



Identifying Developmental Coordination Disorders in Early Childhood

January 2016

Take Home Message

1. Early identification of Developmental Coordination Disorders (DCD) enhances opportunities for improving both physical and social skills essential for **school readiness**
2. The new **Little Developmental Coordination Disorder Questionnaire** seems to be a better tool for screening preschoolers, as compared with its predecessor (DCDQ)
3. Newer treatments such as **virtual reality games and Lycra body suits** show promise of efficacy
4. Prematurity, sex, and perinatal factors may offer **clues to predicting DCD**

Overview

This project was completed during the Spring 2015 term by students in an upper-level Psychology course, *Community-Based Research*, at the University of Waterloo. The students were: **Sean Griffin, Alisha Karmali, Justin Leung, Alexandra Rett, and Jay Solanki**. Dr. Kathleen Bloom, course instructor, guided the review work. Supreet Sandhu assisted in editing and preparing the final report. The work was supported in part by the Social Sciences and Humanities Research Council of Canada through a Partnership Development Grant: "Building Systems for Sustainable Knowledge Mobilization," (K. Bloom, Principal Investigator) and Knowledge Impact Strategies Consulting Ltd. (www.kimpact.ca).

The community partner organization for this project was Infant and Child Development Services (ICDS) Halton. Its partnership with the University was coordinated by Roxanne Young, a Manager and Early Childhood Education Specialist at ICDS Halton.

ICDS Halton is a community-based organization that provides a range of resources to families with children who experience developmental delays. ICDS Halton works collaboratively with families to mitigate the personal and societal costs of developmental delays.

Developmental coordination disorder (DCD) is characterized by delayed coordination and development of fine and gross motor skills. DCD's secondary consequences include

impairments in both academic and social success. Historically DCD was not typically identified and diagnosed until school age. Owing to the likely physical, social, and learning impacts of the disorder on school readiness, ICDS Halton proposed the need to identify DCD as early as possible. Diagnosis is the first step in creating programs to support success in the foundational years of school and social play. The review of research presented in this report was conducted to support these goals.

What Was Studied?

Research review question: **How can DCD be identified in early childhood?**

How Was It Studied?

Using the scientific methods of systematic scoping reviews, this project identified all relevant research articles published between 2012 and 2015 that addressed DCD in children under the age of 6 years. The goal was to characterize assessment tools that were described, used, and/or discussed and to summarize the research results in general.

The review was conducted between May and July 2015. The research literature was searched in the Scopus database which compiles peer-reviewed articles from over 21,000 academic journals. The search string used was:

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TITLE-ABS-KEY("Developmental Coordination Disorder" OR "DCD" OR "dyspraxia" OR "clums*") AND TITLE-ABS-KEY("infant" OR "child*") AND LANGUAGE(french OR english) AND PUBYEAR > 2011
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The search was conducted on May 25, 2015 and resulted in 460 hits. Because journal indexing software is not an exact science, articles that fit the following criteria were found and then had to be excluded from the review:

- The study was focused on topics unrelated to developmental or motor disorders
- The article described disorders that would eclipse a diagnosis of Developmental Coordination Disorder such as Cerebral Palsy or Muscular Dystrophy

Three hundred and seventy-eight research articles remained after the above exclusion criteria were applied. A second set of exclusion criteria was then applied to these articles:

- The age of participants was 6 years old or greater
- The article was an editorial, letter, short commentary, or book chapter
- Did not specifically mention or address issues of DCD such as screening, assessment, identification, treatment, or outcomes.

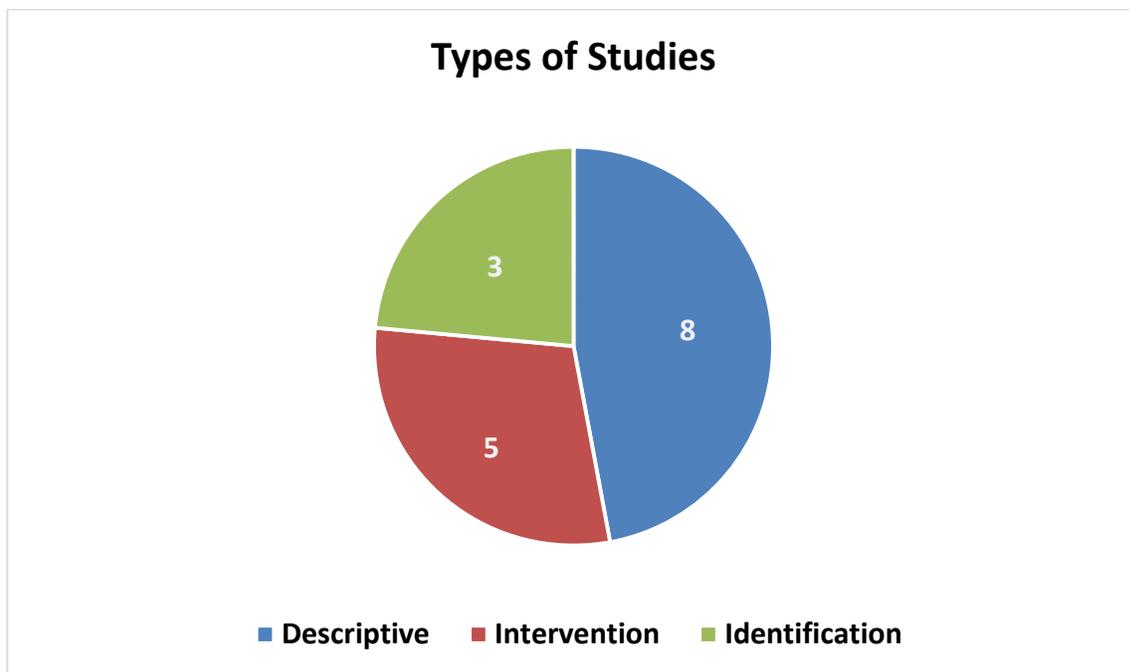
After the above criteria were applied, only 16 research articles remained. The citations, purposes, methods, and results of each article are presented in a spreadsheet and described below. In addition to the research studies carried out and reported in the 16 articles, 11 reviews

