If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

This handout is for reference only. It may not include content identical to the PowerPoint. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.

© 2017 continued.com, LLC. No part of the materials available through the continued.com site may be copied, photocopied, reproduced, translated or reduced to any electronic medium or machine-readable form, in whole or in part, without prior written consent of continued.com, LLC. Any other reproduction in any form without the permission of continued.com, LLC is prohibited. All materials contained on this site are protected by United States copyright law and may not be reproduced, distributed, transmitted, displayed, published or broadcast without the prior written permission of continued.com, LLC. Users must not access or use for any commercial purposes any part of the site or any services or materials available through the site.
Comprehensive Management of Developmental Coordination Disorder

Patti Sharp, OTD, MS, OTR/L
Cincinnati Children’s Hospital Medical Center
Objectives

- List common signs and symptoms of possible DCD, as well as the specific criteria required for a diagnosis for DCD.
- Identify recommended screening tools, assessments, family interview formats, and outcome measures for children with DCD.
- Explain the difference between process-based and task-based interventions and describe evidence-based recommended interventions for DCD.

Background

- CCHMC Top Conditions work
- At CCHMC, we found the greatest variation in care with this population.
Highly under-diagnosed disorder  
5-6% of school aged children (APA, 2013)

Historically ambiguous terminology

Limited continuity and consistency of care

Continues throughout lifespan (Cantell et al., 2003; Cousins & Smyth, 2003)

Presents global health concerns

Significantly impacts perceptions of competence and self-esteem (Cairney et al., 2011; Dewey et al., 2002; Hendrix et al., 2014; Missiuna et al., 2014; Zwicker et al., 2012)

You are likely treating a child with DCD right NOW.
What does it feel like to have DCD?

- Materials: 2 pieces of paper pen, smartphone
- Task: Without viewing your hand, look in the phone and use that image to guide you in drawing a 5-point star or flower the size of a plum

What is it like to have DCD?

- For those with DCD, most tasks feel like novel tasks every time
- The motor plan does not become integrated as it does for typical children
- Imagine tying your shoes... but every day brings a new shoe, new fastening devices, some days you wear gloves, etc.
What do kids with DCD look like?

- Bouncing a ball
  - [http://elearning.canchild.ca/dcd_workshop/sports.html](http://elearning.canchild.ca/dcd_workshop/sports.html)
- Buttoning a shirt
  - [http://elearning.canchild.ca/dcd_workshop/dressing.html](http://elearning.canchild.ca/dcd_workshop/dressing.html)
- Opening a snack
  - [http://elearning.canchild.ca/dcd_workshop/eating.html](http://elearning.canchild.ca/dcd_workshop/eating.html)
- Handwriting
  - [https://www.youtube.com/watch?v=5vUtj84VkJU&feature=youtu.be](https://www.youtube.com/watch?v=5vUtj84VkJU&feature=youtu.be)

Characteristics

- Motor skill delays
- ADL limitations
- School challenges
- Social implications
- Communication issues
- Poor fitness/obesity
ADL limitations

- Difficulty sequencing and completing tasks
- Inability to fasten buttons, zippers, or tie shoes
- Require assistance with cleaning up/getting ready
- Lunch time difficulties
  - coordinating use of utensils
  - frequent spills
  - positioning self at the table
  - carrying a tray

ADL challenges in school

- Fine motor:
  - Issues with handwriting and keyboarding
  - Using scissors, folding paper, completing artwork
  - Opening locker or combination lock
  - Opening lunch items

- Gross motor:
  - Problems keeping up with peers at recess or in gym class
  - Donning/doffing coat and shoes, gym clothes
  - Getting off/on the bus
  - Achieving appropriate posture for circle time, class seating
Handwriting Sample

- Sample of a typical 1st grader
- Sample of a 1st grader with DCD

Motor Delay in DCD

- Developmental Coordination Disorder
  - Body functions Structures
    - motor planning
    - timing
    - sequencing
    - fluidity/control
    - visual perception
  - Activities
    - handwriting/drawing
    - ADLs
    - kicking, catching, throwing, jumping, skipping, etc.
    - Stairs
  - Participation
    - sports
    - group projects/classroom activities
    - playground activities

- Environmental Factors
  - caregiver support
  - equipment/tools
  - school/classroom set-up
  - IEP/504 modifications

- Personal factors
  - age
  - likes/dislikes
  - self-esteem
  - coping mechanisms

(WHO, 1980)
Social implications of DCD

- Social implications:
  - Lower self-esteem
  - Behavioral issues
  - Anxiety and depression
  - Higher levels of frustration

