process of identification. With referral to a motor coordination specialist, differential diagnosis can then occur.

The interaction between children's needs and SLP assistance

An exploratory study was conducted to examine the types of activities that SLPs use typically with preschool children. The purpose was to determine whether it would

Table 1
Typical Milestones in the Areas of Self-Care and Fine Motor Development

Two- to Three-Year-Olds	Three- to Four-Year-Olds	Four- to Five-Year-Olds	Five- to Six-Year-Olds
Self Care:			
Dressing:			
· Removes most clothes · Finds armholes in T shirts · Unbuttons large buttons · Removes shoes · Tries to put on socks	· Undresses independently · Dresses with supervision · Fastens large buttons · Puts shoes on correct feet · Unzips zippers · Puts on boots, mittens, hats	· Puts on shoes and socks · Puts on jacket · Fastens all buttons · Fastens Velcro shoes · Zips up zippers	· Dresses unsupervised · Ties a knot · Begins to tie shoe laces
Feeding:			
· Spoon feeds with little spilling · Uses rotary chewing pattern · May use fork · Drinks with no liquid loss	· Spoon feeds most food · Uses fork to stab foods · Pours liquids with few spills · Holds cup with one hand	· Serves own food with spoon · Spoon feeds liquid (soup)	· Uses knife for spreading
Other:			
· Grasps toothbrush · Brings Kleenex to nose · Imitates hair brush use · May be toilet trained	· Washes and dries face · Brushes teeth with supervision · Toilet trained, day and night	· Washes hands effectively · Brushes teeth independently · Toilets independently	· Blows nose independently · Brushes hair independently · Bathes with supervision
Fine Motor:			
· Hand preference detectable · Copies vertical strokes · Traces simple shapes · Unscrews bottle caps · Makes little snips with scissors · Scribbles to colour	· Stacks 8-10 blocks · Completes inset puzzles · Uses tip pinch to pick tiny objects · Consistent hand preference · String beads · Uses scissors to cut along straight and curved lines but without accuracy · Imitates horizontal and vertical lines · Draws a person with head and arms or legs recognizable	· Cuts accurately with scissors · Uses key in lock · Folds paper accurately · Draws 4-5 part person · Copies squares, diagonals · Static 3-finger grasp of crayon	· Builds complex structures (Lego) · Colours with accuracy · Copies letters and numbers · Draws recognizable pictures · Draws triangle · Prints name · Mature grasp of pencil

be possible for SLPs to observe behaviours that would indicate a risk of DCD (Hoggan, Dawson, & Missiuna, 2001). Speech-language pathologists were asked to identify children on their caseloads whom they believed to be typically developing in the area of motor skills and other children whom they suspected might have coordination difficulties. None of the children had been referred previously for occupa-tional therapy or physical therapy intervention. Following ethical approval, five SLPs volunteered to participate in the study. Parents gave consent for the videotaping of twelve children during speech therapy sessions that lasted from 20-30 minutes each for a total of 350 minutes of tape.

A senior occupational therapist and a physical therapist who were familiar with preschool children with DCD independently viewed all of the videotapes. Both therapists identified 4 of 12 children whom they believed demonstrated the motor characteristics of children with DCD. Of interest, exactly the same set of four children was identified by each observer. Student occupational therapists who were naïve to the child's identification systematically coded all 12 videotapes looking for the presence of observable characteristics that would be predictive of children with DCD. They also coded the presence of assistive and helping behaviours demonstrated by the SLP during interaction with the child. Child behaviours that were observed much more frequently during speech-language sessions in the identified children than in typically developing children included:

Child Behaviours

- fails to use hands in dominant-assistive manner during bilateral activities (e.g., colours without stabilizing paper)

- uses same side hand during task rather than crossing midline with dominant hand (e.g., reaches to turn pages using ipsilateral hand)
- inappropriate task-related stabilization or fixing across joints (e.g., holds arm in fixed, awkward position and bends at waist to pour a drink)
- executes task while demonstrating hypermobility across joints (e.g., hands look floppy, child sways back and forth when standing at table, child squirms around and changes positions when sitting on floor)
- inappropriate postural set or preparation for a task (e.g., child sits down sideways on chair and does not swing legs around under table)