of already existing research on DCD and related topics were published between 2012 and 2015. The reviews of the literature are cited below and the two most relevant are summarized.

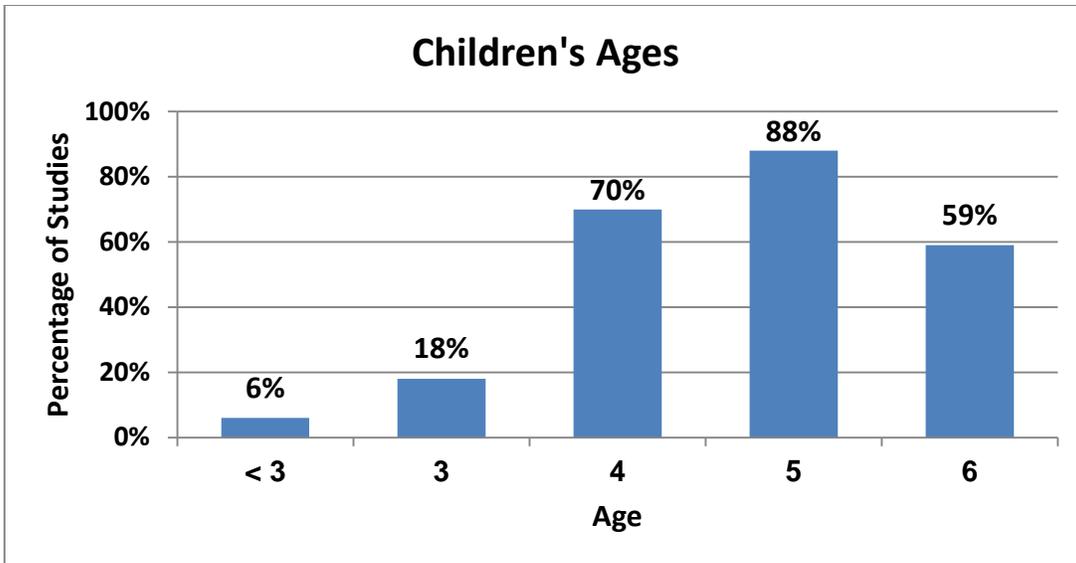
To assess reliability and quality control of the analyses of the articles, a small number of articles were independently reviewed by two or more students during the process of exclusion. Any discrepancies were resolved through group discussion and consensus. Criteria for the analysis of the articles were also established by the group as a whole.

Characteristics of the Research Articles

The figures below depict the general characteristics of the 16 studies of DCD that have been recently published

