Program & Abstracts
WELCOME to
DCDVIII International Conference, 2009

It is our great pleasure to welcome you to the 8th International Conference on Developmental Coordination Disorder held in Baltimore, MD, USA. The Departments of Physical Therapy and Rehabilitation Science, University of Maryland, Baltimore and Kinesiology, University of Maryland, College Park are proud to co-host this event which is held in the School of Medicine’s teaching facility. We are particularly honored to be the first US site for the conference and hope that this event will spur more research on, and recognition of, Developmental Coordination Disorder (DCD) in this country. Given that there are over 140 registrants from 20 countries we trust that the interactions during the conference will foster research agendas and broaden collaborations as we all strive for a greater understanding of DCD.

The conference is organized over three days which broadly reflect the following topics:

- Mechanisms that underlie poor coordination/control
- Diagnosis, assessment and characteristics including co-morbidity
- Intervention and other issues such as Genomics and Physical activity

We have included some parallel sessions to provide alternatives as well as to accommodate more verbal talks. We have advertised the 3rd day as a parent/professional day and therefore expect a few more people on that day who are interested in what we can say about how to treat this population. We are fortunate to have solicited an outstanding set of distinguished keynote speakers. Drs Peter Wilson, Reint Geuze, Jan Piek and Cheryl Missiuna will give talks as experts within the field, Drs Stewart Mostofsky, a pediatric neurologist with expertise on developmental disorders in general and ADHD in particular and Maureen Weiss, an expert in children’s psychological well-being as it relates to physical activity will give keynote talks as experts from related fields. In addition, a new feature of the conference, are tutorials from Dr Jeffrey Harring on new ways to analyze repeated measures data and from Dr. Stephen Roth on genomics. Another new feature is the Collaborative Café where participants can self-organize into small break-out groups to discuss topics of mutual interest. In addition, there are 73 posters and 51 verbal presentations.

We would like to thank the local organizing committee, the scientific committee and our sponsors for helping us to put on this event.

Finally, we hope that you enjoy the city of Baltimore which is rich in history and has many cultural and ethnic neighborhoods to enjoy. We are fortunate to hold our banquet in the historic Westminster Hall where, in addition to excellent food, the docents will take you to the catacombs! Please enjoy the conference and make new friends and colleagues.

Jane E. Clark      Jill Whitall      Marcio Oliveira      Conference Convenors
**Organizing Committee:**

Jane E. Clark, Ph.D.
Department of Kinesiology
University of Maryland, College Park.

Jill Whitall, Ph.D.
Department of Physical Therapy and Rehabilitation Science
University of Maryland, Baltimore.

Marcio A. Oliveira, Ph.D.
Department of Kinesiology
University of Maryland, College Park.

Melissa Pangelinan
Department of Kinesiology
University of Maryland, College Park.

Karen Sack
Department of Physical Therapy and Rehabilitation Science
University of Maryland, Baltimore.

Angel Jackson
Department of Physical Therapy and Rehabilitation Science
University of Maryland, Baltimore

Marlene King
Department of Physical Therapy and Rehabilitation Science
University of Maryland, Baltimore

Terry Heron
Department of Physical Therapy and Rehabilitation Science
University of Maryland, Baltimore

Alison Nagle
Conference & Visitor Services
University of Maryland, College Park
Scientific Committee

Anna Barnett, Ph.D.
Department of Psychology
Oxford Brookes University (UK)

Mary Chambers, Ph.D.
School of Education
University of Leeds (UK)

Deborah Dewey, Ph.D.
Department of Pediatrics
University of Calgary (CA)

Reint Geuze, Ph.D.
Clinical and Developmental Neuropsychology
University of Groningen (NL)

Cheryl Missiuna, Ph.D.
School of Rehabilitation Science
McMaster University (CA)

Motohide Miyahara, Ph.D.
School of Physical Education
University of Otaga (NZ)

Jan Piek, Ph.D.
School of Psychology
Curtin University of Technology (AU)

Michael Wade, Ph.D.
School of Kinesiology
University of Minnesota (USA)

Helene Polatajko, Ph.D.
Department of Occupational Therapy
University of Toronto (CA)

Bowien Smits-Engelsman, Ph.D.
Motor Control Laboratory
Katholieke Universiteit, Leuven (Belgium)

Peter Wilson, Ph.D.
Division of Psychology
RMIT University (AU)

Stephania Zoia, Ph.D.
Department of Pediatrics
University of Trieste (IT)

Local organizing staff:

Woei-Nan Bair
Kristin Cipriani
Yue Du
Cintia Freitas
Brad King
Courtney Filippi
Robyne Rivers
Priya Viswanathan
General Information

Venue:
DCD VIII will be held on the campus of the University of Maryland, Baltimore in the School of Medicine [building #24 Medical School Teaching Facility (MSTF), 685 W. Baltimore St., Baltimore, MD 21201] and jointly organized by the Department of Physical Therapy and Rehabilitation Science, University of Maryland, Baltimore and the Department of Kinesiology, University of Maryland, College Park.

Admission to Sessions:
All delegates are requested to wear their name badges to all sessions and functions.

Registration and Accommodation
Any queries regarding registration or accommodation should be directed to the registration desk. The registration desk will be open during the conference to assist you with any administrative matters.

Audio-visual Equipment
All Power-Point files should be loaded in the break before the sessions begin on the morning of your presentation. If you need any assistance with audio-visual equipment, please contact the registration desk.

Poster Session
Posters need to be put up before the coffee break in the morning. This will enable delegates to take their time and browse the posters during the break sessions. However, presenters are only expected to be at their poster during the formally scheduled poster session. Please ensure that posters are taken down immediately after the close of proceedings each day.
Hosts

Sponsors

Chesapeake ADHD Center of Maryland
Specializing in Attention and Learning Disorders

Kennedy Krieger Institute

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Conference Banquet

On Friday night, a special conference banquet is planned at the historic Westminster Hall. Adjoining the Hall is the Westminster Burying Ground, one of Baltimore’s oldest cemeteries, an amazing survivor of the old city and the burial place of Edgar Allan Poe, one of America’s great authors. Before dinner, a docent will take groups on a tour of the grounds and discuss the significance of the property and the story of Poe’s life and death.

The historic Westminster Hall is one of the area’s most intriguing architectural landmarks; a converted Gothic church built on arches above Westminster Burying Ground, creating catacombs.

Edgar Allan Poe and his young wife found their final resting place within Westminster Burying Ground, as did several early mayors of Baltimore, heroes of the American Revolution and members of the city’s elite.
**DCD VIII – Program**

**Tuesday June 23, 2009**

<table>
<thead>
<tr>
<th>5:00-6:30pm</th>
<th>Registration open</th>
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<tr>
<td>6:00-8:00pm</td>
<td>Welcome Reception</td>
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**Wednesday June 24, 2009**

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<tr>
<th>8:00-8:30am</th>
<th>Registration</th>
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<tr>
<td>8:30-8:50am</td>
<td>Welcome to DCDVIII – opening remarks</td>
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<td>University of Maryland School of Medicine Associate Dean Bruce Jarrell</td>
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<td>Conference Organizers: Jane Clark &amp; Jill Whitall</td>
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<tr>
<td>8:50-10:00am</td>
<td>Keynote Speaker - Peter H. Wilson (RMIT University)</td>
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<td></td>
<td>The development of online motor control in children and the interdependence of thought and action</td>
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<td>Introduced by Jane Clark (University of Maryland, College Park)</td>
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**Papers presentation - Neural Correlates**  
**Moderator: Ann Smiley-Oyen (Iowa State University)**

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<thead>
<tr>
<th>10:00-10:20am</th>
<th>Motor learning of children with Developmental Coordination Disorder: An fMRI study</th>
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<tr>
<td>10:20-10:40am</td>
<td>Electroencephalographic resting state networks in children with DCD</td>
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<tr>
<td></td>
<td>Oliveira, M.A., Vagts, C., Pangelinan, M.M. &amp; Contreras-Vidal, J. L.</td>
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<tr>
<td>10:40-11:00am</td>
<td>Differences in electrocortical activity during movement planning in children with DCD</td>
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<td>Pangelinan, M., Hatfield, B. &amp; Clark, J.</td>
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**Coffee Break**

**Papers presentation A – Cognitive Correlates**  
**Moderator: Jere Gallagher (University of Pittsburgh)**

<table>
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<tr>
<th>11:20-11:40am</th>
<th>Steering control and looming detection in young adults with DCD</th>
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<tr>
<td></td>
<td>de Oliveira, R.F., Purcell, C., Poulter, D., Wilmut, K. &amp; Wann, J.</td>
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<tr>
<td>11:40-12:00pm</td>
<td>Understanding executive function skills in relation to movement in children diagnosed with DCD</td>
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<td>Pratt, M. &amp; Hill, E.</td>
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<td>12:00-12:20pm</td>
<td>Do patterns of performance of motor imagery tasks differ between children with Developmental Coordination Disorder and Cerebral Palsy?</td>
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<td></td>
<td>Williams, J., Reddihough, D., Anderson, V. &amp; Reid, S.</td>
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</table>

**Papers presentation B - Epidemiology**  
**Moderator: John Cairney (McMaster University)**

<table>
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<tr>
<th>11:20-11:40am</th>
<th>Prevalence of Developmental Coordination Disorder using DSM IV: a UK study</th>
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<td></td>
<td>Lingam, R., Hunt, L., Golding, J., Jongmans, M. &amp; Emond, A.</td>
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<tr>
<td>11:40-12:00pm</td>
<td>Poor motor coordination: A growing problem or a sign of the times?</td>
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<td>Williams, M., Saunders, J. &amp; Wilson, C.</td>
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<tr>
<td>12:00-12:20pm</td>
<td>Epidemiology of co-occurrence of DCD and other developmental disabilities</td>
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<td>Van Waelvelde, H., Vandervsvalmen, R., Van Vreckem, C., Pieters, S. &amp; Desoete, A.</td>
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**Lunch**

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<tr>
<th>1:30-2:40pm</th>
<th>Keynote Speaker - Reint H. Geuze (University of Groningen)</th>
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<tr>
<td></td>
<td>A developmental approach to Developmental Coordination Disorder</td>
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<td>Introduced by Marcio Oliveira (University of Maryland, College Park)</td>
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**Papers presentation A - Sensory-motor Integration**  
**Moderator: Brad King (University of Maryland, College Park)**

<table>
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<tr>
<th>2:40-3:00pm</th>
<th>On-line motor adaptation in children with Developmental Coordination Disorder (DCD): Double-step perturbation performance</th>
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<tr>
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<td>Hyde, C. &amp; Wilson, P.H.</td>
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<tr>
<td>3:00-3:20pm</td>
<td>Do children with DCD evidence a proprioceptive deficit in visual capture of felt limb position?</td>
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<td>Bremer, A.J., Pratt, M., Spence, C. &amp; Hill, E.L.</td>
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<tr>
<td>3:20-3:40pm</td>
<td>Visual processing and motor deficits in children with DCD: 10 years later</td>
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<td>Cantin, N. &amp; Polatakajo, H.</td>
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**Papers presentation B – Physiological Correlates**  
**Moderator: Kristin Cipriani (University of Maryland, College Park)**

<table>
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<tr>
<th>2:40-3:00pm</th>
<th>Should we measure muscle strength in children with DCD: An exploratory study into the relationship between strength and motor skills</th>
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<tr>
<td></td>
<td>Smits-Engelsman, B.C.M., Verhoef-Aertssen &amp; W.F.M. van Uden, E.</td>
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<tr>
<td>3:00-3:20pm</td>
<td>Limits to cardio-respiratory exercise performance in DCD: A pilot study</td>
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<td>Morris, M., Barnett, A., Dawes, H., Wilmut &amp; K. Howells, K.</td>
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<td>3:20-3:40pm</td>
<td>The relationship between aerobic fitness and perceived adequacy in children with Developmental Coordination Disorder</td>
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<tr>
<td>3:40-4:00pm</td>
<td>Coffee Break</td>
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<tr>
<td>4:40-5:00pm</td>
<td>Postural control during sit-to-stand in children with and without Developmental Co-ordination Disorder Plumb, M.</td>
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<tr>
<td>5:00-6:30pm</td>
<td>Paper presentation – Posters (Courtney Fillipi &amp; Robyne Rivers)</td>
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<tr>
<td>1</td>
<td>Single error analysis of representational gestural production in different sample of children with DCD Sinani, C. Sugden, D.</td>
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<td>2</td>
<td>Do task complexity and type of scoring influence the performance in DCD children? Insights from unimanual and bimanual hand postures Sinani, C. Sugden, D.</td>
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<td>3</td>
<td>Examining an underlying problem for children with DCD - Forming an action representation Gabbard, C. Cordova, A.</td>
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<td>4</td>
<td>Dynamic touch in typically developing children and children with DCD Sugden, D. Kirby, A. Edwards, L.</td>
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<td>5</td>
<td>Automatic attention orienting by social cues in children with Developmental Coordination Disorder Wang, C.H. Tsai, C.L.</td>
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<td>6</td>
<td>What reaching movements can tell us about children with DCD Skabar, A. Zoia, S. Biancotto, M. Blason, L. Castiello, U.</td>
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<tr>
<td>7</td>
<td>Kinematic analysis tool for the evaluation of treatment effectiveness in children with handwriting disorders Accardo, A. Chiap, A. Borean, M. Bravar, L. Zoia, S.</td>
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<td>8</td>
<td>The effectiveness of exercise intervention on inhibitory response capacity in children with Developmental Coordination Disorder Tsai, C.L. Wang, C.H.</td>
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<td>9</td>
<td>Tentative proposals towards a framework for understanding DCD Hill, E.L. Morton, J.</td>
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<td>10</td>
<td>Effects of prenatal testosterone on lateralization in children Lust, J.M. Geuze, R.H. Groothuis, T. Van de Beek, C. Cohen-Kettenis, P. Bouma, A.</td>
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<td>12</td>
<td>Rhythmic bimanual performance in children with Developmental Coordination Disorder Bobish, T. Smiley-Oyen, A. Gallagher, J.</td>
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<td>13</td>
<td>Coordination differences in jumping: A contribution to the identification of DCD subgroups Williams, M. Saunders, J. Wilson, C. Maschette, W.</td>
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<tr>
<td>14</td>
<td>Postural constraints on mental rotation in children with DCD Deconinck, F.J.A. Spitaels, L. Fias, W. Lenoir, M.</td>
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<tr>
<td>15</td>
<td>Strategy use during motor learning in children with Developmental Coordination Disorder Henze, M. Lumagne, M. Cantin, N. Polatajko, H.</td>
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</tbody>
</table>
16 Guided discovery of cognitive strategies: Impact on motor skill acquisition in children with Developmental Coordination Disorder
Lumague, M. Henze, M. Cantin, N. Polatajko, H.