Certain behaviors of SLPs were also observed to occur much more frequently when they were interacting with children with coordination difficulties than with typically developing children, including:

Clinician's Behaviours

- task for child to do is completed entirely by the SLP while child observes
- SLP stabilizes and/or supports objects as child works on activity
- SLP moves child's chair or table into position, repositions child
- verbal guidance is used to cue physical components of the task
- assistance is provided such that the SLP takes over and finishes the task for the child

While this exploratory study initiated the search for clinically meaningful information that SLPs might be able to use, there were several limitations. Children with probable DCD were designated as such if they were independently identified by both a physiotherapist and an occupational therapist who observed the videotapes. No formalized clinical assessment was used to validate the identification; hence, we do not know whether these children did, in fact, have DCD. Observations of child and clinician behaviors were independently coded by two students and were found to be reliable; however, the numbers of children and clinicians participating in this study was quite small. The clinician and child behaviours identified, though, provide some support for the premise that SLPs may be able to increase their awareness of the characteristics of preschool children, and of the way that they help and support the children, to detect children who are at risk of DCD. A larger study has been proposed by Gaines and Missiuna at the Children's Hospital of Eastern Ontario, in order to address the limitations of the previous study. The outcome of this research may assist SLPs in identifying strategies for earlier and more accurate identification of children who have DCD.

Table 2.
Frequent Observations of Preschool Children with DCD

Observations of Posture and Movement
Trouble organizing self to get seated properly at a table
Slouched posture, seems to fatigue easily, leans on wall or furniture
Frequently shifts position, appearing inattentive but still attends to task
Moves whole body rather than individual body parts (looks stiff)
Head too close to the table top, leans on arms
Use of Hands During Preacademic Tasks
Difficulty with two handed tasks (e.g., cutting accurately, catching ball)
Doesn't use "helper hand" (e.g., to hold paper, pour water, hold zipper)
Frequently changes hands when colouring, printing
Awkward pencil, marke,r or scissor grasp
Excessive tightness of grasp (hyperextension of finger joints)
Excessive pressure on pencil or marker
Approach to, or Avoidance of Tasks
Rushes through tasks, work appears to be careless or works very slowly, deliberately and meticulously
Avoids certain tasks, particularly those demanding fine motor skill
Doesn't sustain eye gaze or visually track during a task
Not able to predict next steps in a sequenced task
Easily frustrated, impulsive, lacks persistence
Observations During Free Play
Avoids "messy" and/or tactile activities and play centres
Difficulty joining in a play group, tends to watch others play
Moves from activity to activity in unstructured play time
Wanders the perimeter of the playground at recess or outdoor playtime
Exhibits preference for reading or talking rather than physical activities

Summary and Conclusions

Children with DCD have subtle, but pervasive problems that do not appear to resolve with age and that can lead to significant academic, social, and emotional consequences. Although the prevalence of DCD is 5-6% in the general population, the prevalence rate in children who are already identified with speech and language

delays is much greater. Speech-language pathologists can work together with motor development specialists to help recognize and refer children who appear to be at-risk for DCD. Careful observation during therapeutic intervention should focus on children's management of self-care tasks, the quality of their fine motor skills, and their approach to new task demands. In addition, an increased awareness of the type of physical assistance and support that the SLP is providing to the child can indicate the need for further evaluation. Referral to an occupational therapist or physical therapist may be warranted. Comprehensive assessment and early identification will lead to more supportive management of the population of children who have DCD.

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Authors' Note

Additional education resources suitable for parents, health professionals, and teachers can be found on the Web site of CanChild, Centre for Childhood Disability Research at www.fhs.mcmaster.ca/canchild/. Please address all correspondence to Cheryl Missiuna, McMaster University, School of Rehabilitation Science, IAHS 414, 1400 Main St. West, Hamilton, Ontario, Canada, L8S 1C7 or to missiuna@mcmaster.ca.

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