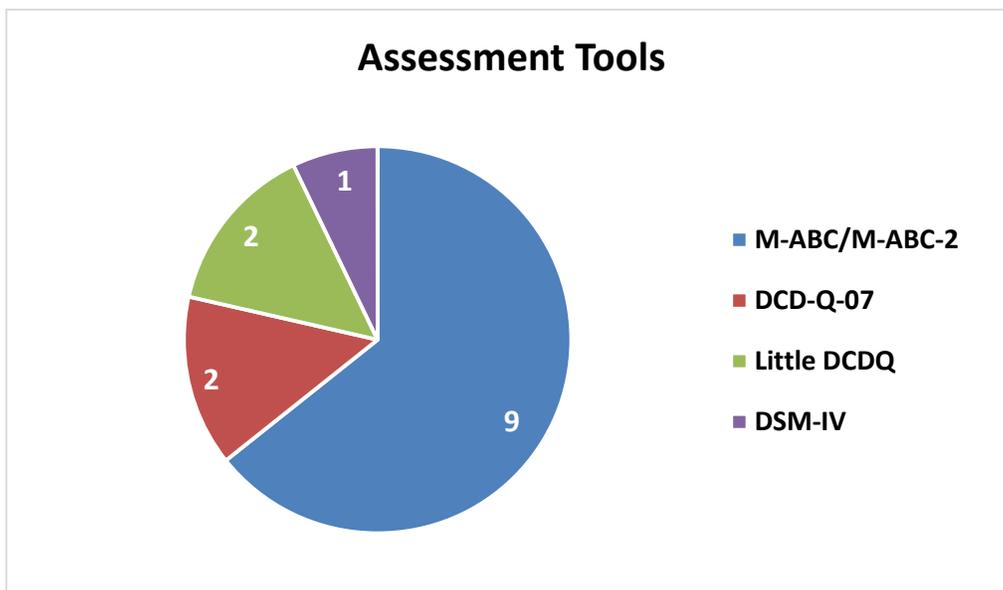


Only 3 of the 16 studies focused on the development and psychometric properties of tests designed for early identification of DCD. Instead the articles merely described typical characteristics and manifestations of the disorder. However, 5 articles went a step further to test the efficacy of DCD treatment interventions for early childhood.

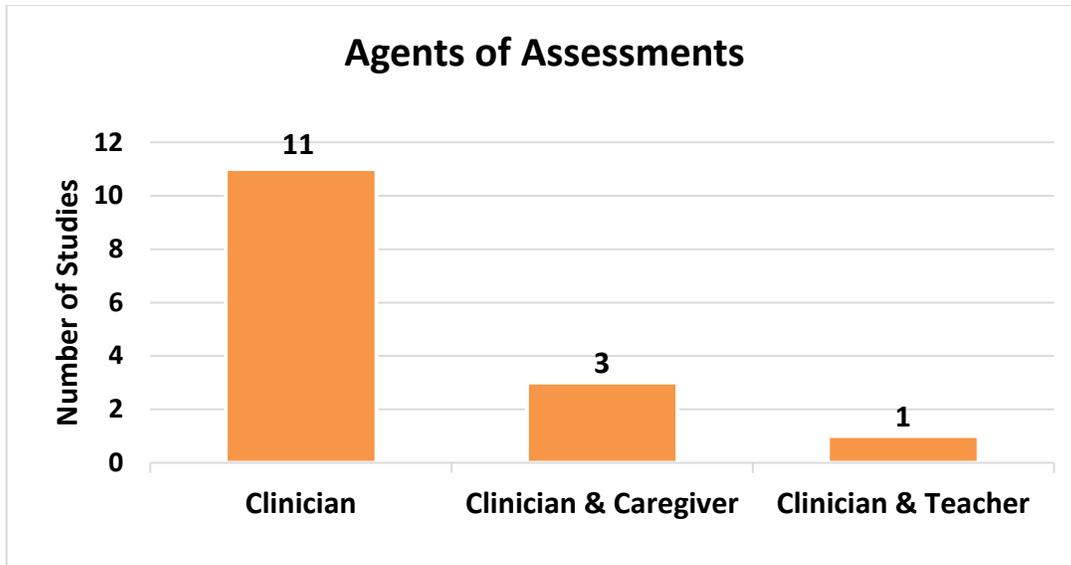


* Some article included more than one age in sample

The children studied in the 16 articles ranged in age from 3-6 years. Many studies included a mix of children of various ages.



The Movement Assessment Battery for Children (M-ABC) and the Movement Assessment Battery for Children 2nd Edition (M-ABC-2) were the most commonly used assessments for categorizing children who participated in these studies.



The majority of DCD assessments were carried out by trained clinicians.

Examples of the Three Types of Studies

Identification/ Assessment:

1. The Little DCDQ (Venter, A. et al.; Wilson, B. N. et al.)
 - Two studies tested the effectiveness of using the Little DCDQ to identify DCD in 3-5-year-old children.
 - Overall, both studies found that the Little DCDQ was reliable and valid when compared with the M-ABC-2.
2. The Developmental Coordination Questionnaire 2007 (DCD-Q-07) (Parmar, A. et al.)
 - In contrast to the Little DCDQ, the DCD-Q-07 showed poor psychometric properties (such as validity and reliability) when trying to diagnose DCD in 4-6 year old children.
 - Thus, the results suggest that the DCD-Q-07 may not be an appropriate screening tool for children below age 6.

Descriptive:

1. Male sex, low birth weight, and low gestational age were significant predictors of DCD. (Zhu, J. L. et al., Zwicker, J. G. et al.).
2. Children with DCD ranked lower overall on language and verbal capacity, and showed both higher externalizing and internalizing behaviors than their typically developing peers. (King-Dowling, S. et al.).

- Children with DCD also show lower performance skills on activities of daily living and a lower sense of coherence, hope, and effort. (Lieberman, L. et al.).

Intervention:

- Virtual reality games such as the SONY PlayStation 2 EyeToy and Growing with Timocco are lower cost and equally as effective as conventional therapy programs in increasing motor performance of young children with DCD. (Ashkenazi, T., Laufer, Y., et al., Ashkenazi, T., Weiss, P. L., et al., Tresser, S. 2012).
- The Lycra Body Suit led to improvements in balance, movement, coordination skills and functional activities for children with DCD. (Rathinam, C. et al.).