17 The attentional brain network and motor preparation in adults with Developmental Coordination Disorder: An EEG study
Brown, D. Velzen, J.V. & Hill, E.

18 Bimanual coordination dynamics in children with Developmental Coordination Disorder
Chung, H.C. Kagerer, F.A.

19 Development of neuromuscular and temporal control in upper limb coordination
Traynor, R. Galea, V.

20 Motor preparation and execution in an aiming task in children with Developmental Coordination Disorder
Gama, D.T. Hiraga, C.Y. Pellegrini, A.M.

21 Control of sequential actions in children with DCD
Viswanathan, P. Whitall, J.

22 Performance in a simple rhythmic task improves relative to age in children with developmental coordination disorder (DCD)
Roche, R. Viswanathan, P. Whitall, J.

23 Multilimb coordination pattern of clapping and jumping in children with Developmental Coordination Disorder
Ferraccioli, M.C. Pellegrini, A.M.

24 Investigating Heterogeneity in children with Developmental Coordination Disorder during sensorimotor adaptation: The use of a Random Coefficient Model
King, B.R. Kagerer, F.A. Harring, J.R. & Clark, J.E.

25 Decreased motor cortical excitability in Developmental Coordination Disorder: A TMS pilot study
Kagerer F.A. Whitall, J.

26 Finger independency and visual force control in children with Developmental Coordination Disorder (DCD)
Du, Y. Hsu, J. Shim, J.K. Clark, J.E. & Oliveira, M.A.

27 Sleep behaviour in children with Developmental Coordination Disorder: An exploratory study
Barnett, A. Wiggs, L. Keating, A.

Thursday June 25, 2009

8:30-9:40am Keynote Speaker - Jan P. Piek (Curtin University of Technology)
The social-emotional implications for children with Developmental Coordination Disorder
Introduced by Jill Whitall (University of Maryland, Baltimore)

9:40-10:50am Tutorial - Jeffrey R. Harring (University of Maryland, College Park)
Developing a Random Coefficient Model for analyzing repeated measures data
Introduced by Brad King (University of Maryland, College Park)

9:40-10:50am Collaborative Café

10:50-11:00am Coffee Break

Papers presentation – MABC 2nd edition Moderator: Kathryn Levit (University of Maryland, College Park)

11:00-11:20am Validity of the Movement ABC Test - Second Edition
Barnett, A., Henderson, S., Sugden, D. & Schulz, J.

11:20-11:40am Factor analytical validation of the Movement Assessment Battery for Children - Second edition
van Waalvelde, H., Peersman, W., Debrabant J. & Smits-Engelsman, B.C.M.

11:40-12:00pm Becoming motor delayed as a birthday present?
Smits-Engelsman, B.C.M., van Alphen D & Niemeijer, A.

12:00-12:20pm Reliability of the outcomes of the Movement Assessment Battery for Children, second edition (MABC-2): Are 3-year-old children ready for formal testing?
Smits-Engelsman, B.C.M., Niemeijer, A. & Van Waalvelde, H.

12:30 – 1:30pm Lunch
1:30-2:40pm  Keynote Speaker - **Stewart Mostofsky** (Johns Hopkins University)
Mirror Overflow: A reflection of the association between ADHD and DCD
Introduced by Marcio Oliveira (University of Maryland, College Park)

**Papers presentation A - Co-morbidity**  Moderator: Marina Shoemaker (University of Groningen)

2:40-3:00pm  The impact of attention on motor performance of children with co-morbidity of DCD and ADHD
**Bart, O., Podoli, T. & Bar-Haim, Y.**

3:00-3:20pm  Visual-perceptual and perceptual-motor skills in children with Developmental Coordination Disorder and/or Mathematical Learning Disabilities
**Pieters, S., Desoete, A., Vanderswalmen, R., Roeyers, H. & Van Waelvelde, H.**

3:20-3:40pm  DCD and associated developmental traits: more than just an IQ
**Lingam, R., Golding, J., Jongmans, M., Hunt, L. & Emond, A.**

**Papers presentation B – Cognitive Strategies**  Moderator: Dido Green (Newcomen Centre, Guy's & St. Thomas NHS)

2:40-3:00pm  Cognitive strategy use of children with DCD during ball throwing/catching and wrapping up a parcel
**Volman, M., Verkaik, M. & de Kloet, A.**

3:00-3:20pm  Inattention and in air time: Handwriting is not just a motor task
**Kirby, A., Woodward, A. & Jackson, S.**

3:20-3:40pm  Children with Disorganization: A unique subgroup of children diagnosed with Developmental Coordination Disorder (DCD)
**Lifshitz, N., Josman, N. & Tiros, E.**

3:40-4:00pm  Coffee Break

**Papers presentation A – Characterization**  Moderator: Lisa Rivard (McMaster University)

4:00-4:20pm  Psychometric properties of the little DCDQ
**Rihtman, T., Parush, S. & Wilson, B.N.**

4:20-4:40pm  Incremental Validity of Instruments for the Identification and Assessment of DCD
**Wilson, B., Green, D., Schoemaker, M. & Crawford, S.**

4:40-5:00pm  DCD: Not just a motor learning difficulty - but specific type of learning 'disability'
**Kamps, P.**

**Papers presentation B – Handwriting**  Moderator: Frederik Deconinck (Manchester Metropolitan University)

4:00-4:20pm  Development and standardization of a new handwriting speed test: the DASH
**Barnett, A., Henderson, S., Scheib, B. & Schulz, J.**

4:20-4:40pm  SOS: a screening instrument for graphomotor writing disorders
**Van Waelvelde, H., Peersman, W. & Smits-Engelsman, B.C.M.**

4:40-5:00pm  Handwriting disorders: Profiles of children with DCD compared to other profiles, with and without co-morbidity
**Borean, M., Zoia, S., Bravar, L., Paciulli, G. & Skabar, A.**

5:00-6:30pm  Papers presentation Posters (Courtney Fillipi & Robyne Rivers)

6:30 – 7:30pm  ISR-DCD Meeting – International Society for Research into DCD
9 Development of a motor skill checklist for 3- to 5-year-old children
Debrabant, J., Peersman, W., Van Waelvelde, H.

10 Cross-cultural adaptation of the Developmental Coordination Disorder Questionnaire 2007 (DCDQ’07) for Japanese children
Nakai, A., Yoshizawa, M., Kawatani, M., Wilson, B.N.

11 Prevalence of Developmental Coordination Disorder in Taiwanese 9- to 12-year-old aboriginal children
Wu, S.Y., Wu, S.K.

12 Relationships between DCD, learning related difficulties and ADHD among 6 -7 year old school children
Pienaar, A., Peens, A., Wessels, Y.

13 Overlapping cognitive-behavioural profiles in children diagnosed with DCD and children diagnosed with autism
Pratt, M., Hill, E.

14 Development of the DCDDaily: An instrument for the assessment of activities of daily living for children with DCD

15 Body Mass Index and performance on the Movement Assessment Battery for Children
Wilson, C., Saunders, J., Williams, M.

16 The development of the Japanese version of the Motor Observation Questionnaire for Teachers (MOQ-T)
Nakai, A., Yoshizawa, M., Kawatani, M., Schoemaker, M.M.

17 How am I doing, a new pictorial scale for perceived motor competence for children aged 6 to 12 years
Volman, M., Gijzen, R., Calame, E., Reinders, H., De Kloet, A.

18 The effects of attention on motor screening and testing
Wilson, B., Crawford, S., Green, D.

19 Description of motor, attention, and intellectual characteristics in a population-based sample of children screened for motor impairment
Cairney, J., Missiuna, C., Pollock, N., Cousins, M., Schmidt, L.

20 Developmental Coordination Disorder and its academic implications
Rigoli, D., Piek, J.P., Davis, M., Barrett, N., Oosterlaan, J.

21 Comparing the short form of the Bruininks-Oseretsky Test of Motor Proficiency and the Movement-ABC in a school-based setting
Spironello, C., Cairney, J., John, H., Veldhuizen, S., Faught, B.

22 Further validation of the DCDQ for Brazilian children
Magalhães, L.C., Lousada, T.M., Ruggio, C.B., Araújo, C.R.S.

23 Performance on specific motor tasks in children with DCD with or without comorbid ADHD
Veldhuizen, S., Missiuna, C., Cairney, J., Pollock, N., Cousins, M.

24 Using the perceived efficacy and goal setting system pegs with Brazilian children with and without motor disabilities: Strengths and limitations
Magalhães, L.C., Ruggio, C.B., Castro, M.L.D., Chimeli, J.V., Takenaka, I.M.

25 Are intelligence and motor performance related? Comparison of the K-ABC and the MABC-2
Reinders-Messelink, H., Evers, M., Faber, I., Niemeijer, A., Smits-Engelsman, B.

26 Critical motor skills forming nursery school teacher’s impression of preschooler’s motor difficulties
Shibuya, I., Kawanabe, T.

27 Developmental Coordination Disorder: Can one rely on parent information?
Wills Floet, A.M., Viswanathan, P., Roche, R., Clark, J.E., Whitall, J.

Friday June 26, 2009

8:30-9:40am Keynote Speaker - Cheryl Missiuna (McMaster University)
Partnersing for Change
Introduced by Jill Whitall (University of Maryland, Baltimore)
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<tr>
<td>9:40-10:50am</td>
<td>Tutorial - <strong>Stephen M. Roth</strong> (University of Maryland, College Park)</td>
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<td>Genomics 101: An introduction and implications for DCD</td>
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<td>Introduced by Jane Clark (University of Maryland, College Park)</td>
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<td>9:40-10:50am</td>
<td>Collaborative Café</td>
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<td>10:50-11:00am</td>
<td>Coffee Break</td>
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### Papers presentation A - Intervention

**Moderator:** Anna Barnett (Oxford Brookes University)

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<tr>
<td>11:00-11:20am</td>
<td>Activities of daily living: Assessment, intervention and outcomes for children with Developmental Coordination Disorder</td>
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<td><strong>Dunford, C.</strong></td>
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<tr>
<td>11:20-11:40am</td>
<td>Activities of daily living and participation in children with Developmental Coordination Disorder: Systematic review</td>
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<td><strong>Magalhães, L.C., Cardoso, A.A. &amp; Missiuna, C.</strong></td>
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<tr>
<td>11:40-12:00pm</td>
<td>Experiences of driving in emerging adults with DCD</td>
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<td><strong>Kirby, A., Sugden, D. &amp; Edwards, L.</strong></td>
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<tr>
<td>12:00-12:20pm</td>
<td>Framework for clinical practice guidelines in DCD based on evidence and interdisciplinary consensus</td>
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<td><strong>Blank, R., Smits-Engelsman, B.M.C. &amp; Polatajko, H.</strong></td>
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### Papers presentation B - Genetics and Psychosocial

**Moderator:** Jacqueline Williams (Royal Children’s Hospital)

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<tr>
<th>Time</th>
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<tr>
<td>11:00-11:20am</td>
<td>Monozygotic twins concordant and discordant for DCD and ADHD: Two sides to the story</td>
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<td></td>
<td><strong>Pearsall-Jones, J.G., Steed, L., Piek, J.P. &amp; Levy, F.</strong></td>
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<tr>
<td>11:20-11:40am</td>
<td>How do children with DCD participate and enjoy daily activities?</td>
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<td><strong>Bart, O., Rosenberg, L., Yonit, E. &amp; Jarus, T.</strong></td>
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<tr>
<td>11:40-12:00pm</td>
<td>Exploring psychological distress in children with DCD and/or attention deficit hyperactivity disorder: A population-based study</td>
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<td><strong>Missiuna, C., Cairney, J., Pollock, N., Cousins, M. &amp; Macdonald, K.</strong></td>
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<tr>
<td>12:00-12:20pm</td>
<td>An examination of the association between motor control and body satisfaction in young children</td>
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<td><strong>Hay, J., Del Ben, M., Cairney, J., Faught, B. &amp; Liu, J.</strong></td>
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<tr>
<td>12:30-13:00</td>
<td>Lunch</td>
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### Papers presentation A - Physical activity

**Moderator:** Carl Gabbard (Texas A&M University)

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<tr>
<th>Time</th>
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<tr>
<td>2:40-3:00pm</td>
<td>Developmental Coordination Disorder (DCD) and physical activity in a UK birth cohort study</td>
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<td><strong>Green, D., Lingam, R., Mattos, C., Ridding, C., Ness, A. &amp; Emond, A.</strong></td>
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<tr>
<td>3:00-3:20pm</td>
<td>Physical activity of children with Developmental Coordination Disorder in the presence of Attention Deficit Hyperactivity Disorder: Does gender matter</td>
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<td><strong>Baerg, S., Cairney, J., Hay, J., Rempel, L. &amp; Faught, B.E.</strong></td>
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<tr>
<td>3:20-3:40pm</td>
<td>Trajectories of cardiovascular risk in children with and without Developmental Coordination Disorder: Results from a large, prospective cohort of children</td>
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<td><strong>Cairney, J., Hay, J., Veldhuizen, S., Missiuna, C. &amp; Faught, B.</strong></td>
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### Papers presentation B - Intervention

**Moderator:** Reint Geuze (University of Groningen)

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<th>Time</th>
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<tr>
<td>2:40-3:00pm</td>
<td>Can group interventions be effective in improving activity of daily living skills for children?</td>
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<td></td>
<td><strong>Dunford, C.</strong></td>
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<tr>
<td>3:00-3:20pm</td>
<td>The effects of synchronized timing training on timing accuracy and consistency, attention, motor function, and self-perception in children with Developmental Coordination Disorder</td>
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<td><strong>Bartcherer, M., Nicholson D. Sullivan K. Schlough, K. Dole, R.</strong></td>
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<tr>
<td>3:20-3:40pm</td>
<td>Developmental Coordination Disorder - do personnel and environment impact on intervention outcomes for this condition?</td>
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<td><strong>Ward, E., Hillier, S. &amp; Raynor, A.</strong></td>
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<tr>
<td>3:40-4:00pm</td>
<td>Coffee Break</td>
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### Papers presentation – Posters

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<th>Time</th>
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<td>4:00-5:30pm</td>
<td><strong>(Courtney Fillipi &amp; Robyne Rivers)</strong></td>
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### Conference Reception, Tours, and Banquet – Westminster Hall

1. Goal Attainment Scaling (GAS) - a valid outcome measure for D.C.D. paediatric physiotherapy?
   - Lee, M., Yoxall, S.

2. Changes in parents’ concerns - moving from child to adulthood
   - Kirby, A., Sugden, D., Edwards, L.
3 A quantitative analysis of physical activity of children with Developmental Coordination Disorder in Taiwan

4 Associations between obesity and motor coordination ability in children
   Zhu, Y.C. Wu, S.K.

5 Pulmonary function of children with Developmental Coordination Disorder in Taiwan
   Song, T.F. Wu, S.K. Lin, H.H.

6 Evaluation of a specific program for dysgraphia: Handwriting task program
   Baldi, S. Nunzi, M. Franceschini, L. Tufarelli, D.