- Communication issues:
  - Verbal and written
  - Receptive and expressive

Physical Implications of DCD

- Tend to avoid physical activity and lead a more sedentary lifestyle than peers without DCD (Cairney et al., 2005)
- Increased risk for obesity and cardiovascular disease (Cairney et al., 2010; Faught et al., 2005)
- Motor difficulties tend to persist into adolescence and adulthood (Cantell et al., 2003; Cousins Smyth, 2003)
Health implications of DCD

Cairney et al., 2011;
Dewey et al., 2002;
Hendrix et al., 2014;
Missiuna et al., 2014;
Zwicker et al., 2012

---

DSM-5 Criteria

A) Impaired planning, learning, and execution of motor skills
B) Impacts various areas of the child's life
C) Onset in the early developmental period
D) Not explained by intellectual disability, visual disturbance, or other neurological diagnosis

All criteria must be met and a diagnosis provided by a physician.
Assessment – Criterion A

The acquisition and execution of coordinated motor skills is substantially below that expected given the individual's chronological age and opportunity for skill learning and use.

- Motor performance tools can identify motor deficiencies, but do not diagnose DCD
- Interpret with caution
- Standardized tests:
  - Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2)
  - Movement Assessment Battery for Children (MABC-2)
MABC-2  
(Henderson, Sugden & Barnett, 2007)

- Age Range: 3y:0m – 16y:11m
- Time to complete: 20-40 minutes
- Content: 8 tasks over the following 3 areas:
  - Manual Dexterity
  - Ball Skills
  - Static & Dynamic Balance
- Recommendations on use for DCD:
  - A score below 16th percentile (or below 5th for ages 3-5) indicates need for intervention, suspect of DCD
  - If a child scores ≤ 5th percentile in one domain but scores >16th percentile in other domains, a DCD diagnosis could be made if other diagnostic criteria are met.

BOT-2  
(Bruininks & Bruininks, 2005)

- Age range 4y:0m-21y:11m
- Time to complete
  - Short Form - 15-20 minutes
  - Complete Form - 45-60 minutes
  - Fine Motor - 25-30 minutes
  - Gross Motor Form - 25-30 minutes
- Content: 8 sections (4 fine motor, 4 gross motor)
  - Fine Motor Precision, Fine Motor Integration, Manual Dexterity, Bilateral Coordination
  - Balance, Running Speed & Agility, Upper-Limb Coordination, Strength
- Recommendations on use for DCD
  - No specified cut-offs
Assessment – Criterion B

The motor skills deficit in Criterion A significantly and persistently interferes with activities of daily living appropriate to chronological age (e.g., self-care and self-maintenance) and impacts academic/school productivity, prevocational and vocational activities, leisure, and play.

- Developmental Coordination Disorder Questionnaire (www.dcdq.ca)
- Movement Assessment Battery for Children - Checklist
- Clinical interview guidelines (Missiuna et al., 2008)
- Listening for DCD Checklist

DCD-Q (Wilson et al. 2009)
& Little DCD-Q (Wilson et al. 2015)

- 15 question parent questionnaire
- Age Range: 5-15y (3-4 for the Little)
- Time to Complete: 10 minutes
- Content: parent rating of skills requiring fine motor, gross motor, and total body coordination
- Scores indicate “suspect DCD” or “probably not DCD”
- Free and online ($50 for the Little)
- DCD-Q (http://dcdq.ca/)
MABC Checklist  (Henderson, Sugden & Barnett, 2007)

- 30 question parent/teacher questionnaire
- Age Range: 5-12y
- Time to Complete: 10 minutes
- Content: Movement in static/predictable environments, movement in dynamic/unpredictable environments, and non-motor factors that might affect movement
- Scores indicate “traffic light” levels of concern for DCD

Clinical Interview Guidelines  
(Missiuna et al., 2008)

- Guidelines give specific examples and probes to gather information to answer the following three questions:
  - What types of activities are difficult for your child (self-care, school, leisure)?
  - Are these difficulties that you have noticed for a while or has anything changed?
  - Has there been a time when you have tried to teach your child something and it has taken longer than you think it should?
Listening for DCD Checklist

- Canchild Listening for DCD Checklist:
  (http://elearning.canchild.ca/dcd_pt_workshop/resources/physiotherapists.html)

Assessment – Criterion C

- Age of onset is early in the developmental period
- Kids begin to show signs 3-5 years, though often not identified until in school
Assessment – Criterion D

- Motor skill deficits are not better explained by intellectual disability, visual impairment, or neurological condition affecting movement.
- Cognitive function does not need to be evaluated by objective measures (e.g., IQ testing) if there is a normal history of school and academic achievements (Blank et al., 2012).