Detailed Features of Each Article

Glossary of Abbreviations	
6MWT	6 Minute-Walk Test
BOTMP	Bruininks-Oseretsky Test of Motor Proficiency
CBCL	Child Behaviour Checklist
COPM	Canadian Occupational Performance Measure
CPQ	Child Participation Questionnaire
Das-Naglieri CAS	Das-Naglieri Cognitive Assessment System
DCD-Q	Developmental Coordination Disorder Questionnaire
DCD-Q-07	Developmental Coordination Disorder Questionnaire-2007
DSM-IV	Diagnostic and Statistics Manual, 4th Edition
HRQoL	Health-Related Quality of Life
KBIT-2	Kaufman Brief Intelligence Test, 2nd Edition
KINDL	Revised Children Quality of Life Questionnaire
Little DCDQ	Little Developmental Coordination Disorder Questionnaire
M-ABC	Movement Assessment Battery for Children
M-ABC-2	Movement Assessment Battery for Children, 2nd Edition
pDCD	Probable DCD
PLS-4	Preschool Language Scales, 4th Edition
POS	Play Observation Scale
PSQ	Performance Skills Questionnaire
RKPPS	Revised Knox Preschool Play Scale

Note: Each article is displayed across two consecutive pages.

Citation	What was studied	Study Type						Participants				DCD				
		Identification	Intervention	Descriptive	Comparison		Psychometric	Case Study	Age	Sample Size	Boys	Girls	Diagnosed	Suspected	Not Diagnosed	DCD Diagnostic Tool
					RCT	Non-RCT										
Ashkenazi, T., Weiss, P. L., Orian, D., & Laufer, Y. (2013). Low-cost virtual reality intervention program for children with developmental coordination disorder: A pilot feasibility study. <i>Pediatric Physical Therapy, 25</i> (4), 467-473.	Feasibility of using a low-cost virtual reality game as a DCD intervention.		•			•			4-6	9	•	•		•		• M-ABC-2
Ashkenazi, T., Laufer, Y., Ashkenazi, T., Orian, D., & Weiss, P. L. (2013). Effect of training children with Developmental Coordination Disorders in a virtual environment compared with a conventional environment. <i>International Conference on Virtual Rehabilitation</i> , art. no. 6662075, 46-50.	Conventional media vs. low-cost virtual reality training games.		•			•			4-6	30	•	•		•		• M-ABC-2
Asonitou, K., Koutsouki, D., Kourtessis, T., & Charitou, S. (2012). Motor and cognitive performance differences between children with and without developmental coordination disorder (DCD). <i>Research in Developmental Disabilities, 33</i> (4), 996-1005.	Specific motor and cognitive abilities in children with and without DCD.			•		•			5-6	108	•	•	•	•		• M-ABC

Citation	Outcome Measures	Intervention Details	Admin.			What was found
			Clinician	Primary Caregiver	Teacher	
Ashkenazi, T., Weiss, P. L., Orian, D., & Laufer, Y. (2013). Low-cost virtual reality intervention program for children with developmental coordination disorder: A pilot feasibility study. <i>Pediatric Physical Therapy, 25</i> (4), 467-473.	<ul style="list-style-type: none"> • Motor Skills (DCD-Q-07) • Parents' Reports • Walking and Talking Test • 6MWT 	<p>Virtual Reality Intervention: <u>Sony's Playstation 2 EyeToy</u> A collection of games that entail motor planning, balance, eye-hand coordination, etc.</p>	•			<ul style="list-style-type: none"> • 12 weeks after starting the intervention, there were improvements in M-ABC-2 and DCD-Q scores. • Parents reported that children truly enjoyed the treatment.
Ashkenazi, T., Laufer, Y., Ashkenazi, T., Orian, D., & Weiss, P. L. (2013). Effect of training children with Developmental Coordination Disorders in a virtual environment compared with a conventional environment. <i>International Conference on Virtual Rehabilitation</i> , art. no. 6662075, 46-50.	<ul style="list-style-type: none"> • Motor Skills (DCD-Q-07) • Parents' Reports • Walking and Talking Test • Short Feedback Questionnaire for Children (SFQ-Child) 	<p>Virtual Reality Intervention: <u>Sony's Playstation 2 EyeToy</u> A collection of games that entail motor planning, balance, eye-hand coordination, etc.</p> <p>Conventional Intervention: Games such as basketball and bowling, using typical physiotherapy equipment.</p>	•			<ul style="list-style-type: none"> • 12 weeks after starting the interventions, both groups showed equal improvements in M-ABC-2, DCDQ-07, and Walking and Talking Test scores. • Parents' and children's subjective responses were also positive following the interventions. • Thus, low-cost virtual reality games can be used to expand the current treatment tools.
Asonitou, K., Koutsouki, D., Kourtessis, T., & Charitou, S. (2012). Motor and cognitive performance differences between children with and without developmental coordination disorder (DCD). <i>Research in Developmental Disabilities, 33</i> (4), 996-1005.	<ul style="list-style-type: none"> • Running Speed and Agility (BOTMP) • Cognitive Ability (Das-Naglieri CAS) 		•			<ul style="list-style-type: none"> • Children with DCD showed poorer scores on all relevant motor and cognitive scales (M-ABC), when compared to children without DCD.