7 How are motor learning strategies applied within physical and occupational therapy intervention approaches for
   children with DCD?
   Levac, D.

8 What are the educational needs of health professionals who transfer knowledge about DCD to parents and teachers?
   Levac, D. Missiuna, C.

9 Motor skills, psychological well-being and perceived difficulties in adults with DCD: A quantitative and qualitative
   study
   Hill, E.L. Sörgardt, S.

10 Investigating the social and emotional wellbeing and links to motor difficulties in children with DCD
    Pratt, M. Hill, E.

11 Why worry? Stories from and trends within schools
    Kamps, P.

12 Is motor proficiency and limitations in ADL associated with current and past signs of DCD in young adults?
    Geuze, R.H.

13 Rehabilitation of graphomotor disturbances by means of the spatio-temporal Terzi’s method
    Perrone, I. Accardo, A. Antoniazzi, A. Mina, A. Moro, S.

14 From identification to intervention
    Chambers, M. Sugden, D.

15 Four year old children with motor skill difficulties: How effective is parent and teacher focused intervention?
    Pridham, L. Hillier, S. Esterman, A.

16 What are the effects of occupational therapy for children with Developmental Coordination Disorder?
    Kaiser, M.L. Albaret, J.M. Cosandey, V. Müggler, F.

17 Difficulties of written expression in children with Developmental Coordination Disorder: Do they improve over time?
    Webb, A.M. Henderson, S.E. Stuart, M.

18 Feasibility and motor outcomes of intensive Physical and Occupational Therapy for a child with motor coordination
   difficulties
   Joshi, S. Shiratori, T. Jensen, J.

19 Physical fitness and motor coordination in 10-11 year old German children
    Hultsch, D. Schulze, J. Munzert, J.
Keynote speakers

Peter Wilson, Ph.D.

RMIT University Melbourne, Australia

Professor Wilson is a psychologist whose research interest seeks to determine the cognitive underpinnings of delayed and abnormal motor skill development in children. A well-published scholar, Dr. Wilson’s seminal paper with his co-author, McKenzie, in 1998 on a meta-analysis of information processing deficits in children with DCD had laid an important foundation for much of the work in the next decade. His current work on Developmental Coordination Disorder focuses on developing neuroscience models of cognitive function. He has also contributed to our understanding of motor imagery mental representation children with DCD. Dr. Wilson hosted DCD VII in Melbourne, February, 2007.

The development of online motor control in children and the interdependence of thought and action

From a cognitive neuroscience perspective, this paper discusses the development of movement skill in children and the nexus between action systems and cognition. It is now well accepted that the development of motor control in children is non-monotonic. While young children and even older infants demonstrate prospective control, this ability seems to undergo a temporary re-organisation during middle childhood, and then a more mature integration of so called feedback and feedforward control from 9-10 years onward. While this pattern has been described in numerous studies, it has never been fully explained. This paper attempts to explain this trend based on a new theory about the unfolding of motor-cognitive relations during childhood. Understanding the nature of DCD forms a vital part of this theory. The broad hypothesis is that with cortical maturation and experience there is reciprocal development of frontal executive processes, distributed spatial systems, and motor networks that support goal-directed behaviour; a transition period occurs during which the activity of these systems becomes more coordinated. More specifically, a crucial re-organisation occurs at around 7-8 years as frontal executive systems and their posterior connections exert more influence on attentional and motor networks. A consequence of this coordinated activity is an extension of the child’s sense and experience of time and space. At a functional level, while the young child becomes quite proficient acting in near (or peripersonal space), I argue that he/she must learn to adjust or recalibrate control processes as the temporal and spatial realm of action broadens with age. Movements into extrapersonal space and actions designed to achieve ends that are extended in time eventually become part of the repertoire for older children. But the ability to implement these sorts of behaviour (e.g. online control in extrapersonal space, anticipation, motor simulation) does not unfold overnight—they are refined along specific timelines with maturation and experience. This paper will describe the logic behind these processes of organisation and re-organisation. Notwithstanding this interactive view of development, I maintain that the process of integrating feedback control with feedforward models represents an important control parameter in skill acquisition, one that helps explain deviations from a normal developmental course, as seen in DCD.

Reint H. Geuze, Ph.D.

Clinical & Developmental Psychology, University of Groningen, The Netherlands

Professor Geuze is a leading scientist on Developmental Coordination Disorder who has published extensively on children with DCD including serving as an editor of a book on DCD, Developmental Coordination Disorder: A review of current approaches. In addition to his work on DCD, Dr. Geuze is currently working on the topic of lateralization and the possible evolutionary advantage it might confer.

A developmental approach to Developmental Coordination Disorder

In this presentation a theoretical scheme for the study of the development of children with DCD will be presented and discussed. Development is in its essence change in the direction of increased functionality. Developmental pathways are the sequences of these changes over time. These may be studied at several time scales. For example, at a short time scale - say one to 10 hours of practice - one may study how the skill of riding a bicycle is mastered; at a much longer time scale – say 6 years – one may study the relation between hormonal changes during puberty and motor proficiency. I will discuss possibilities and limitations related to the choice of the specific time scales for studying the processes and products of motor development. Interestingly this approach is relevant to the study of both spontaneous development, and instruction and learning including intervention. It is clear that longitudinal studies are necessary to study the developmental processes; cross-sectional developmental studies remain descriptive but may generate theoretical ideas to be tested in longitudinal research. I will illustrate the value of analyses of group differences and individual data (individual developmental pathways; measures of sensitivity and specificity) in both type of studies of DCD. I aim to conclude with a global overview of the research efforts on the topic of DCD over the past 25 years, derive the gaps in our knowledge, and show avenues to proceed.
Jan P. Piek, Ph.D.

Professor, Developmental Psychology
School of Psychology
Curtin University of Technology
Perth, Western Australia

Professor Jan Piek, who earned her PhD from the University of Western Australia, is a well-known scholar in motor development who has studied and published extensively on children with Developmental Coordination Disorder. Her research has appeared in a wide range of journals in psychology and the movement sciences. She has authored a text, Infant Motor Development, as well as edited several other books on motor control and motor development. Since 1991, Dr. Piek has coordinated the Motor Control & Human Skill Research Workshops. In 1996, she received the Vice-Chancellor’s Award for Excellence from Curtin University of Technology.

The social-emotional implications for children with Developmental Coordination Disorder

School-age children with movement problems such as Developmental Coordination Disorder (DCD) are known to have social and emotional difficulties, including low self-worth and self-perceptions, perceptions of less social support, and higher levels of anxiety and depression. There has been minimal research examining the relationship between poor motor ability and social and emotional development. Generally, psychosocial problems are thought to be secondary to the motor problems, appearing once a child begins school when he or she is challenged by social and peer demands. However, this relationship has not been established, and recent evidence that children with movement difficulties as young as 4 years of age have higher levels of anxiety and depression than their peers suggests that this may not be the case. In our longitudinal research examining the development of children born full-term and preterm, we have identified an association between early motor development in infancy and later social-emotional difficulties. This finding emphasizes the importance of early identification of children who are at risk of Developmental Coordination Disorder.

Stewart Mostofsky, M.D.

Associate Professor of Neurology & Psychiatry
Director, Laboratory for Neurocognitive and Imaging Research
Medical Director, Center for Autism and Related Disorders
Kennedy Krieger Institute
Johns Hopkins University School of Medicine, Baltimore, MD, USA

Dr. Mostofsky received his MD in 1990 through the Rensselaer Polytechnic Institute-Albany Medical College Six Year Program, where he won the Jack Spitaley Prize for exceptional achievement in Pediatrics. He went on to an internship and residencies in pediatrics and pediatric neurology at the University of Minnesota. Dr. Mostofsky first came to the Kennedy Krieger Institute in 1995 for a fellowship in Developmental Cognitive Neurology, and stayed on as a pediatric neurologist, involved in both research and clinical evaluations of children with developmental disorders affecting cognition and behavior, including Attention Deficit Hyperactivity Disorder (ADHD), Tourette Syndrome, and Autism. Dr. Mostofsky is a pediatric neurologist in Kennedy Krieger Institute’s Department of Developmental Cognitive Neurology, with subspecialty training and experience in behavioral neurology as it applies to the study of childhood developmental disorders. Dr. Mostofsky uses both structural and functional imaging techniques and experimental neurobehavioral paradigms, including motor/oculomotor and cognitive testing, to better understand the neurologic basis of developmental disorders.

Mirror overflow: A reflection of the association between ADHD and DCD

Children with Attention Deficit/Hyperactivity Disorder (ADHD), often have difficulty with control of movement in a way that parallels difficulty with control of higher-order behaviors. Consequently, there is a high rate of comorbidity with Developmental Coordination Disorder (DCD). Motor overflow movements, including mirror synkinesis, are a normal developmental phenomenon. These movements persist in children with ADHD, beyond that observed in typically developing (TD) children. This motor sign provides a window into understanding the neurophysiologic basis of ADHD and its comorbidity with DCD. The phenomenology and physiologic basis of these movements will be discussed, including evidence from behavioral, functional imaging and electrophysiologic studies.
Dr. Cheryl Missiuna and her colleagues have published extensively scientific papers and educational materials about DCD that include evidence-based information and strategies for the management of children with DCD. Dr. Missiuna holds a prestigious Mid-Career Rehabilitation Scientist award from the Ontario Neurotrauma Foundation and the Ministry of Health and Longterm Care. This award allows her to research models of health service delivery that encourage health promotion, early identification, the creation of supportive environments and prevention of secondary consequences for children with developmental coordination disorder. An important emphasis throughout this work is the development of targeted educational materials that facilitate knowledge transfer and uptake by different audiences including children and youth, families, teachers, health professionals and decision-makers.

Partnering for change

Evidence about children with DCD has accumulated rapidly over the past 15 years and there is now a much better understanding of the natural history, the mechanisms underlying the disorder, its impact on daily functioning and the effectiveness of different intervention approaches. We know that: DCD is a chronic health condition that is common (5-6% of children) but is often unrecognized; that the motor impairment does not go away in adolescence or adulthood; and that the secondary consequences of these motor difficulties put children at high risk of lifelong physical and mental health problems. While there is evidence regarding the efficacy of particular interventions, the reality is that – with the large numbers of children affected by DCD – we cannot be focusing on remediating individual children. Instead, we need to be working together to enhance the ability of families, schools and communities to support children whose motor differences are a daily source of frustration. In this keynote address, newer models will be explored and evidence will be shared that supports the idea that researchers and service providers need to be actively partnering with families, educators, policy and decision-makers and the media to bring about the changes needed to support children and youth with DCD. Specific educational initiatives (e.g., universal design for learning, response to intervention) and current healthcare priorities are extremely compatible with this philosophical shift. Researchers and practitioners will be challenged to ensure that they are developing new partnerships in order to make certain that their work is making a difference for those living with DCD.

Maureen R. Weiss, Ph.D.

Professor, School of Kinesiology, Co-Director, Tucker Center for Research on Girls and Women in Sport, University of Minnesota, Minneapolis, MN, USA

Dr. Weiss is a noted researcher in the field of psychological and social development of children and adolescents and their participation in sport and physical activity, with particular interests in the areas of self-perceptions, motivation, observational learning, moral development, and the influence of significant others (parents, peers, coaches) on youth participation. An accomplished scholar, Dr. Weiss has applied her work to positive youth development in summer sports camps as well as community development activities. Here she turns her attention to what her research might mean for the physical activity participation and skill learning in children with DCD.

Motivating youth to be physically active: Strategies for children with developmental delay

Knowing that children’s physical activity should be increased is not enough to enhance their activity frequency, intensity, and duration. Motivating youth to initiate, continue, and sustain physical activity enables them to embrace an active lifestyle that leads to a variety of health benefits. An understanding of the psychological and social predictors of physical activity behaviors is essential to contributing to active lifestyles. Adults in children’s lives can structure everyday environments in ways that enhance children’s motivation for physical activity. In typically developing youth, the pathways to enhancing physical activity motivation, activity behaviors, and positive health outcomes include four common elements or ingredients: feelings of competence, perceptions of choice or autonomy, supportive relationships, and enjoyment of activity participation. Youth who are encouraged to participate in activities they find enjoyable, feel competent doing, and have chosen to do, and that include positive social support, show optimal motivation for physical activity that allows them to glean the physical, social, and psychological health benefits afforded from such participation. Among children with developmental delay in physical competencies, however, addressing the four ingredients of motivation for physical activity is more challenging. Parents, teachers, and healthcare professionals will need to identify and teach physical activities appropriate for children with DCD that satisfy the four needs—competence, autonomy, relatedness, and enjoyment—to ensure sufficient activity levels and the health- and skill improvement outcomes that are available from adopting a physically active lifestyle.
Jeffrey Harring, Ph.D.
Assistant Professor Department of Measurement, Statistics, and Evaluation School of Education
University of Maryland College Park, MD USA

Dr. Harring has degrees in statistics and quantitative methods from the University of Minnesota. His research interests focus on applications for repeated measures data and nonlinear structural equation models. Dr. Harring’s tutorial will focus on the random coefficient model for continuous repeated measures data; it appropriateness and interpretation. He has invited participants to submit their repeated measures data sets as exemplars.