Differential diagnosis

- Genetic (Down’s Syndrome)
- Neurological (CP)
- Degenerative (muscular dystrophy, brain tumors)
- Musculoskeletal (Legg-Perthes, EDS)
- Physical (visual impairment)
- Cognitive (MR, DD)
- Injuries (TBI)
- NOTE: DSM-5 allows for DCD diagnosis in the presence of Autism
Terminology

- Clumsy children have many names
- Often called Developmental Dyspraxia, or just Dyspraxia
- Dyspraxia has multiple definitions, no consensus

Are they synonymous?

- The UK continues to use the term “dyspraxia” largely a political decision) but uses the term synonymously with DCD, e.g., Dyspraxia/DCD (Gibbs et al., 2007).
- DSM-5 lists “childhood dyspraxia” as another term to describe DCD (APA, 2013)
- Some consider dyspraxia a symptom and DCD as one of several possible causes (Baxter, 2012).
- Published DCD guidelines state that “the term dyspraxia has not become recognized as a separate entity or subgroup of DCD” (Blank et al., 2012).
- Dyspraxia should not be considered a medical diagnosis (Gibbs et al., 2007).
History of DCD Terminology

- **1994** An international consensus meeting was held in London, Ontario to adopt the term DCD to describe these children (Polatajko & Missiuna, 1995).
- **2004** Over 50% of all published articles used the term DCD, showing that DCD is gaining acceptance as the preferred terminology to describe these children (Magalhaes et al., 2006).
- **2006** Leeds Consensus Statement: document highlights the agreement of international researchers and clinicians to retain the term DCD and the recognition that DCD is a distinct and unique disorder (Sugden, 2006).

Why use the term DCD?

- “It is clearly helpful for professionals and parents to adopt a single term when describing these children to avoid confusion and to facilitate a consistent understanding of approaches to management and research” (Gibbs et al., 2007).
- **International and multidisciplinary recognition** (Polatajko & Missiuna, 1995; Sugden, 2006; Blank et al., 2012)
- **DCD is in the DSM-5 with established diagnostic criteria** (APA, 2013)
Diagnosis determines approach

Sensory Processing Disorder (SPD)

- Sensory Modulation Disorder (SMO)
- Sensory-Based Motor Disorder (SBMD)
- Sensory Discrimination Disorder (SDD)

Visual
Auditory
Tactile
Taste/Smell
Position/Move
Introspection

Miller et al., 2012

DCD and Sensory Processing

- Sensory processing difficulties are not a core presentation of DCD.
- While some children with DCD may have sensory issues, it is likely these are a result of a co-occurring condition (e.g., ASD).
- Recent study found no association of sensory processing and sensory integration with motor coordination (Allen & Casey, 2017).
- American Academy of Pediatrics states that “sensory processing disorder generally should not be diagnosed” (AAP, 2012).
Recommendation

- While controversy remains, converging evidence suggests that DCD and dyspraxia are synonymous.
- International consensus meetings state that we should use the term DCD.
- We have established diagnostic criteria for DCD and international guidelines for diagnosis, assessment, and intervention.

Comorbidity

- 50% Developmental Coordination Disorder
- 25-30% Speech & Language Difficulties
- Attention Deficit Hyperactivity Disorder
- Learning Disabilities

www.canchild.ca
Predictors of DCD

- Male gender
- Low birth weight  (Holsti et al., 2002)
- Prematurity (<32 weeks gestation)  (Edwards & Zwicker, 2011)
- Post-natal steroid exposure  (Zwicker et al., 2013)

Neuroimaging studies

- Children with DCD activate more and different brain regions than typically developing children when performing a motor task  (Zwicker et al., 2010).
- Children with DCD show under-activation of brain regions associated with motor learning  (Zwicker et al., 2011).
- Children with DCD show different development of sensory and motor pathways  (Zwicker et al., 2012).
But it’s not being diagnosed

- Despite being one of the most common childhood disorders, DCD is often under-recognized and under-diagnosed (Blank et al., 2012).
- Many physicians and pediatricians are unaware of the disorder and/or how to diagnose it (Gaines et al., 2008; Wilson et al., 2013).

Educating others

- What we’ve learned...
- Most challenging
  - Differential diagnosis and terminology
  - Comorbidities vs. exclusion conditions
- Most important
  - Community education
  - Physicians & local medical professionals
  - Schools
  - Parents
Now What?