Citation	What was studied	Study Type						Participants				DCD				
		Identification	Intervention	Descriptive	Comparison		Psychometric	Case Study	Age	Sample Size	Boys	Girls	Diagnosed	Suspected	Not Diagnosed	DCD Diagnostic Tool
					RCT	Non-RCT										
Kennedy-Behr, A., Rodger, S., & Mickan, S. (2013). A comparison of the play skills of preschool children with and without developmental coordination disorder. <i>OTJR Occupation, Participation and Health</i> , 33(4), 198-208.	Developmental play age and frequency of play in preschool children with and without DCD.			•		•			4-6	63	•	•		•		• M-ABC-2 (German)
Kennedy-Behr, A., Rodger, S., & Mickan, S. (2013). Aggressive interactions during free-play at preschool of children with and without developmental coordination disorder. <i>Research in Developmental Disabilities</i> , 34(9), 2831-2837.	Frequency of victimization and aggression during preschool free-play of children with and without DCD.			•		•			4-6	63	•	•		•		• M-ABC-2 (German)
Kennedy-Behr, A., Rodger, S., & Mickan, S. (2015). Play or hard work: Unpacking well-being at preschool. <i>Research in Developmental Disabilities</i> , 38, 30-38.	Relationship between engagement in play and well-being for preschool children with and without DCD.			•		•			4-6	63	•	•		•		

Citation	Outcome Measures	Intervention Details	Admin.			What was found
			Clinician	Primary Caregiver	Teacher	
Kennedy-Behr, A., Rodger, S., & Mickan, S. (2013). A comparison of the play skills of preschool children with and without developmental coordination disorder. <i>OTJR Occupation, Participation and Health</i> , 33(4), 198-208.	<ul style="list-style-type: none"> • Play Skills (RKPPS) • Free-Play Behaviour (POS) 		•			<ul style="list-style-type: none"> • Children with pDCD: <ul style="list-style-type: none"> • Showed a lower developmental play age and scored lower on 3 of 4 dimensions of the RKPPS. • Had problems with gross motor play, engaged in less group play outdoors and more frequently engaged non-play (POS). • Were found to have negative affect more frequently than typically developing children.
Kennedy-Behr, A., Rodger, S., & Mickan, S. (2013). Aggressive interactions during free-play at preschool of children with and without developmental coordination disorder. <i>Research in Developmental Disabilities</i> , 34(9), 2831-2837.	<ul style="list-style-type: none"> • Free-Play Behaviour (POS) 		•			<ul style="list-style-type: none"> • Children with pDCD: <ul style="list-style-type: none"> • Were more likely to be involved as aggressors and victims. • Were more frequently involved in physical proactive aggression (unprovoked hitting, grabbing, kicking).
Kennedy-Behr, A., Rodger, S., & Mickan, S. (2015). Play or hard work: Unpacking well-being at preschool. <i>Research in Developmental Disabilities</i> , 38, 30-38.	<ul style="list-style-type: none"> • Free-Play Behaviour (POS) • Well-Being (Parent-Proxy version of the KINDL) 		•			<ul style="list-style-type: none"> • Parents of children with pDCD rated their children's well-being at preschool lower than parents of typically developing children. • For children with pDCD, group play was negatively related to well-being.

Citation	What was studied	Study Type						Participants				DCD				
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					RCT	Non-RCT										
Kennedy-Behr, A., Rodger, S., Graham, F., & Mickan, S. (2013). Creating Enabling Environments at Preschool for Children with Developmental Coordination Disorder. <i>Journal of Occupational Therapy, Schools, and Early Intervention</i> , 6(4), 301-313.	Occupational performance coaching (OPC) in combination with a traditional intervention for children with DCD.		•					•	4-5	3	•		•		• M-ABC-2 (German)	
King-Dowling, S., Missiuna, C., Rodriguez, M. C., Greenway, M., & Cairney, J. (2015). Co-occurring motor, language and emotional-behavioral problems in children 3-6years of age. <i>Human Movement Science</i> , 39, 101-108.	If children at risk for motor coordination problems also experience more emotional/behavioural and language difficulties.			•		•			3-6	214	•	•	•		• M-ABC-2	
Liberman, L., Ratzon, N., & Bart, O. (2013). The profile of performance skills and emotional factors in the context of participation among young children with Developmental Coordination Disorder. <i>Research in Developmental Disabilities</i> , 34(1), 87-94.	The relations between participation and senses of coherence, effort, and hope in children with and without DCD.			•		•			5-6	50	•	•	•		• M-ABC-2 • DSM-IV Criteria	