Developing a Random Coefficient Model for analyzing repeated measures data

The random coefficient model provides a framework which allows investigation of inter-individual differences in subject-specific development. While the model subsumes more traditional approaches to the analysis of repeated measures data, such as repeated measures analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA); unlike these conventional methods, it can be applied to unequally spaced data where times of measurement may be completely unique to each individual, as well as to data that are unbalanced – due to individuals having potentially different number of observations. The random coefficient model is particularly useful in research situations in which (i) repeated observations of a continuous response are obtained on each of several individuals over time or other condition; (ii) variability exists in the relationship between response and time or other condition across individuals, and (iii) availability of a scientifically-relevant model characterizing individual behavior in terms of meaningful parameters that vary across individuals and dictate variation in patterns of time-response. Research objectives are to understand the "typical" behavior of the phenomena represented by the parameters; the extent to which the parameters, and hence these phenomena, vary across individuals; and whether some of the variation is systematically associated with individual characteristics. The purpose of this presentation is to acquaint researchers with the random coefficient model for continuous repeated measures data. The talk will primarily focus on development of the model with emphasis on the appropriateness of the function and interpretability of the parameters. Several data sets will be used to underscore the flexibility that random coefficient models offer over their more time-honored modeling counterparts in analyzing repeated measures data.

Stephen M. Roth, Ph.D.
Associate Professor Department of Kinesiology School of Public Health University of Maryland College Park, MD USA

Dr. Roth is trained as an exercise physiologist with post-doctoral training in genetics. His research focuses on understanding how genetic variation in interaction with the environment influences various phenotypes in the contexts of aging and exercise. His collaborations include working with groups on the potential for genetic-related variation in hypertension and exercise and exercise as a moderator of genetic risk of dementia. In addition to his extensive scientific publications, Dr. Roth has authored a text on genetics, Genetics Primer for Exercise Science and Health. Although Dr. Roth does not study the genetics of DCD, his tutorial will include a “primer” on genetics as well as his ideas about the future of genetics and developmental disorders such as DCD.

Genomics 101: An introduction and implications for DCD

The human genome project served as a catalyst for an explosion of genomic research investigating the etiology of a variety of different developmental disorders (autism, Fragile X syndrome, attention deficit hyperactivity disorder, etc). Although these disorders may have very different behavioral, neurological, and physical manifestations, the process by which genetic etiology is investigated is the same. It is clear that we are still very far from determining a possible genetic basis for DCD. However, as we begin to learn more about DCD, particularly it’s overlap with other developmental disorder, we may begin to answer the prerequisite questions that will progress genomic research towards this goal.
Oral Presentations

Wednesday June 24, 2009

Motor learning of children with Developmental Coordination Disorder: an fMRI study

Zwicker, J.G.¹ Missiuna, C.² Harris, S.R.¹ Boyd, L.A.¹
¹University of British Columbia ²McMaster University

Statement of purpose: The purposes of this behavioural and neuroimaging study were to: (1) determine whether children with DCD are able to demonstrate motor learning of a tracing task; and (2) ascertain how patterns of brain activation may be shifted by motor skill learning in children with and without DCD using functional magnetic resonance imaging (fMRI). Methods: We measured change in motor performance and functional brain activation in 8-12 year old children with DCD (n=4) and typically-developing (control) children (n=4). A computerized line-tracing task was used to index motor behaviour across 4 days of practice. Using a 3-Tesla MRI scanner, we indexed motor learning by measuring changes in brain activation from early practice (Day 1) to retention (Day 5). Findings: Using repeated measures ANOVA, we compared motor task performance and retention in children with and without DCD. Preliminary results indicate a significant Group by Block interaction for number of traces completed [F(1,8) = 8.9, p =.017] and mean time to complete each trace [F(1,9) = 8.0, p =.02]. Children with DCD showed poorer initial performance and improved more during practice than controls. There was no significant difference between groups at retention, with both groups demonstrating motor learning. During fMRI on Day 1, controls showed significantly more brain activation (t = 3.7, p =.01) than the DCD group in motor-related areas (e.g., sensorimotor and premotor cortices, basal ganglia, cerebellum). In contrast, children with DCD showed significantly more activation in bilateral superior frontal gyri. At retention, children with DCD showed significantly more activation than controls in several areas, including frontal, parietal, and temporal regions, supplementary motor area, parahippocampus, and cerebellar tonsil. Conclusions: Children with DCD had poorer initial performance on the tracing task, but benefited from practice and performed similarly at retention to typical children. Although children with DCD demonstrated motor learning, they activated a different neural network than control children to support their learning.

jzwicker@interchange.ubc.ca

Electroencephalographic resting state networks in children with DCD

Oliveira, M.A. Pangelinan, M. M. Vagts, C. Contreras-Vidal, J.L.
Department of Kinesiology, University of Maryland College Park

Endogenous resting state neural networks have been identified and may serve as the foundation for complex brain processes. Thus, it is possible that some of the deficits in movement planning and control evident in children with DCD may result from disrupted or abnormal resting state networks. This study is the first to investigate endogenous electrocortical processes in children with and without DCD during rest. It is hypothesized that children with DCD will exhibit abnormal endogenous brain activity compared to their typically developing peers. Four children with DCD (2 boys and 2 girls; mean age: 11.8 years), characterized by a MABC score below the 15th percentile, and four age- and gender-matched controls (mean age: 11.9 years), characterized by a MABC score above the 25th percentile, were tested using the GeoDesics Electroencephalography System 300 and 65 channel HydroCel Geodesic Sensor Nets. While EEG was collected, children were asked to sit entirely still, placing their heads in a chin rest for 1 minute with their eyes open and 1 minute with their eyes closed. Alpha power over the occipital cortex, a metric of resting state processes, was analyzed following blind source separation with Independent Component Analysis (ICA). Given the heterogeneity within the group of children with DCD, as well as a small sample size, individual children were examined with respect to their age- and gender-matched controls. The results showed that all children with DCD exhibited lower alpha peak frequency across both resting conditions, possibly indicative of maturational delay.

marcio@umd.edu
Differences in electrocortical activity during movement planning in children with DCD

Pangelinan, M. Hatfield, B. Clark, J.E.
University of Maryland, College Park

Children with Developmental Coordination Disorder (DCD) exhibit marked delays in movement planning and adaptive visuomotor behavior. To characterize the neurophysiological correlates underlying these behavioral deficits, we recorded electroencephalography (EEG) during motor planning and performance of center-out drawing movements in children with DCD (m: 10.5 yrs) and two groups of typically-developing (TD - m: 6.7, 10.2) children and adults (m: 22.1 yrs). During the task, the targets and online visual feedback were provided on a computer monitor. For each of 60 trials, participants self-selected a target, and after remaining still in the center position for 2 s., moved quickly and accurately to the target. The EEG signals were analyzed during the period before and after movement onset. Similarities were found between the young TD children and children with DCD both in terms of the brain activation patterns and motor control, and different than the age-matched TD children and/or adults. Young children and children with DCD showed decreased activation of task-relevant sensorimotor areas from both the time- and frequency-domain analyses of the EEG signals (movement-related cortical potentials and task-related spectral power). Children with DCD show a lack of facilitation, as indicated by the decreased negativity over the contralateral motor cortex, similar to the young children. Similarly, functional communication (task-related coherence) for these two groups was also different from the age-matched TD children and adults. Young children and children with DCD exhibit decreased networking between the frontal midline and sensorimotor regions. Moreover, the young TD children and children with DCD exhibited slower, jerkier, and less consistent movement kinematics compared to other two groups. These results suggest that children with DCD appear delayed compared to their typically-developing peers at both the electrocortical and kinematic levels.

pangel@umd.edu

Steering control and looming detection in young adults with DCD

de Oliveira, R.F. 1 Purcell, C.2 Poulter, D. Wilmot, K.3 Wann, J.2
1Department of Psychology, Royal Holloway University of London, UK and Institute of Psychology, German Sport University Cologne, Germany
2Department of Psychology, Royal Holloway University of London, UK
3Department of Psychology, Oxford Brookes University, UK

We investigated the perceptual-motor abilities of young adults with DCD both as pedestrians in road crossing situations and as car drivers. Participants were young adults originally identified in 1997 using the M-ABC (1992) and re-tested in this study using the M-ABC-2 (2007). As pedestrians, participants were asked to identify the looming of a car presented for 200 ms against a road scene background. We tested the sensitivity to looming information that routinely signals hazards in traffic situations, with adaptive (BEST-PEST) procedures, both in central and peripheral monocular vision, using a photo-realistic image of a car. Car images changed in size and rate of expansion to simulate approach at different speeds. As car drivers, participants used a steering wheel to control the direction and velocity of an object on a virtual road of random sinusoidal configuration. We tested the ability of participants to use visual information online and to use it in combination with planned movements, by presenting the whole road, a glimpse of it, or an object travelling on it. These conditions were structured to manipulate the visual information that could be used for corrections and assess the advanced planning that participants could incorporate into their actions. Also as car drivers, participants were asked to drive around a virtual city, presented through a large screen, using a steering wheel and accelerator pedal. Moreover, they were to react to virtual pedestrians who stepped towards their path, by pressing a key on the wheel, and ignore those who didn’t. We assessed the ability of participants to control their position within the lane and to adjust steering around corners as well as their ability to detect potential hazards. The results of the three sets of experiments and their implications for young adults with DCD becoming independent road users will be discussed. Research supported by the UK ESRC ES/F017650/1 and The Netherlands Organisation for Scientific Research.

Catherine.Purcell@rhul.ac.uk
Understanding executive function skills in relation to movement in children diagnosed with DCD

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Previous research has indicated that children with DCD may experience problems with executive function related skills such as planning and working memory. Therefore, it is important to establish exactly where children with DCD struggle in relation to executive function, and how this may be related to other abilities. It may be that those children with DCD who have more effective executive function skills are able to use these skills to compensate for poor movement abilities for example. One other important aspect in relation to executive function is to understand whether or not the reported deficit is present across a wide variety of tasks that rely on executive function, or whether the deficit may actually be related to movement per se, presenting only on tasks that rely on a combination of executive function and movement. To this end, the current research looked at executive functions in relation to DCD. A group of children diagnosed with DCD aged between 6 and 14 years (n = 34), and a matched control group of typically developing children (n = 30), were tested on a battery of tasks which focussed on testing executive functions with and without a motor component. Non-motor executive tasks assessed inhibition, mental flexibility, working memory, and planning. Executive function tasks with an elevated motor component assessed inhibition, attention, and planning. Analysis of the data set highlighted differences between the two groups, and this will be discussed with regards to the implications for people diagnosed with DCD.

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Do patterns of performance of motor imagery tasks differ between children with Developmental Coordination Disorder and Cerebral Palsy?

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The aim of this study was to determine whether children with Developmental Coordination Disorder (DCD) and children with Cerebral Palsy (CP) differed in their performance of motor imagery tasks. Three groups of 21 children participated in the study - a DCD group, who scored below the 5th percentile on the Movement ABC (mean age = 9.38 years); a CP group, consisting of children with mild spastic hemiplegia (mean age = 10.33 years) and; a control group, consisting of children with typical motor skill development (mean age = 9.38 years). Children completed two versions of the mental rotation paradigm, typically demonstrated to elicit the use of motor imagery - hand and whole body rotation. The results show that on both tasks, children with DCD and CP performed similarly. On the hand task, response time analysis indicated no differences between the DCD and CP groups at any angle, though the CP group were significantly slower than controls at lower angles. For accuracy, both the DCD and CP groups were significantly less accurate than controls, but did not differ significantly from each other. On the whole body task, both the DCD and CP groups displayed atypical response time patterns which differed from the controls. As with the hand task, both groups were significantly less accurate than controls, but did not differ from each other. These results indicate that similar deficits in motor imagery ability exist between children with DCD and those with mild spastic hemiplegia. The implications of these findings will be discussed, drawing on previous research examining motor imagery in adults with hemiplegia to further our understanding of these deficits in DCD.

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Prevalence of Developmental Coordination Disorder using DSM IV: a UK study

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Background: Our understanding of children with severe motor coordination delay without associated neurological signs has been hampered by inconsistency in nomenclature and diagnostic criteria. The aim of the current study was to calculate the prevalence of Developmental Coordination Disorder (DCD), at 7 years, using DSM IV criteria in a large UK birth cohort. Methods: Cases of DCD were defined using prospectively collected data from the Avon Longitudinal Study of Parents and Children (ALSPAC), a birth cohort based in south west England. The motor coordination of over 7000 children was assessed using tests that measured manual dexterity, ball skills and balance. The 5th centile of the derived ALSPAC Coordination Impairment Score were used to define severe motor coordination difficulties. Data from national handwriting tests and an activities of daily living (ADL) scale quantified the impact of poor coordination on daily life. Children with known neurological conditions or an IQ less than 70 were excluded. Results: Complete data were available from 6990 children aged 7-8 years who attended the coordination session and also took the writing test or returned their ADL questions. 119 children met DSM IV criteria for DCD, resulting in a prevalence of 17 per 1000 children at a mean age of 7.5 years (SD 2.9 months). A further 222 children were considered probable DCD using broader cut-offs for motor coordination testing and ADL. There was an increased risk of DCD in families from lower socio-economic backgrounds, and in children with a lower birth weight and gestational age. Conclusions: This is the first study to use strict DSM IV criteria to define the prevalence of DCD in a representative UK cohort of children. A prevalence of 1.7% is lower than studies that have not taken into account the impact of poor motor coordination on daily living, but indicates that poor coordination is an important and potentially hidden cause of childhood disability

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Poor motor coordination: A growing problem or a sign of the times?

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It has been estimated that between five and fifteen percent of children have DCD worldwide. Only a fraction of cases will be identified due to financial constraints, time requirements for screening and the lack of a concise descriptor (Hay, Hawes & Fraught, 2004). Traditionally, of those identified with DCD, boys have been more commonly reported to have DCD than girls (Miller, Missiuna, Macnab, Malloy-Miller & Polatajko, 2001) although figures from clinical referrals imply that this gender bias is less (Parker & Larkin, 2003). It is well known that children identified with DCD often avoid physical activity and lead sedentary lives. The consequences of this avoidance may include not only inefficient muscle activation patterns (Bouffard, Watkinson, Thompson, Causgrove Dunn & Romanow, 1996), socio-emotional consequences such as depression and social isolation (Bar-Or & Rowland, 2004), but also a decline in health status. This report includes Movement-ABC data from a sample of children (255 males: 249 females) aged between 5 and 12 years who lived in Melbourne, Australia at the time of the screening. Using the 15th percentile or below as the criterion, 35% (83 Males: 92 Females) of all children screened were identified as DCD. The prevalence of DCD presented in this report is alarmingly greater than cited in the literature. The characteristics of the study population are discussed and implications drawn for the significance of these findings. In particular, in the context of the ‘obesity epidemic’ in many contemporary societies, the notion of a more widespread hypo-activity syndrome arising out of the ‘the vicious cycle of inactivity’ is raised. Issues for the future of DCD research and interventions are identified.