Intervention

- Levels of Evidence

<table>
<thead>
<tr>
<th>Strength</th>
<th>Level</th>
<th>Design</th>
<th>Randomization</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Level 1</td>
<td>Randomized controlled trial (RCT)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meta-analysis of RCT with homogeneous results</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Level 2</td>
<td>Prospective comparative study (therapeutic)</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Level 3</td>
<td>Retrospective cohort study</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Level 4</td>
<td>Case Series</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Level 5</td>
<td>Case Report</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td>Expert Opinion</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Personal Observation</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Intervention

- “Traffic Light” System
- Novak & McIntyre, 2010
European Academy for Childhood Disability (EACD): Recommendations on the definition, diagnosis and intervention of developmental coordination disorder (long version)*

RAINER BLANK* | BOUVEN SMITS-ENGELSMA† | HELENE POLATAJKO† | PETER WILSON†

1 Kinderkliniek Maastricht and University of Heidelberg, Germany; 2 Department of Biomedical Kinesiology, Catholic University Leuven, Leuven, Belgium and Aarhus University for Professionals, Bedra, the Netherlands; 3 Department of Occupational Science and Occupational Therapy, University of Toronto, Toronto, Canada; 4 Discipline of Psychology, School of Health Sciences, RMIT University, Melbourne, Australia.

- Comprehensive document analyzing best practices for DCD
- Updated version to be published 2018

Green Light Interventions

- Best interventions for DCD start with appropriate functional goal-setting (Blank et al., 2012; Polatajko & Wilson, 2012)

- Recommended goal-setting tools:
  - Canadian Occupational Performance Measure (COPM) (Law, 2014)
  - Goal Attainment Scale (GAS) (Ottenbacher & Cusick, 1990)

- Note: The MABC-2 and BOT-2 are not recommended for goal-setting
Yellow Light Interventions

- Research in this area is starting to grow.
- Best available evidence at this time is not yet strong enough to be considered green-light, but is well-supported enough to make treatment recommendations.

Task-based interventions

- Meta-analysis evidence shows that task-oriented approaches and contemporary motor training offer superior motor performance gains to all other approaches, and should be considered best practice (Smits-Engelsman, et al., 2013).
- Current evidence overwhelmingly supports task-specific interventions as the most effective for children with DCD (Pless-Carlsson, 2000; Polatajko & Cantin, 2006; Hillier, 2007; Smits-Engelsman et al., 2013; Preston et al., 2017).
- This includes motor learning and cognitive strategies.
Process-oriented
- Addresses the body functions required to perform an activity
- Sensory integration, kinesthetic training, perceptual training, strength training, neurofacilitation
- Bottom up approach

Task-oriented
- Addresses the motor task itself
- Can be whole or part training
- Cognitive strategy & problem solving training
- Top down approach
Process-oriented approach:

- Work on putty for proprioception and hand strength, coloring for speed and endurance, Where’s Waldo for visual perception… eventually work on handwriting.

Task-based example: handwriting

- Have the child write, assess where the breakdown in performance is.
- Coach the child through making a goal and plan, then gaining awareness into what went wrong and helping them discover new solutions.
- Work on handwriting the entire time.

Practice makes perfect?

- “Children with DCD lack the required motor problem-solving skills necessary to further improve their performance. Explicit motor teaching with an emphasis on developing these problem-solving skills is a necessary ingredient of intervention in DCD, leveraging the effectiveness of intervention above that of mere practicing,” (Schoemaker & Smits-Engelsman, 2015).
Task Oriented Training

Three primary interventions in the literature:
- Neuromotor Task Training
- Cognitive Orientation to Occupational Performance (CO-OP)
- Motor Imagery

CO-OP

- Cognitive Orientation to Occupational Performance (Polatajko & Mandich 2004, Missiuna 2001)

  “A client-centered, performance-based, problem solving approach that enables skill acquisition through a process of strategy use and guided discovery,” (Polatajko & Mandich, 2004).

- CO-OP leads to generation of more effective strategies than any combination of neurodevelopmental, multisensory, biomechanical, functional, SI, and fine and gross motor approaches (Blank et al., 2012).
Motor Learning Theory
(Fitts & Posner, 1967; Magill, 1998)

1. Cognitive Stage
   - Thinking guides behavior
   - Getting the general idea of the movement
   - Reflection on prior knowledge
   - Attention to gaining new information

2. Associative Stage
   - Gaining accuracy of movement
   - Using feedback to correct movement

3. Autonomous Stage
   - Skill is performed fluently and automatically

Learning Continuum

- Stimulus-Response
- Reinforcement
- Minimal cognitive processing
- Errorless Learning
- Repetitive Task Training
- No transfer

- Trial & Error
- High cognitive processing
- Strategy training
- Potential to transfer
CO-OP

Goals of CO-OP:
1. Skill acquisition
2. Strategy use
3. Generalization to other settings
4. Transfer to other tasks

- The client’s goals are really a means to an end, which is effective use of metacognitive strategies.
- The real goal of CO-OP is proficient use of strategies.