Citation	Outcome Measures	Intervention Details	Admin.			What was found
			Clinician	Primary Caregiver	Teacher	
Kennedy-Behr, A., Rodger, S., Graham, F., & Mickan, S. (2013). Creating Enabling Environments at Preschool for Children with Developmental Coordination Disorder. <i>Journal of Occupational Therapy, Schools, and Early Intervention, 6(4)</i> , 301-313.	<ul style="list-style-type: none"> Occupational Performance (COPM) Play Skills (RKPPS) Free-Play Behaviour (POS) 	<p>Two Part Intervention: <u>OPC with Preschool Teacher</u> Therapists worked with teachers to create a more enabling environment for the child.</p> <p><u>Traditional Intervention</u> Play-based intervention.</p>	•		•	<ul style="list-style-type: none"> 4 weeks after starting the program, there were teacher reported increases in children's performance. Teachers' satisfaction with the children's performance also increased. Children's overall play age increased (RKPPS). Frequency of solitary play decreased, and engagement in group play increased (POS).
King-Dowling, S., Missiuna, C., Rodriguez, M. C., Greenway, M., & Cairney, J. (2015). Co-occurring motor, language and emotional-behavioral problems in children 3-6years of age. <i>Human Movement Science, 39</i> , 101-108.	<ul style="list-style-type: none"> Motor Skills (M-ABC-2) Language Skills (PLS-4) Emotional and Behavioural Functioning (CBCL) 		•			<ul style="list-style-type: none"> Compared to typically developing peers, children at risk of DCD: <ul style="list-style-type: none"> Had lower auditory comprehension and expressive communication. Had higher externalizing behaviour problems, more aggression, withdrawn symptoms, and other negative behaviour.
Liberman, L., Ratzon, N., & Bart, O. (2013). The profile of performance skills and emotional factors in the context of participation among young children with Developmental Coordination Disorder. <i>Research in Developmental Disabilities, 34(1)</i> , 87-94.	<ul style="list-style-type: none"> Activities of Daily Living (CPQ, PSQ) The "Senses" (Children's Sense of Coherence, Hope, and Effort Scales) 		•			<ul style="list-style-type: none"> Children with DCD: <ul style="list-style-type: none"> Had lower performance skills, lower sense of coherence, hope, and effort. Enjoyed their participation less and their parents reported less overall satisfaction. Processing skills rather than motor skills predicted parental satisfaction.

Citation	What was studied	Study Type						Participants				DCD				
		Identification	Intervention	Descriptive	Comparison		Psychometric	Case Study	Age	Sample Size	Boys	Girls	Diagnosed	Suspected	Not Diagnosed	DCD Diagnostic Tool
					RCT	Non-RCT										
Parmar, A., Kwan, M., Rodriguez, C., Missiuna, C., & Cairney, J. (2014). Psychometric properties of the DCD-Q-07 in children ages to 4-6. <i>Research in Developmental Disabilities, 35(2)</i> , 330-339.	Suitability of using a questionnaire based tool (DCD-Q-07) for screening younger children for DCD.	•							4-6	181	•	•		•	•	• M-ABC-2 • DCD-Q-07
Rathinam, C., Bridges, S., Spokes, G., & Green, D. (2013). Effects of lycra body suit orthosis on a child with developmental coordination disorder: A case study. <i>Journal of Prosthetics and Orthotics, 25(1)</i> , 58-61.	A 30 week case study on the effects of Lycra body suit for a child clinically diagnosed with DCD.		•						5	1	•		•			• M-ABC-2
Tresser, S. (2012). Case study: Using a novel virtual reality computer game for occupational therapy intervention. <i>Presence: Teleoperators and Virtual Environments, 21(3)</i> , 359-371.	A 12 week case study evaluating 'Growing with Timocco', a virtual reality computer game treatment for children with motor coordination disorders.		•						5	1	•		•			• M-ABC
Venter, A., Pienaar, A. E., & Coetsee, D. (2015). Suitability of the 'Little DCDQ' for the identification of DCD in a selected group of 3–5-year-old South African children. <i>Early Child Development and Care, in press.</i>	Suitability of using the Little DCDQ for screening younger children for DCD in South Africa.	•							3-5	110	•	•			•	• Little DCDQ • M-ABC-2