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Epidemiology of co-occurrence of DCD and other developmental disabilities

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Several studies pointed already to the distinct amount of co-occurrence or co-morbidity between different developmental disorders. However, different recruitment methods were used in those studies and often even different diagnostic criteria. In Belgium 140 children (92 boys and 48 girls) with developmental problems were recruited in private practices of speech therapists or in mainstream schools (16%), in schools for children with special needs (33%) and in multidisciplinary rehabilitation centres (51%). All children had an IQ above 70, no pervasive developmental disorder or a known syndrome. Therapists or teachers putting children in for the study declared a diagnosis or a suspect of ADHD for 46 children (33%) and ADD for 11 children (8%). Children were assessed throughout 2 to 4 sessions of 1 to 2 hours with several reading, writing, mathematical, visual-perceptual, visual-motor and motor tests. Several checklists were completed by teachers and parents. Regarding the test results 51 children (37%) were diagnosed with dyslexia and 35 children (25%) with a mathematical learning disability. In this population 9 children (6%) scored below the 5th percentile on the Movement Assessment Battery for Children- 2 and 30 children (22%) below the 15th percentile. Fifty-four (40%) children scored below the 5th percentile on a graphomotor writing test and 11 children (8%) scored at or below the 5th percentile on the Beery Developmental Test for Visual-Motor Integration. These results show a much lower co-morbidity of a general motor disorder in a clinical group of children as previous studies. Probably this can be explained by the recruitment method, which was not concentrating on motor disorders. Large population based studies, incorporating a broad spectrum of developmental disorders, are still needed to describe the co-occurrence of developmental disorders. Probably these studies can offer also better understanding of the underlying mechanisms of the co-occurrence of disorders.

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On-line motor adaptation in children with Developmental Coordination Disorder (DCD): Double-step perturbation performance

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Recent literature has proposed that children with Developmental Coordination Disorder (DCD) may exhibit an impaired ability to generate and, or, monitor internal models of movement (i.e. the ability to integrate predictive and feedback-based control mechanisms). This has been referred to as the internal modelling deficit (IMD) hypothesis. To date, much of the available literature relating to the role of internal modelling in DCD has been based on measures of movement imagery (Williams et al., 2006; Wilson et al., 2004). The aim of this study was to challenge the IMD hypothesis using a double-step reaching paradigm. Participants included a group of 16 children with DCD and an age-matched control group. The double-step paradigm involved participants reaching and touching one of three targets presented on a touch-screen computer monitor. For 80% of the trials, target location remained unchanged for the duration of the movement (non-jump trials), while for the remaining 20% of trials, the target jumped to one of the two alternative locations at movement onset (jump trials). Reaction time (RT), movement time (MT), and reaching errors were recorded. Results showed a significant increase in MT for jump trials relative to non-jump trials, consistent with prior work. Results provided mixed support for the hypothesis that children with DCD would display impaired on-line motor adaptation. Analysis of MT data showed that the jump condition constrained the performance of the DCD group to a significantly greater extent than controls. No interaction between condition and group was observed for RT, as expected. The pattern of results suggests a selective impairment in DCD of the ability to efficiently adapt their movements on-line, supporting the IMD hypothesis. However, individual differences were noted among the DCD group. Future research should further explore both group-level and idiosyncratic transitions in motor control strategies between typically and atypically developing children.

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Do children with DCD evidence a proprioceptive deficit in visual capture of felt limb position?

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In adult humans, vision plays a dominant role in determining both the perceived location of the arms when stationary, and in controlling reaching (Holmes et al., 2004). Some have argued that vision becomes more important than proprioception in localization as a function of the increased visual experience typically obtained during childhood. We report data assessing the development of visual dominance in the control of reaching in children diagnosed with developmental coordination disorder (DCD; n=10) in comparison to age and IQ-matched typically developing group (45 children aged 6-12 years) and adults (n=15). Participants completed Holmes et al.'s (2004) mirror reaching task. In this task, participants viewed their left arm on both sides of their midline (by virtue of a mirror placed at the midline facing the left arm, and obscuring the right arm) and were asked to reach with their right (hidden) hand for a target placed 25cm in front of that hand. Reach accuracy was measured when proprioceptive and visual cues to the location of the right hand were placed in varying degrees of intersensory conflict (by moving the hidden hand in the azimuthal plane with respect to the mirror image of the left hand) and also when no visual information concerning the location of the hand was made available (by covering the mirror). Results indicate that all groups showed comparable visual capture effects (as demonstrated by a greater reliance on visual cues in the mirror even when these were misleading). However, the DCD group was more impaired at reaching accurately in the absence of visual information about their hand (i.e. when the mirror was obscured). We will discuss the implications of these findings regarding the development of multisensory representations of the body in typically

Visual processing and motor deficits in children with DCD: 10 years later

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Over 10 years ago, Wilson and McKenzie [W&M] (1998) conducted a meta-analysis aimed at identifying perceptual processing deficits associated with motor coordination deficits in children. Their results showed that while these children performed poorly compared to typically developing children on most measures, the largest differences were on measures of visual processing. Objectives: Since 1998, numerous studies have built on W&M’s results, and focused on visual processing. However, to date, no synthesis of these more recent studies has been completed. Accordingly, the objective of this study was to classify and synthesize the current state of the literature on the visual processing abilities of children with motor coordination deficits. Methods: A systematic review of the literature published between 1996 and 2008 was undertaken. Studies comparing the performance of children with coordination deficits to that of typically developing children on measures of visual processing were considered. Similarly to W&M’s selection criteria, only studies of children who would meet the diagnostic criteria for developmental coordination disorder were included. Results: Most studies support the conclusions reached by W&M. However, despite the fact that W&M already demonstrated that children with DCD have visual processing deficits, 78 % of the studies still used standardized measures of visual processing as their methodology. Accordingly, the current state of the literature limits our ability to go beyond the identification of a visual processing deficit in children with DCD and further characterize their visual processing abilities. Conclusions: Results from this study provide researchers and clinicians alike with important information on the visual processing skills of children with DCD. A discussion of the construct that is visual processing will shed light on the disconnect between what is needed to further characterize the visual processing abilities of children with DCD and what is currently being done in this field of research.

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Should we measure muscle strength in children with DCD: An exploratory study into the relationship between strength and motor skills

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Introduction: To date little is known about muscle strength and force generation in children with DCD. Results so far suggest that children with DCD, as compared to TD children, seem to be capable of producing the same level of maximum hand and finger force. Moreover experimental evidence suggests they have a parameterisation or force gradation problem and show increased levels of variability (poorer signal to noise ratios). It this study we examined the relationship between motor skills (as measured by MABC-2 and parental checklists) and isometric force of arm and leg muscles (using a Hand Held Dynamometer) and a functional strength measure (as measured by the newly developed 6 item Functional Strength Measure for children (FSM), Smits-Engelsman et al.)

Method: 36 children (24 boys, 12 girls) participated in the study, 9 of which were classified as at risk for DCD or as DCD. Correlations between the measures at various levels of the ICF (Strength, Motor skills, experienced problems in Activities Daily Living) were calculated. Although the DCD group was small, the data were tested for differences between groups primarily to calculate the effect size for future studies. Results: Results indicated strong to moderate predicted relationships between the isometric force and the items of the FSM (r 0.78-0.56). Importantly most of the MABC-2 items correlated with the strength measures. Throwing and catching items were related to strength of the muscles around the elbow and fingers, while manual dexterity was not. Knee extension and lower extremity FSM items (vertical jump, long jump, and stair climbing) were all significantly related to the balance items (r 0.68-0.40). All but one of the strength items were significantly different between TD and DCD children.

Conclusion: Results suggest that coordination difficulties in children with DCD may lead to loss of force or that force loss may be one of the mediating factors in poor motor performance. In either case, assessment of force is important for an appropriate intervention advice.

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Limits to cardio-respiratory exercise performance in DCD: A pilot study

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Background: Children with DCD are less physically active than their typically developing peers, raising concerns for their long-term health and wellbeing. (Cairney et al., 2005; 2006) Studies reporting poor levels of cardio-respiratory fitness in DCD (e.g. Schott et al., 2007) have used group shuttle-running endurance tests. However, results from such tests are difficult to interpret in children with DCD as low perceived adequacy may partly account for poor performance (Cairney et al., 2006), as may atypical gait patterns. We employed clinical exercise testing methodology in order to better understand limits of cardio-respiratory exercise performance in DCD. Aim.

To examine physiological responses and perceived exertion of teenagers with DCD compared to controls during a cycle ergometer exercise test. Methods: Two groups of teenagers participated in this pilot study: a group with a diagnosis of DCD (n=4) and a typically developing control group (n=3). Participants performed an incremental test, with each stage lasting 1 minute and work load progressed by 20 watts from an initial 20. The test ended after volitional exhaustion or if participants were unable to maintain a cadence of 60rpm. Heart rate (HR), expired air and rates of perceived exertion (RPE; Easton et al., 2000) were measured throughout. Results & Discussion: The cycle ergometer test was well tolerated by all participants and indicated reduced exercise performance in the DCD group. They had a lower peak work rate (145 vs. 213 watts), HR (145 vs. 183) and oxygen consumption (35 vs. 54 ml.kg-1.min-1) than controls. However, mean respiratory exchange ratios were over 1.10 in both groups, indicating that participants were working maximally. The RPE were similar for both groups, demonstrating that all participants perceived that they were working to their exercise limits. Details of the exercise data will be discussed to explore the characteristics and limits of performance of the DCD group.

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The relationship between aerobic fitness and perceived adequacy in children with Developmental Coordination Disorder

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It was suggested that in field based aerobic tests the competitive and social nature of the test may negatively affect the performance of children with developmental coordination disorder (DCD). A significant amount of the differences in VO2 peak between children with DCD and those without (34%) was explained by differences in perceived adequacy. No comparable data exist in laboratory based setting. The purpose of the current study was to examine how perception of adequacy account for the differences in VO2 peak between 12-13 years old children with DCD (N=63) and age-matched controls (N=63) using laboratory based setting. Participants were screened for DCD using the movement ABC test. VO2 peak was determined by a progressive exercise on cycle ergometer until exhaustion. Prior to the assessment, subjects were instructed as to the expected physical exertion associated with this evaluation and the importance of exercising until they have reached maximum volitional fatigue. Perceived adequacy was measured using a 7-item factor from The Children’s Self perception of Adequacy in and Predilection toward Physical Activity. Both boys and girls with DCD had significantly lower perceived adequacy (p<0.001) and lower VO2peak (p<0.05) even after the later was corrected for percent body fat. Perceived adequacy explained only 3% of the differences in peak VO2 between children with DCD and those without. It seems that when controlling for environmental and social factors, psychological variable such as perceived adequacy may play a less significant role when testing aerobic fitness in children with DCD. Since direct measurement of VO2 peak is not feasible for use in field based settings and it is critical to assess whether or not DCD children truly are at greater risk for poorer aerobic fitness, the results of this study suggest that when testing children with DCD in the field we should address the psychological barriers associated with their condition.

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Motor, cognitive and behavioral differences between children with Developmental Coordination Disorder and children at risk for DCD

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According to Criterion A of the DSM-IV-TR the motor skills of children with DCD are below that expected for their age. It is recommended in the Leeds Consensus Statement to administer a standardized motor test to investigate whether children meet Criterion A, and the 5th percentile is proposed as cut-off criterion. However, this decision was taken without broad clinical information on the group with scores between the 5th and 15th percentile on the MABC (at-risk-group). The question is: in what way do children at risk differ from children with scores below the 5th percentile (dcd-group)? To this end, differences between the dcd group (n=84) and the at risk group (n=36) were investigated on measures of motor, cognitive and behavioral performance (i.e. the Developmental Coordination Disorder-Questionnaire (DCDQ), the Visuo-Motor Integration Test (VMI), the WISC-R, and subscales of the Child Behavior Checklist (CBCL) and the Teacher Report Form (TRF). Preliminary analyses reveal that both groups do not differ on motor behavior as measured with the DCDQ or VMI. However, performance IQ is significantly lower for the dcd-group than the at-risk-group. But the at-risk-group tends to demonstrate more externalizing problems on the CBCL than the DCD-group. Both groups demonstrate more behavioral problems, as measured with the TRF, than typically developing children, but do not differ from each other. Differences between the DCD group and the at risk group seem to be smaller than expected. During the conference, these results will be presented in more detail, and implications for research and clinical practice will be discussed.

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DCD VIII – International Conference Baltimore 24 – 26 2009
Patterns of praxic performance in different samples of children with DCD: Evidence from a multiple case series analysis

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Introduction/Aim: The aim of this study was to examine the patterns of praxic performance in different samples of children with Developmental Coordination Disorder (DCD). To obtain more information of the profile of each child across assessments, a multiple case series analysis was carried out which was consisted of two steps. Methods: Praxis was assessed using a series of tasks examining non-representational and representational gestures including praxis imagery. Children with DCD aged 9-11 years were selected from schools and clinics forming two samples; the school DCD (sDCD, n=26) and the clinical DCD (cDCD, n=19) groups respectively. The test scores obtained across tasks from each child in both DCD groups was compared with norms obtained from an aged matched control (AMC) group (n=24) using multiple case series analysis. All children were assessed on the MABC and fulfilled DSM IV criteria. Results: The patterns seen in both DCD groups revealed that a number of children had problems in some tasks, across all tasks or no problems at all irrespective of group membership. The range of children falling below the normal distribution was from 16 – 63% with the cDCD group having more severe problems than the sDCD across tasks. Severity of impairment and gender were contributed factors of the proportion of the children falling below the norms particularly for the cDCD group. Discussion: The patterns observed here are in accordance with other studies in sub-typing where children with general or no problems at all have been reported. The implications for clinical practice and research are also discussed.

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The prevalence of DCD in children born preterm: A systematic review

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Motor skill impairment, similar to that seen in DCD and often referred to as such, is a common negative outcome of preterm birth. The purpose of this systematic review was to determine the prevalence of such motor impairment. We included in the review studies published between 1990 and 2008 that used a standardized assessment battery to assess the motor skills of children born preterm when they had reached school age. We excluded those studies that did not include information regarding the proportion of children in their sample that were considered to have motor impairment. Year of birth for the various samples ranged from 1980-1997 and children’s age at follow-up ranged from 4-13 years. The two most common assessment batteries used were the Movement ABC and the Bruininks-Oseretsky Test of Motor Proficiency. Although the assessment battery used and the cut-off score for determining motor impairment varied across studies, we devised a method of classification that provided us with two estimates of the prevalence of motor impairment - one based on definite or severe impairment and another based on borderline or mild impairment. Prevalence estimates for motor impairment were, as expected, significantly higher than in the general population, highlighting the need for ongoing screening for motor impairment in preterm children once they reach school age. We will discuss issues of heterogeneity among the included studies and make recommendations for reporting in studies of preterm children and DCD, so that individual studies become more comparable and our knowledge of atypical motor development can advance.