CO-OP

Pre-requisites – Client
• Ability to identify goals
• Sufficient language
• Basic cognitive ability
• Behavioral responsiveness
• Basic awareness

Pre-requisites – Therapist
• Client-centered
• Understanding of disability per ICF participation level)
• Effective communication
• Activity analysis
• Learning theory
CO-OP: Strategy use

Global strategy:
- Goal
- Plan
- Do
- Check
- Skill Acquisition

Domain specific strategies:
- body position
- attention to task
- task modification
- knowledge supplementation
- feeling the movement
- verbal mnemonics
- scripting

CO-OP: Guided Discovery

- A means of providing both instruction and feedback
- Encourages learner to problem solve independently
- Guided by knowledgeable instructor who provides coaching and hints

- Basic premise is that meaningful learning occurs when the learner makes sense of material by
  - selecting relevant information
  - organizes it
  - integrates it into other organized knowledge (Mayer 2004)
CO-OP: Guided discovery

- One thing at a time
- Ask, don’t tell
- Coach, don’t adjust
- Make it obvious

Let’s see CO-OP in action!

- 1) Shoe-tying with 7yo girl diagnosed with DCD and ADHD
- 2) Handwriting with 6yo girl diagnosed with DCD
Once upon a time there was a beautiful girl named Susie. She was so smart that her words were so precise.
Neuromotor Task Training: NTT

- Combination of theories
- Motor learning theory:
  - Task structure
  - Repetition
  - Ecological theory:
    - The task and environment can be modified
  - Assessing the interaction between the child, the task, and the environment

NTT

- Tailored to the child because it uses neuromotor assessment - task analysis
- Steps:
  - Determine the child’s goal
  - Perform task analysis
  - Identify barriers
  - Adapt the task/environment
  - Train to overcome barriers & promote learning
- Consider types and frequency of feedback provided
Motor Imagery

Mental rehearsal of a skill without the motor component
- Can be used in a group setting
- Use of videos to assist with problem solving and preparation
- Keying them into thinking about how the activity feels

Adaptation Techniques - M.A.T.C.H.
- **Modify** task – size of the tool, time to complete, technology use
- **Alter** expectations – consider the ultimate goal, be flexible
- **Teach** strategies – break down the task, give clues to problem solve
- **Change** the environment – noise, visual distractions, furniture, tools
- **Help** by understanding – educate others, emphasize successes
Red light interventions

- Process-oriented approaches (SI and kinesthetic training) only provide a weak treatment effect, similar to no treatment at all, and are therefore no longer recommended (Novak, 2013).
- Several systematic reviews have reported that sensory integration and kinesthetic training are not effective for children with DCD (Pless & Carlsson, 2000; Polatajko & Cantin, 2006; Smits-Engelsman et al., 2013).

Treatment

- No evidence supporting an intensive model
- Task-oriented strategies have been used in group and camp models
- Several successful CO-OP studies were completed using weekly 1-hour outpatient sessions for 10 weeks
- Episodic care has been successful at CCHMC
  - Increases participation in HEP
  - Improves child & parent accountability
  - Helps to prioritize goals
  - Decreases no-shows and cancellations
Outcome measures

- Track progress on child-centered, functional goals with the COPM and/or GAS
- While the MABC-2 and BOT-2 can help identify motor deficiencies to assist with identification and diagnosis of DCD, they are neither sensitive enough to change nor goal-focused enough to be useful to children with DCD.

Take home message

- You are probably treating kids with DCD right now, though they likely do not have a formal DCD diagnosis.
- Screen for DCD and determine functional impact with the DCD-Q or MABC Checklist.
- Assess motor performance with the MABC or BOT-2.
- Set child-centered, functional goals and track outcomes with the COPM or GAS.
- Treat with task-oriented approaches, like CO-OP & NTT to improve motor performance in functional skills.
- Use M.A.T.C.H. strategies to improve functional participation immediately.
- Educate parents, teachers, colleagues, and physicians (CanChild is a great resource).
Please stay in touch!

Patricia.Sharp@cchmc.org

Discussion

Questions?