Citation	Outcome Measures	Intervention Details	Admin.			What was found
			Clinician	Primary Caregiver	Teacher	
Parmar, A., Kwan, M., Rodriguez, C., Missiuna, C., & Cairney, J. (2014). Psychometric properties of the DCD-Q-07 in children ages to 4-6. <i>Research in Developmental Disabilities, 35(2)</i> , 330-339.	<ul style="list-style-type: none"> Psychometric Properties of the DCD-Q-07: <ul style="list-style-type: none"> Construct Validity Concurrent Validity Reliability, etc. 		•			<ul style="list-style-type: none"> The DCD-Q-07 showed poor psychometric properties for ages 4-6. Therefore, it may not be an appropriate screening tool for preschool aged children.
Rathinam, C., Bridges, S., Spokes, G., & Green, D. (2013). Effects of lycra body suit orthosis on a child with developmental coordination disorder: A case study. <i>Journal of Prosthetics and Orthotics, 25(1)</i> , 58-61.	<ul style="list-style-type: none"> Motor Skills (M-ABC-2) Clinical Observations 	Lycra Body Suit Orthoses (LSBO): The child wore a lycra body suit for 8 hours/day per week, for 12 weeks.	•	•		<ul style="list-style-type: none"> Manual dexterity improved during intervention, but fell sharply after removal. Balance improved with intervention and remained unchanged at follow-up. Increase in throwing/catching ability towards end of intervention, with slight increase post intervention.
Tresser, S. (2012). Case study: Using a novel virtual reality computer game for occupational therapy intervention. <i>Presence: Teleoperators and Virtual Environments, 21(3)</i> , 359-371.	<ul style="list-style-type: none"> Movement Related Data (Number of Errors, Number of Missed Objects, Performance Efficiency) 	Virtual Reality Intervention: <u>Growing with Timocco</u> A monkey named "Timocco" guides children and caregivers through a series of games which have been designed to provide occupational therapy.	•			<ul style="list-style-type: none"> Improvements observed in children's self-esteem, motivation to cope with challenges and maintenance of posture. However, the researchers were unable to conclude if there were improvements in motor skills.
Venter, A., Pienaar, A. E., & Coetzee, D. (2015). Suitability of the 'Little DCDQ' for the identification of DCD in a selected group of 3–5-year-old South African children. <i>Early Child Development and Care, in press.</i>	<ul style="list-style-type: none"> Psychometric Properties of the Little DCDQ (Reliability and Validity) 		•	•		<ul style="list-style-type: none"> Compared to the M-ABC-2, the Little DCDQ showed: <ul style="list-style-type: none"> Good internal consistency Strong reliability (test-retest) Poor sensitivity, but reasonable specificity. Overall, the Little DCDQ is a promising tool.

Citation	What was studied	Study Type						Participants				DCD				
		Identification	Intervention	Descriptive	Comparison		Psychometric	Case Study	Age	Sample Size	Boys	Girls	Diagnosed	Suspected	Not Diagnosed	DCD Diagnostic Tool
					RCT	Non-RCT										
Wilson, B. N., Creighton, D., Crawford, S. G., Heath, J. A., Semple, L., Tan, B., & Hansen, S. (2015). Psychometric properties of the Canadian Little Developmental Coordination Disorder Questionnaire for preschool children. <i>Physical and Occupational Therapy in Pediatrics, 35</i> (2), 116-131.	Suitability of using the Canadian Little DCDQ for screening younger children for DCD.	•						3-4	353	•	•			•	• Canadian Little DCDQ • M-ABC-2	
Zhu, J. L., Olsen, J., & Olesen, A. W. (2012). Risk for developmental coordination disorder correlates with gestational age at birth. <i>Paediatric and Perinatal Epidemiology, 26</i> (6), 572-577.	Correlation between gestational age at birth and the risk of developing DCD.			•				0-7	22, 898	•	•		•	•	• DCD-Q-07	
Zwicker, J. G., Yoon, S. W., MacKay, M., Petrie-Thomas, J., Rogers, M., & Synnes, A. R. (2013). Perinatal and neonatal predictors of developmental coordination disorder in very low birthweight children. <i>Archives of Disease in Childhood, 98</i> (2), 118-122.	Association between perinatal and neonatal risk factors with DCD in a cohort of children with very low birthweight, and to identify DCD in younger children.			•		•		4-5	157	•	•		•		• M-ABC	

Citation	Outcome Measures	Intervention Details	Admin.			What was found
			Clinician	Primary Caregiver	Teacher	
Wilson, B. N., Creighton, D., Crawford, S. G., Heath, J. A., Semple, L., Tan, B., & Hansen, S. (2015). Psychometric properties of the Canadian Little Developmental Coordination Disorder Questionnaire for preschool children. <i>Physical and Occupational Therapy in Pediatrics, 35</i> (2), 116-131.	<ul style="list-style-type: none"> Psychometric Properties of the Little DCDQ (Reliability and Validity) Beery-Buktenica Developmental Test of Visual-Motor Integration 		•	•		<ul style="list-style-type: none"> Compared to the M-ABC-2, the Little DCDQ: <ul style="list-style-type: none"> Had good reliability and validity Effectively distinguished between typically developing and the probable DCD group. Effectively distinguished between 3 and 4 year olds. Thus, the Little DCDQ is a reliable and valid tool for the early screening of DCD.
Zhu, J. L., Olsen, J., & Olesen, A. W. (2012). Risk for developmental coordination disorder correlates with gestational age at birth. <i>Paediatric and Perinatal Epidemiology, 26</i> (6), 572-577.	<ul style="list-style-type: none"> Demographic Data 					<ul style="list-style-type: none"> Birth before gestational week 37 was associated with an increased risk of DCD. A decline in gestational age by a week was associated with a 19% increased risk of DCD screening positive, among children delivered before 40 weeks.
Zwicker, J. G., Yoon, S. W., MacKay, M., Petrie-Thomas, J., Rogers, M., & Synnes, A. R. (2013). Perinatal and neonatal predictors of developmental coordination disorder in very low birthweight children. <i>Archives of Disease in Childhood, 98</i> (2), 118-122.	<ul style="list-style-type: none"> Perinatal Variables: <ul style="list-style-type: none"> Mode of Delivery Gestational Age Birth Weight Postnatal steroid exposure, etc. 		•			<ul style="list-style-type: none"> Male sex, lower birth weight, lower gestational age, and greater postnatal steroid exposure were predictors of DCD. Therefore, male infants born with a lower birth weight should be monitored more closely for the development of DCD.