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Obstacle crossing in children with DCD: A matter of anticipation or balance?

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Understanding of the atypical behaviour of children with DCD requires insight into the specific constraints that act upon their general motor acquisition. The aim of this study was to examine the role of two specific constraints, visuomotor anticipatory control and balance, that according to previous literature may hamper optimal obstacle avoidance during locomotion in these children (Deconinck et al. 2006). To this end, we compared the gait characteristics and the centre of mass behaviour of 12 children with DCD (10 boys, 2 girls, mean age: 7.8 ± 0.5) and 12 matched TD children (mean age: 7.7 ± 0.6) during walking on a 9.60m walkway in three experimental conditions: (1) unobstructed walking, (2) crossing a low obstacle (5% of leg length), and (3) crossing a high obstacle (30%). It was found that children with DCD adopted the same approach strategy as the TD children when faced with an obstacle. Both groups approached the obstacle with a similar velocity that was slower than in level walking, while keeping the approach distance, i.e. the distance of the last foot to the obstacle, constant across conditions. Further, both groups scaled the clearance height of lead and trail foot to cross the obstacle equally. During the crossing stride the relative duration of the swing was longer for higher obstacles, however to a lesser extent in children with DCD. Additionally, the crossing stride elicited significantly larger medio-lateral sway amplitudes of the centre of mass compared to level walking in children with DCD, but not in TD-children. In sum, these findings indicate that in obstacle negotiation visuomotor control is probably not a major limiting factor in children with DCD. However, the balance threat provoked by the obstacle did put the body stability of children with DCD at greater risk and may be considered a key constraint in obstacle crossing.

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Anticipatory postural adjustments in children with Developmental Coordination Disorder

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Postural control is a fundamental component of action and deficits in it have been shown to contribute to motor difficulties in children with developmental coordination disorder (DCD). It has been shown that DCD children are especially prone to encountering difficulties when they are placed in novel situations and in dynamic postural tasks. The purpose of the study was to examine anticipatory postural adjustments (APAs) in DCD children in a bimanual load-lifting task. The task required to maintain a stable elbow angle despite imposed or voluntary unloading of the forearm. Sixteen children with reported motor problems and 16 typically developing (TD), age-matched children took part in the study (mean: 9 years, S.D.: 2 years). The Movement Assessment Battery for Children (M-ABC) was used to test the children before administering the bimanual load-lifting task. The results showed that when considering the M-ABC impairment score, not all the children with reported motor problem met the criteria for DCD. Although children with DCD could compensate for the consequences of unloading by using APAs, the postural forearm was not as stable as that of TD children during voluntary unloading. This less efficient postural stabilization was accompanied by atypical patterns of agonist postural muscles. A positive correlation between flexor inhibition latency and postural stabilization was only found in TD children. The stabilization deficit observed in children with DCD may stem from a lack of coordination between synergic muscles and from a deficit in coordinating postural and motor programmes. These results corroborate the hypothesis of a central origin of the motor difficulties in children with DCD. Finally, APAs should also be investigated in children with reported motor difficulties but who score above the 5th or 15th percentile on the M-ABC.

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Postural control during sit-to-stand in children with and without Developmental Co-ordination Disorder

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Developmental Coordination Disorder (DCD) occurs in a significant proportion of children, who present with poor motor co-ordination, postural control, and poor acquisition of motor skills. DCD can be defined as a specific problem with coordinative tasks despite normal IQ and no evidence of neurological, biochemical or physical abnormalities (American Psychiatric Association 1994). Recent evidence suggests children with DCD are less fit and physically active than control children and display lower muscular strength, which negatively impacts on motor performance and exacerbates co-ordination problems (Cemark and Larkin, 2001; Cairney et al, 2005). This present study examined postural stability, muscular activity and co-ordination of body segments during sit-to-stand in six children with and six without DCD (aged 8-16 years). Kinematic measures were obtained using a 7-camera VICON MX 3-D motion analysis system (Vicon Motion Systems, Oxford, UK). Surface EMG for tibialis anterior (TA), quadratus lumborum (QL), and external obliques was recorded during sit to stand. EMG results showed altered muscle timing and decreased QL and TA activity during sit-to-stand in children with DCD compared to age matched controls. Kinematics revealed increased anterior and posterior pelvic tilt and pelvic obliquity in children with DCD during sit-to-stand. Hip flexion and plantar flexion where also increased in children with DCD, whilst lumbar spine extension was significantly decreased. These data suggest children with DCD have less efficient stability and postural control of the pelvis and lumbar spine due to decreased and altered QL muscle activity and a decreased lumbar extension ROM. Increased hip and plantar flexion during sit-to-stand may be a strategy children with DCD employ to overcome this lack of postural control. Future work will implement a core stability exercise programme in children with DCD to help improve postural control and ultimately motor performance.

Thursday June 25, 2009

Validity of the Movement ABC Test - Second edition

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Background and aims. Movement ABC-2 (Henderson et al., 2007), like its predecessor, includes an individually administered performance Test, an observational Checklist to be completed by an adult familiar with the child and guidelines for intervention. The previous version of the Test (Henderson & Sugden, 1992) was one of the most popular instruments used in research and clinical practice to identify children with DCD. Production of the second edition involved revision of the structure and content, an extension of the age norms, and substantial improvements to scoring. A simple ‘traffic light’ system, based on the 5th and 15th percentile points, aids the interpretation of total scores. The aim of this presentation is to report findings on aspects of the validity of the Test, including concurrent validity as tested against the Checklist and another commonly used motor test, the BOT-2 (Bruininks & Bruininks, 2005). Findings from a factor analysis of the test items will also be reported.

Method. A stratified sample of 1200 children, aged 3-16 years, from the UK, comprised the normative sample. All children were individually assessed on the MABC-2 Test. Class teachers of the children, aged 5 to 12 years were asked to complete the revised Checklist and 650 were returned. A sub-set of 30 children from the normative sample aged 4-6 years were also tested on the short form of the BOT-2. Results and discussion. There was a significant correlation (.55) between the Test and Checklist total scores, with an agreement across the ‘traffic light’ zones of 78%. Agreement with the BOT-2 was good, although some BOT-2 items seemed inappropriate for the youngest age group. The principal component analysis yielded a single factor for age bands 1 and 2 but supported the three-part division of the test in the oldest age band. Suggested uses of this new assessment instrument will be discussed.
Factor analytical validation of the Movement Assessment Battery for Children - Second edition
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The Movement Assessment Battery for Children second edition (M-ABC-2) (Henderson & Sugden, 2007) contains 8 items. The SOS is a recently developed writing test (Van Waelvelde & Smits-Engelsman, 2008). The Beery Developmental Test for Visual-Motor Integration (VMI) (Beery & Buktenica, 2000) contains a copy task, a visual perception (VP) and a drawing task (MC). The aim of this study was to determine the underlying factors that explain the common variance of the different items of the M-ABC-2 (age band 2), the SOS and the VMI. A population based sample from mainstream schools of 202 children (7 y - 9 y) (106 boys and 96 girls) and a clinical sample of 139 children (7y -10y) (91 boys and 48 girls) with dyslexia, arithmetic disorders, ADHD and/or DCD were assessed on M-ABC-2, VMI and SOS. A Principal Axis Factoring with varimax rotation, identified four factors with an eigenvalue greater than 1 (Kaiser criterion). A first factor ‘writing and drawing’ is correlated with the VMI copy task (.64), the VMI MC (.64), the SOS (.52) and the M-ABC drawing task (.41). The items placing pegs (.43) and threading lace (.60) loaded on a second factor ‘manual dexterity’. The items catching (.54) and throwing (.48) loaded on a third factor ‘ball skills’ and the items one-board balance (.67) and walking heel-to-toe (.40) loaded on a fourth factor ‘balance. The VMI-VP correlated with two factors: ‘writing and drawing’ and on ‘ball skills’ but both loadings are rather low (.34). None of the factors could explain the variance of the item hopping on mats. The four-factor solution closely resembles the structure of the M-ABC2, representing three different aspects or domains of motor skills. The pen and paper task of the M-ABC loads with the other writing tasks in our study. Most items have a low communality indicating that they all have an important unique variance.

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Becoming motor delayed as a birthday present?
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The second edition of the MABC has less age bands than the first edition with a larger age range: Age band 1: 3-6 years of age; Age band 2: 7-10; Age band 3 11-16. This means that there will be two birthdays within the total age range of the test, after which the child will be tested on a new set of items. Two important questions arise; 1) Are the two sets of items per age band measuring comparable motor performance?; 2) How large is the drop in performance if a child moves to the next age band after his/her birthday? The present study will focus on the birthday effect in children who change from age band 1 to age band 2 around their 7th birthday (6 becoming 7 years; n=37) and from age band 2 to age band 3 around their 11th birthday (10 becoming 11 years; n=36). All children were tested twice with two different age bands within 4 weeks. To control for test order, we also tested children with the higher age band first (with which they would be tested after their birthday) and later with the age band for younger children. It seems that the total 8 items of the different age bands measure a comparable motor construct. Pearson correlation coefficients showed good relationship between the total percentile scores of age band 1 and 2 (r= .79; p< .000) and age band 2 and 3 (r =.78; p<.000). However correlation coefficients are insensitive for absolute differences. A drop in mean percentile rank is found: from age band 1 to age band 2 of 20 percentiles ( 2.2 standard score) and between 2 and 3 of 18 percentiles (1.8 standard score). From band 1 to 2 the number of at risk children increased from 0 to 6 and for age band 2 to 3 from 0 to 3. These results should be taken into account when children are evaluated that are young or old for their age group.

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Reliability of the outcomes of the Movement Assessment Battery for Children, second edition (MABC-2): Are 3 year old children ready for formal testing?

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The first aim of this study was to evaluate the repeatability of the second edition of the Movement Assessment Battery for Children (MABC-2). The second aim was to explore the MABC-2's clinical applicability in very young children, since formal testing of 3 year old children is new in the revised test. Fifty typically developing 3 year old children were tested twice within a one to three weeks interval by 2 physical therapists. Of these children, 28 were tested twice by the same therapist. The inter class correlation (ICC) and the standard error of measurement (SEM) are calculated to estimate the reproducibility of the outcomes. Overall the results were promising for future implementation in clinical practice. Six children could not do or refused to do 6 or more items, therefore results are based on 44 children. The ICC for the total group was 0.90 and 0.89 for the standard score and the percentiles, respectively. As expected the ICC for intra reliability (standard score 0.95, percentiles 0.96) was higher than the inter reliability (standard score 0.81, percentiles 0.78). The SEM of the standard scores ranged from 0.22 to 1.55 and for the percentiles from 0.02 to 14.20 for intra- and intertester scores. These differences have great impact on the smallest detectable difference. To ameliorate the feasibility in very young children, we will recommend some adaptations in the testing procedure. In conclusion, the MABC-2 can be applied reliably to assess motor performance in 3-year old children (ICC 0.78-0.96) but the retests should preferably be administered by the same tester as these young children seem extra sensitive to tester-child interaction. Further research should repeat this study with clinical groups.

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The impact of attention on motor performance of children with comorbidity of DCD and ADHD

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Attention Deficit Hyperactivity Disorder (ADHD) and Developmental Coordination Disorder (DCD) are two developmental disorders that cause difficulties in motor, academic, social and emotional functioning. There is a strong connection between motor deficits and attention deficits. The impact of Methylphenidate on attention is well known. Therefore, we assessed the influence of attention by using Methylphenidate (MPH) on motor performance of children with DCD and ADHD. Method: Eighteen children (13 boys, 5 girls, Mean age was 8.3, SD = 2.05) with comorbidity of DCD and ADHD participated in this study. Three questionnaires were transmitted to the parents: a demographic questionnaire, the Kiddie-Sads-Present and Lifetime Version, and the checklist-Movement Assessment battery for children, which served as inclusion criteria for motor deficits. The study was pre-post and included two sessions in which a motor test Movement Assessment Battery for Children (M-ABC) was administrated to all the children. The first session was under the influence of MPH, and the second one under placebo. Results: We found a significant difference between motor performance with MPH and motor performance under the influence of placebo. Significant improvement was observed in all the M-ABC tasks except the static balance. Conclusions: Attention plays a part in motor performance but it is not the only mechanism causing motor deficit in children with DCD and ADHD. In addition, MPH direct influence on motor coordination should be considered.

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Visual-perceptual and perceptual-motor skills in children with Developmental Coordination Disorder and/or Mathematical Learning Disabilities

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Visual-perceptual skills are believed to play an important role in motor as well as mathematical performances. Many studies display deficits in visual-perceptual and perceptual-motor skills in children with Developmental Coordination Disorder (DCD), but research on visual-perceptual and perceptual-motor skills in children with a mathematical learning disability (MLD) is rather rare. There are no studies concerning these skills in children with co-morbid DCD and MLD. The purpose of this study is to investigate visual-perceptual and perceptual-motor skills in children with DCD and/or MLD. In this study 20 children with DCD, 27 children with MLD, 11 children with DCD + MLD and 23 typically achieving control children participated. All 81 children had at least an IQ > 70 and were between 7 and 11 years old. Visual-perceptual and perceptual-motor skills were assessed with the Beery VMI copy task and the additional VMI visual perception and VMI motor coordination task, the block design from the WISC-III and the Shortened Visuospatial Questionnaire. Control children performed significantly better than children with DCD, MLD and DCD + MLD, but no significant differences between clinical groups could be identified. A trend was perceived for the DCD + MLD group, they performed poorer in comparison with the DCD and the MLD group on the VMI copy task and the VMI visual perception task. This might suggest that having DCD or MLD on its own is not associated with visual-perceptual disorders, rather it is the presence of having a co-morbid MLD that makes children underachieve on this domain. These findings underscore the need for the application of a wide range of carefully selected measures in the diagnostic process and the assessment of the individual child.

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DCD and associated developmental traits: More than just an expression of IQ

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Background: Although an overlap between DCD and difficulties in attention, language and social communication have been reported in clinical samples, there has been limited research analysing these associations in a population based sample accounting for confounding factors, most notably IQ. Aim: To analyse the association between DCD and inattention, poor verbal and non-verbal skills, and impaired social communication in childhood. Method: Analysis of prospectively collected data (N=6990) from the Avon Longitudinal Study of Parents and Children (ALSPAC), a UK birth cohort. Motor coordination was assessed at 7.5 years using tests that measured manual dexterity, ball skills and balance derived from the Movement ABC. Developmental traits assessed between 7.5 and 8.5 years included: inattention (Development and Well-Being Assessment- DAWBA), expressive language (subtests from the Wechsler Objective Language Dimensions-WOLD), nonverbal skills (Diagnostic Analysis of Nonverbal Accuracy- DANVA) and social communication (The Social and Communication Disorders Checklist- SCDC). A series of multivariable regression models explored the associations between DCD and the developmental traits accounting for confounding factors. Results: 341 children met DSM IV criteria for DCD or probable DCD (4.9%). Multivariable analysis demonstrated there were significantly more symptoms of inattention/hyperactivity and worse verbal, non-verbal skills, and social communication in children with DCD compared to controls after controlling for confounding variables The odds ratio of having any severe attention difficulties (DAWBA) in children with DCD compared to controls was 2.01 (95%CI 1.39 to 2.93) p<0.001. Odds ratio of having significant difficulties with expressive language (lowest 15th centile - WOLD expressive language subtest) was 1.84 (95%CI 1.28 to 2.63) p=0.001; significant difficulties in non verbal skills (>=7 errors DANVA Faces subtest) 1.90 (95%CI 1.37 to 2.65) p<0.001 and social communication skills (SCDC cut off Scores >=9) 2.42 (95%CI 1.53 to 3.83) p<0.001. Conclusion: Children with DCD have difficulties in associated developmental traits, after controlling for IQ, in a population based sample. These associated difficulties should be considered during assessment and intervention.

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Cognitive strategy use of children with DCD during ball throwing/catching and wrapping up a parcel

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Children with DCD have problems with activities of daily living that require coordination. It has been suggested that children with DCD not only lack proficient movement coordination and control, but also have difficulty in applying adequate cognitive strategies needed to solve a motor task properly. The present study examined more in detail the use of cognitive strategies in children with DCD (N=14) and control children (N=14) during a ball throwing and catching task and during wrapping up a parcel task. A thinking aloud paradigm was applied to investigate and evaluate the cognitive strategies the children used. Verbalizations of the children were categorized based upon a coding schedule. Distinction was made between planning versus evaluation verbalizations with regard to Task and Performance aspects, and adequate versus inadequate verbalizations (cf. Martini et al., 2004). On the whole, children with DCD made significantly less verbalizations than control children on both tasks. During the ball throwing task children with DCD showed a significantly smaller proportion of evaluation verbalizations than control children, particularly for Performance. Also, the proportion of adequate verbalizations was significantly lower for Performance. During the wrapping up a parcel task the DCD group showed a significantly smaller proportion of planning verbalizations compared to the control group, particularly with regard to Performance. These results suggest that the strategy use of children with DCD is less effective when performing a motor task, and that it is therefore useful to help these children to improve their cognitive strategies. A thinking aloud paradigm seems to be a useful method to evaluate cognitive strategy use in children with DCD under the condition that they are encouraged to produce sufficient verbalizations.

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Inattention and in air time: Handwriting is not just a motor task

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Handwriting difficulties are often reported in children with developmental coordination disorder (DCD), and are formally recognised in the DCD diagnostic criteria set out in the DSM-IV. Traditional methods of handwriting evaluation commonly focus on the handwriting product, however by utilising digitizer technology the handwriting process can now be captured, producing objective, quantifiable measurements. Applying this method, Rosenblum and Zirinski (2008) found that DCD children spent significantly more time with their pen both on and off the paper whilst writing, and exerted less pen pressure when compared to a control group. Children with attentional deficits have also been highlighted as a population with handwriting difficulties. Therefore this study set out to investigate the handwriting process in children with high inattentive classroom behaviour, focusing on duration and pen pressure variables. From a cohort of over 400 children attending mainstream schools in Newport, Wales (UK), fourteen children rated as ‘abnormally’ inattentive by teachers were age- and gender-matched to participants without attentional difficulties, and their performance on two handwriting tasks was compared using a digitiser, wireless pen and the Computerised Penmanship Evaluation Tool (ComPET – Rosenblum, Parush and Weiss, 2003). The inattentive children took significantly longer to complete the tasks, principally as a result of an increased proportion of time spent with the pen off the paper, or ‘in air’, during the session. The amount of pen pressure exerted did not differ between groups, however the variance of pressure applied within participants was higher in the inattentive group. The inflated ‘In Air’ duration of the inattentive children were still observed when smaller groups were used, and were compared to a third group of poor readers without attention problems. These results suggest that handwriting is not just a motor task, and factors such as inattention are also important to consider. Examining the process behind handwriting performance may have implications in terms of recognising attentional difficulties that otherwise may be missed and may assist the implementation of suitable intervention strategies.

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**Children with Disorganization: A unique subgroup of children diagnosed with Developmental Coordination Disorder (DCD)**

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Disorganization is one of the most common problems for which students with DCD are referred to occupational therapy. Despite this fact, this problem has not yet been studied in depth. Moreover, there is no information as to whether or not these children constitute a subtype of children within DCD, or whether the Disorganization is part of their ADHD. The purpose of this presentation is to describe the identification process of children with Disorganization, DCD and ADHD. Methods: The study sample was comprised of 120 (out of 376) fifth and sixth grade Israeli school boys with normal intelligence. The assessment instruments included a newly developed Questionnaire for Assessing Students’ Organizational Abilities - T/P (teachers and parents versions), M-ABC, WISC-R-95 and Conners questionnaire. The questionnaires were distributed to parents and teachers; both the M-ABC and WISC-R were administered to all children. Findings: The study identified, out of all the children with DCD (n=63), a subgroup of children (48%) with Disorganization. In addition, the children with Disorganization (n=57) were classified into 4 groups: 1. Children with "pure" Disorganization (32% without DCD or ADHD) 2. Children with Disorganization + DCD (37% without ADHD) 3. Children with Disorganization + ADHD (15.5 % without DCD) 4. Children with Disorganization+DCD+ADHD (15.5%). Conclusions: There is a subgroup of children with Disorganization among the children diagnosed with DCD. However, not all the children with Disorganization within the DCD group have concurrent ADHD. Implications: The procedure of evaluating children with Disorganization should include an assessment to rule out the presence of DCD and ADHD. Identification of the disorders that co-occur with Disorganization will shed light on the main problem of the child and will help the therapist in planning an appropriate intervention program.

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**Psychometric properties of the little DCDQ**

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Purpose: Identification of motor coordination challenges before school age may enable families and service providers to monitor a child’s development more closely and perhaps ameliorate some of the social, psychological and behavioral sequela that often accompany Developmental Coordination Disorder (DCD) when it is unrecognized. At present, there is no parent questionnaire with a scoring system to identify possible DCD in preschoolers. Method: The fifteen items of the Developmental Coordination Disorder Questionnaire 07 (DCDQ) were translated into Hebrew according to guidelines for cross-cultural adaptation of instruments, and back-translated into English. Thereafter, the suitability of the fifteen Hebrew items was assessed for 3 and 4 year olds, and 22 additional items were devised based on expert opinion. All items were rated by 15 child development experts, using three criteria to establish content validity. Items which had 80 percent agreement among the experts and which were similar to areas of skills in the school-age DCDQ were included and categorized into three sub-scales. The 15-item questionnaire was then translated into English and back-translated into Hebrew. The pilot version, called the Little DCDQ, was administered to the parents of 28 children, ages 3 and 4. Results: Test-retest reliability for the total score and subscale scores ranged from =0.73-0.87. Item consistency and item-total correlations will also be reported. A study designed to establish construct validity and criterion validity with other measures for both the Hebrew and English versions of the Little DCDQ will also be described. Conclusions: Development of a parent questionnaire for use with preschool children will provide better support for younger children. The development of the Little DCDQ in two languages will also facilitate cross-cultural collaboration and comparison of diverse populations of children.

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Incremental validity of instruments for the identification and assessment of DCD

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In the clinical and research fields of Developmental Coordination Disorder (DCD), there is debate over the appropriate assessments to use to define the condition. Because DCD is multi-dimensional, children with DCD form a heterogeneous group, and there is no gold standard, the Leeds Consensus group recommends multiple measures. Although many standardized and non-standardized tests are available, their properties have mainly been measured in isolation rather than in reference to other measures, even though clinical diagnosis is rarely made on the basis of one test and the validity of any one instrument depends on which alternate measure is used as a comparison. Incremental validity can be defined as the degree to which a measure explains or predicts a phenomenon of interest, relative to other measures. It supplements traditional examinations of content, construct, discriminant and other forms of validity. A measure has incremental validity to the degree to which it increases the ability to predict phenomena when used in combination with other tests. This presentation will review the incremental validity of measures that are widely used internationally, such as the Movement Assessment Battery for Children (MABC), Bruininks-Oseretsky Test of Motor Proficiency, Movement Observation Questionnaire for Teachers, Developmental Coordination Disorder Questionnaire, and MABC Checklist, among others. How inferences about their incremental validity vary as a function of the goals of assessment, the criterion measures selected and the target population used will be discussed. Data analytic strategies for future studies which could examine the incremental validity of clinical judgements and tests in predicting DCD will be explored, including Hierarchical and Stepwise Linear Regression. Such evaluation is essential for the development of identification and service delivery strategies for children with DCD; users can combine this information with cost, utility and availability to select the best measure for the purpose.

DCD: Not just a motor learning difficulty -- but specific type of learning 'disability'

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Among others, Larkin and Rakimov (2006) refer to DCD as a motor learning ‘difficulty’ and state clearly that these children deserve support in school environments. However, documents produced by staff at CanChild state that DCD is a medical diagnosis rather than an educational diagnosis and therefore students with DCD may not qualify for or need special education services. After working in schools for the last number of years, this presenter is convinced that DCD fits the diagnostic criteria of a learning ‘disability’ – which is an educational diagnosis – and, that these students qualify for, deserve, and need special education services. DCD just happens to affect the learning and execution of motor skills rather than the acquisition and performance of reading, math, or other such academic skills. Educators are very interested in and must provide programming for students with learning disabilities. It follows that if DCD is recognized as a ‘motor’ learning disability, more professionals in Canada and the USA will come to recognize the need to identify and support these students within academic settings, and DCD will then gain credibility in the world of education. Furthermore, the identification of DCD as a ‘motor LD’ will impact how one should teach and how students with DCD can learn motor skills within a school setting. Overall purpose of this presentation: To explain how DCD fits the current diagnostic criteria of a learning disability, show the implications of that identification within educational settings, and demonstrate how the identification of DCD as a ‘motor LD’ directly impacts teaching strategies when working with students with DCD in a school setting.

Approach used: Theoretical perspective and applied research. Method Utilized: Compare/contrast DCD according to current definitions of learning disabilities and then demonstrate/provide rationale for using specific teaching strategies in educational programming. Conclusions: DCD is indeed a ‘learning disability’; students who have this condition deserve and need support in educational settings, and there are direct, explicit, and effective teaching strategies to use with students who have DCD when they are in the school setting. Further implications: Once DCD is identified as a ‘motor’ learning disability, much more credibility will be assigned to this DSM-IV disorder within the world of education. As such, researchers may then have more access to investigate additional non-motor-related ‘trends’ noticed in schools and further investigate and develop the types of teaching strategies and supports that may help students through-out their academic journey.

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Development and standardisation of a new handwriting speed test: the DASH

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Background: Handwriting remains an important skill throughout a student’s school career and beyond. Only when the basic elements of this skill can be performed automatically and quickly, can sufficient processing capacity be allocated to higher level components of writing such as composition. Handwriting difficulties are known to be common in DCD and can lead to academic underachievement. To date, few reliable tools have been developed to measure handwriting quality or speed. Aim: The aim of this paper is to describe the development and UK standardisation of a comprehensive test of handwriting speed, the DASH. Methods: A stratified sample of 546 children between the ages of 9 and 16 performed five tasks: copying under ‘best’ and ‘fast’ instructions, writing the alphabet, free writing for 10 minutes, and a non-language based task involving drawing intersecting lines within concentric circles. Conclusions: Our data suggest that standard scores on the first four tasks plus a composite score of speed of writing can be used to provide objective evidence of slowness of handwriting. Principal component analyses of the task scores revealed a strong general factor in each age group confirming the unidimensionality of the DASH composite score, which also had excellent internal consistencies in each age group (Cronbach’s alpha > .80). The profile of scores across tasks along with standard scores on the fifth task, provide practitioners working in health and educational settings with supplementary information useful for describing the needs of those with handwriting difficulties in more detail. Preliminary data showing good discriminative validity of this new instrument are also reported. Case studies are presented to illustrate how information from the DASH can be used to plan appropriate support for children with DCD.

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SOS: a screening instrument for graphomotor writing disorders

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Identification of children with graphomotor writing disorders is essential to start early intervention. The objective of this study was to gain information about the psychometric properties of our recently developed screening instrument for graphomotor difficulties. i) to evaluate test-retest reliability, ii) inter-rater reliability, and iii) criterion-related validity. Norms have been gathered for the Flemish population. A Dutch handwriting assessment Beknopte Beoordelingsmethode voor Kinderhandschriften (BHK) was used as starting point for the development of the SOS-test. The child copies a text on unruled paper for 5 minutes. The first 5 lines are used to evaluate 6 criteria: 1) the shape of the letters, 2) the connection between letters, 3) letter height, 4) regularity of letter height, 5) space between words and 6) spatial alignment of the sentence. The number of copied letters is counted to calculate writing speed. Standardization data were collected from a group of 880 children from mainstream schools and 114 children with learning disorders. The SOS test was scored twice by the same tester within a two week interval (50 children) and by two testers (100 children). Two evaluate the stability of the performance, 68 children wrote the SOS text a second time, two weeks later. To evaluate concurrent validity, both the BHK and the SOS were scored for 146 children. Results showed good reliability 1) intra-rater ICC 0.98, 2) inter-rater ICC 0.93 and 3) test-retest ICC was 0.90. A significant difference between the age groups on the SOS score was found. Children with learning disorders performed significantly worse on the SOS compared to typical developing children, showing that the SOS is sensitive to detect differences in writing performance. The Pearson correlation coefficient between BHK and SOS showed moderate to good agreement (0.70). We conclude that the SOS is a reliable and valid instrument to identify graphomotor difficulties.