Two Examples of Literature Reviews

- *Examining the evidence for interventions with children with developmental coordination disorder (Armstrong, D. 2012)*

This paper presented a critical review of 19 articles published from 1984 to 2011. It looked into how effective certain interventions were in improving occupational performance (such as handwriting, dressing, manipulating utensils, etc.) in children with DCD. The review concluded that Cognitive Orientation to Daily Occupational Performance (CO-OP) approach was the most effective.

- The CO-OP approach is a problem solving approach, in which children are facilitated to discover strategies that enable them to achieve three self-selected goals (domain-specific strategies). It is hoped that the children can apply these strategies in a more global manner in the future.

- *Best practice principles for management of children with developmental coordination disorder (DCD): Results of a scoping review. (Camden, C. et al. 2013)*

This paper presented a review of 31 articles published from 2005 to 2012, and analyzed which principles should guide best practice and service delivery for children with DCD. The authors concluded that there is agreement across studies on two service recommendations:

- 1) Organizing services to efficiently meet the comprehensive needs of children with DCD and their families.
 - a. Increasing awareness of DCD and coordination among professional and community groups.
 - b. Implementing clearly defined pathways to ensure access to diagnosis, evaluation, and intervention.
 - c. Using a graduated/staged approach of assessment and intervention to foster capacity building.
- 2) Professionals and families working collaboratively to offer evidence-based integrated services.
 - a. Integration of child and family views in assessment, goal-setting, and intervention.
 - b. Evidence based interventions fostering function, participation and prevention.

Review Article Citations

Reviews of the Literature
<p>1. Armstrong, D. (2012) Examining the evidence for interventions with children with developmental coordination disorder. <i>British Journal of Occupational Therapy</i>, 75 (12), pp. 532-540.</p>
<p>2. Blank, R., Forsberg, H. (2012) European Academy of Childhood Disability (EACD): Recommendations on the definition, diagnosis and intervention of developmental coordination disorder (pocket version) German-Swiss interdisciplinary clinical practice guideline S3-standard according to the Association of the Scientific Medical Societies in Germany. <i>Developmental Medicine and Child Neurology</i>, 54 (11), pp. e1-e7.</p>
<p>3. Cairney, J., Veldhuizen, S. (2013) Is developmental coordination disorder a fundamental cause of inactivity and poor health-related fitness in children? <i>Developmental Medicine and Child Neurology</i>, 55 (SUPPL.4), pp. 55-58.</p>
<p>4. Camden, C., Wilson, B., Kirby, A., Sugden, D., Missiuna, C. (2015) Best practice principles for management of children with developmental coordination disorder (DCD): Results of a scoping review. <i>Child: Care, Health and Development</i>, 41 (1), pp. 147-159.</p>
<p>5. Da Costa, C.S.N., Batistão, M.V., Rocha, N.A.C.F. (2013) Quality and structure of variability in children during motor development: A systematic review. <i>Research in Developmental Disabilities</i>, 34 (9), pp. 2810-2830.</p>
<p>6. Leonard, H.C., Hill, E.L. (2014) Review: The impact of motor development on typical and atypical social cognition and language: A systematic review. <i>Child and Adolescent Mental Health</i>, 19 (3), pp. 163-170.</p>
<p>7. Morgan, R., Long, T. (2012) The effectiveness of occupational therapy for children with developmental coordination disorder: A review of the qualitative literature. <i>British Journal of Occupational Therapy</i>, 75 (1), pp. 10-18.</p>
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<p>9. Peters, L.H.J., Maathuis, C.G.B., Hadders-Algra, M. (2013) Neural correlates of developmental coordination disorder. <i>Developmental Medicine and Child Neurology</i>, 55 (SUPPL.4), pp. 59-64.</p>
<p>10. Smits-Engelsman, B.C.M., Blank, R., Van Der Kaay, A.-C., Mosterd-Van Der Meijs, R., Vlugt-Van Den Brand, E., Polatajko, H.J., Wilson, P.H. (2012) Efficacy of interventions to improve motor performance in children with developmental coordination disorder: A combined systematic review and meta-analysis. <i>Developmental Medicine and Child Neurology</i>. Article in Press.</p>
<p>11. Spittle, A.J., Orton, J. (2014) Cerebral palsy and developmental coordination disorder in children born preterm. <i>Seminars in Fetal and Neonatal Medicine</i>, 19 (2), pp. 84-89.</p>

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