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Handwriting disorders: Profiles of children with DCD compared to other profiles, with and without co-morbidity

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Children generally spend around 45% of their school day writing therefore difficulties in handwriting can strongly interfere with academic achievement. Handwriting disorders therefore represent a specific learning disability that may have a negative effect on the quality and quantity of written products, as well as on handwriting speed. Deficits in handwriting performance are common among children with DCD, although this disorder is also frequently found in other learning disabilities, such as spelling disorders. The main purpose of this work is to better describe the specific handwriting deficits of children with DCD and to determine their prognosis for improvement with respect to children with other specific learning disabilities. A sample of 40 participants was selected and subdivided into 4 clinical groups: 1. DCD + Handwriting disorders, 2. DCD + Handwriting disorders + Spelling disorders, 3. Handwriting disorders + Spelling disorders, 4. Only handwriting disorders. Each child performed 3 speed handwriting tasks and a task requiring the transcription of a sentence in 2 different conditions (best and fast). Apart from handwriting speed, legibility was also analysed in the 2 sentences by considering 12 parameters that describe legibility itself as the result of efficiency in 5 areas: visuo-spatial abilities, motor schemes, degree of motor automatization, personal style and inefficient /inaccurate learning. This method of handwriting evaluation is based on the VGM-Post test (Borean et al, 2008), standardized on a population of 400 Italian school children and similar in some principles to the BHK scale (Hamstra-Bletz, De Bie & den Brinker, 1987). Results suggest different deficits in the 4 clinical groups, with implications for treatment and its efficacy. In literature the importance of proper intervention is generally acknowledged, however it remains unclear if children with DCD + handwriting deficits can benefit from treatment to the same degree as children with other co-morbidities. This issue will also be addressed in this work by comparing the pre and post treatment data of the 4 clinical groups, obtained before and after a two-month specific treatment program.

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Activities of daily living: Assessment, intervention and outcomes for children with developmental coordination disorder

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This study explores the range of activities of daily living that are relevant, and present difficulties, for 5-11 year children with developmental coordination disorder (DCD) as viewed by children, parents, teachers and referrers. The approach is child and family centred within an ecological framework that considers the child in their typical environments. Activities of daily living are identified for 43 children with, or at risk of, DCD as defined in DSM IV. They all scored below the 15th percentile on the Movement Assessment Battery for Children, had identified difficulties with activities of daily living, had been examined by a paediatrician to eliminate any other medical condition and had no identified global developmental delay. The children’s concerns are identified using the Perceived Efficacy and Goal Setting System, the parents/carer’s concerns with questionnaires and the Canadian Occupational Performance Measure’s semi structured interview. The teacher’s concerns are identified via a questionnaire. The referrers’ concerns are collected from the initial referral letter. Respondents could identify several activities in each area. The top three concerns for children are play and leisure (n=55), self-care (n=53) and schoolwork (n=47). The top three concerns for parents are schoolwork (n=43), motor skills (n=24) and social skills (n=17). The top three concerns for teachers are schoolwork (n=52), motor skills (n=23) and attention/concentration (n=11). The top three concerns for referrers are motor skills (n=38), schoolwork (n=35) and self-care (n=25). Three case studies are presented to illustrate the findings. Consulting the children is a requirement of person centred practice and captures the child’s motivation. It also ensures ecologically valid interventions as the children identified many self-care, play and leisure activities not identified by the adults. Negotiating goals for therapy with the team around the child, based on identified issues with activities of daily living means services than are needs led, person centred and ecologically and culturally valid.

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Activities of daily living and participation in children with developmental coordination disorder: systematic review

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Introduction: Children with Developmental Coordination Disorder (DCD) are characterized by clumsiness and marked impairment in the development of motor coordination, however, the DSM-IV also specifies that the motor disturbance must interfere significantly with the performance of activities of daily living. Many articles document limitations in body functions such as balance, strength, and motor coordination, but what do we know about activity and participation issues faced by these children? More specific information concerning the pattern of performance on daily skills is necessary not only to subsidize DCD’s diagnostic criteria, but also with growing evidence that impairments are difficult to change, therapists and other professionals who deal with these children need a clear picture on which to base intervention strategies to improve the performance of daily activities and enhance participation. Objectives: To systematically review all literature published in peer reviewed journals from January 1995 to June 2008 and summarize the activity and participation problems of children with DCD. Methods: Multiple databases were searched for articles related to DCD; only experimental articles were retained. Articles were coded according to the International Classification of Function (ICF) and descriptions of activity and participation issues were identified. Results: Preliminary analysis reveals that of 296 experimental articles that met inclusion criteria, only 56 (19.3%) presented any data related to activity and participation issues. Data was generic and scattered, with only 18 articles using published measurement tools. Most frequently cited issues were poor handwriting, difficulties playing ball games, getting dressed and participating in organized sports. Conclusion: Evidence concerning activity and participation issues of children with DCD is limited in volume and scope. Improved understanding of their participation in daily activities is essential to clarify diagnostic criteria and to guide evaluation to make evidence-based clinical decisions about intervention strategies and relevant outcomes.

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Experiences of driving in emerging adults with DCD

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Whilst past research has focussed on driving skills and ADHD (Barkley, 2004), little research has focussed on the driving difficulties faced by individuals with DCD. Forty students aged 17-25 years who reported co-ordination difficulties since childhood and/or a diagnosis of DCD were compared to 79 age matched controls using a questionnaire used and devised by Barkley in studies with individuals with ADHD. This questionnaire along with additional open ended questions was used to examine factors relating to driving experiences in young people with DCD. Results: DCD students were significantly different to the control group to have avoided learning to drive compared with controls and cited co-ordination difficulties and control issues as reasons for not learning. Driving behaviour seemed more cautious in the DCD group, as control students were shown to drive significantly more miles a week and were more likely to be cited for speeding offences. A reduction in miles driven per week in the DCD group may be related to social behaviour with the control group experiencing more social opportunity. Whilst a higher incidence of driving accidents was reported in the control group, DCD adults were significantly more likely to report difficulties with distance estimation. Themes were extracted from the open ended responses and qualitative statements give a valuable insight into the parking, spatial awareness and control difficulties faced by DCD adults. Conclusions: Driving difficulties in adults with DCD may be due to a combination of poor motor control and executive functioning problems. Driving is a key rite of passage in emerging adulthood and represents an opportunity for independence from parents. With fewer individuals with DCD opting to learn to drive compared to controls, future research should consider attention difficulties in emerging adults with DCD. Practical implications of these results will be discussed.

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Framework for clinical practice guidelines in DCD based on evidence and interdisciplinary consensus

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There are a few consensus papers on diagnosis and treatment of DCD. However, a world-wide search revealed that there are no Clinical Practice Guidelines for DCD based on systematic literature search and on interdisciplinary consensus. In autumn 2007, an interdisciplinary group of German speaking specialists on DCD and an international advisory board started to develop systematically a guideline on DCD (supervision by the Association of the Scientific Medical Societies in Germany (AWMF)). So far, the group established a methodological frame with specific key questions and goal settings relevant for outcome of a systematic literature search related to the International Classification of Functioning (ICF). This frame will be presented for discussion at the conference. On this basis, a systematic literature search is carried out in order to assign levels of evidence. Further questions will be answered on the basis of previous Consensus papers and on further consensus meetings.

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Monozygotic twins concordant and discordant for DCD and ADHD: Two sides to the story

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We used a co-twin control design to study monozygotic (MZ) twins concordant and discordant for Developmental Coordination Disorder (DCD) and Attention Deficit Hyperactivity Disorder (ADHD). In Study 1, using questionnaire data from a total of 922 sets of MZ twins aged six to 17 years, we found that that perinatal oxygen perfusion problems were associated with DCD, and that pre- and perinatal environmental factors were stronger in the etiology of DCD than ADHD, implying different causal pathways for the two disorders (Pearsall-Jones et al., 2008). In Study 2, we further explored our findings using face-to-face interviews of six female and 10 male sets of MZ twins, aged eight to 17 years, from the first study. We also used the McCarron Assessment of Neuromuscular Development (MAND) to assess for DCD, and telephone interview using the Diagnostic Interview Schedule for Children, Fourth Edition, Parent Interview (DISC-IV-P) to assess for ADHD. Our key findings in the second study supported findings in the first study of different causal pathways for the two disorders (Pearsall-Jones et al., 2009). We used the Family Assessment Device and the Five Minute Speech Sample to explore the complex psychosocial relationships within the 16 sets of twins interviewed. Each twin described their unique perceptions of their twin relationship and family dynamics, and what they most and least appreciated about their cotwin and their lives together. Both affected and unaffected siblings have been found to be affected by one or both living with either disorder. These were their stories from a co-twin perspective.

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How do children with DCD participate and enjoy daily activities?

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Background: Participation is defined by the World Health Organization as involvement in life situations and engagement in occupations of daily activities that are essential for development and life experience of individuals. Focusing on participation, the International Classification of Functioning, Disability and Health reflects a shift from a medical model of disability to a broader bio-psychosocial model of health. Participation is a multi dimensional construct that can be represented in few measures such as diversity and frequency of activities, level of independence, child's enjoyment, and parents' satisfaction from child's performance. DCD effect the performance of children in many areas of life, however little is known on the participation level of those children in pre-school years. The purpose of this study was to compare participation and performance skills of children with DCD to those of children who were referred to therapy but without DCD diagnosis and to a control group of children without disability. Method: 21 children with DCD, 21 children who were referred to Occupational Therapy treatment with mild problems but were not diagnosed as having DCD, and 21 matched controls participated in the study. All children were at the age of 4 to 6 years (M = 4.97, SD = 6.26). Procedure: The M-ABC was administered to the three study groups. All parents' participants completed the Child Participation Questionnaire (CPQ). Results: Significant differences were found between the 3 groups on the participation measures of level of independence, child's enjoyment, and parents' satisfaction. In addition, significant differences were also found between the three groups in their motor and organizational skills but not in communication skills. Conclusions: Children with DCD experience less enjoyment in their daily activities and their parents are less satisfied from their participation in comparison to children without disability and even in comparison to children with other mild developmental problems. Even in the pre-school years, the diagnosis of DCD has a major affect on children's quality of life.

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Exploring psychological distress in children with DCD and/or Attention Deficit Hyperactivity Disorder: A population-based study

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Purpose: Developmental Coordination Disorder (DCD) and Attention Deficit Hyperactivity Disorder (ADHD) are prevalent childhood conditions that often co-occur. Strong links have been shown between ADHD and psychological distress, but the potential contribution of DCD has not been established in a population-based sample. In this study, psychological concerns were investigated systematically in a large sample of children initially identified on the basis of motor impairment, not attentional problems. Objectives: The objectives of this study were to examine: 1) the prevalence of depression and anxiety in a population-based sample of children who have DCD; 2) the influence of ADHD, gender and age on these relationships. Method: 3153 children in Grades 4-8 were screened using the Children's Selection and Predilection for Physical Activity scale (CSAPPA: a child-report of participation in physical activity) and the parent-completed DCD Questionnaire (DCD-Q). 113 Children scoring below 5% on either measure (32 of whom were previously diagnosed with ADHD), 55 children scoring above 5% on both measures and previously diagnosed with ADHD, and a random sample of 89 typically-developing children were assessed to determine the presence/absence of DCD according to DSM IV criteria. Parents and children then completed the respective versions of the Children's Depression Inventory and the Self-Report for Childhood Anxiety Related Disorders. For analytic purposes, children were subsequently classified as: DCD only (n=78), ADHD only (n=34), DCD/ADHD (n=54) and typically-developing (n=91). Data collection is now complete. Findings: Children with DCD and children with ADHD were significantly more depressed and anxious than typical children and the presence of both disorders heightened this effect. The gender differences observed within all groups will be described. Implications: This is the largest epidemiological study ever investigating children selected first on the basis of motor impairment. The findings will have clinical and research significance for our understanding of psychological distress in children with DCD.

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An examination of the association between motor control and body satisfaction in young children

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The inverse relationship between motor competence (MC) and body weight, as well as that between body weight and body satisfaction (BSat) have been well documented. However the association between MC and BSat is unexplored. Knowledge of the influence of poor MC on BSat is important if the full burden facing children with DCD is to be understood. This is of particular importance since low BSat is associated with low self-esteem, depression, and disordered eating. In this study we examined this association among 1907 children in Grade Five (971m; 936f; mean age 9.7) from Ontario, Canada participating in the ongoing Physical Health Activity Study Team (PHAST) project. Children were assessed for BMI, MC (Bruininks-Oseretsky Test of Motor Proficiency-short form), and BSat using a seven item scale. Children were grouped as overweight or normal-weight (using BMI cutoffs for age and gender), and as case (potential DCD – lowest 10% BOTMPsf) or non-case. Analyses of variance by gender demonstrated that boys had significantly higher MC scores and therefore gender specific multiple logistic regression models were used to determine the relationship between BSat and BMI and MC for boys and girls. There was a significant relationship between BSat and BMI for both genders (p< .01) and for males a significant relationship between BSat and MC (p<.03). Overweight females were less likely to be satisfied with their bodies with an Odds Ratio (OR) of 0.33 (.CI: 0.227-0.469). The same trend was found in overweight males (OR: 0.44; CI: 0.309-0.631). Males with higher MC reported greater body satisfaction (OR: 1.89; CI: 1.034-3.467). Overweight females were less likely to be satisfied with their bodies with an Odds Ratio (OR) of 0.33 (.CI: 0.227-0.469). The same trend was found in overweight males (OR: 0.44; CI: 0.309-0.631). Males with higher MC reported greater body satisfaction (OR: 1.89; CI: 1.034-3.467). Males with poor MC were at greater risk for low BSat regardless of their overweight status. As overweight is prevalent among children with DCD these results indicate that low BSat is also a significant concern. This finding suggests that attention should be paid to perceptions of body satisfaction among children with DCD. This appears particularly true for boys with poor motor performance whose bodies may fail them in meeting two common societal expectations, shape and skill.

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Developmental Coordination Disorder (DCD) and physical activity in a UK birth cohort study

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Objective: To test the hypothesis that DCD at age 7 years is associated with reduced physical activity (PA) at age 11 years. DESIGN: Longitudinal analysis, using prospectively collected data from the Avon Longitudinal Study of Parents and Children study (ALSPAC), a representative UK birth cohort. Methods: Complete data was available from 4636 children who completed the ALSPAC Coordination Test, derived from subtests of the Movement Assessment Battery for Children at age 7 years, Actigraph accelerometry at age 11 years and a parental questionnaire reporting participation in vigorous PA (VPA). PA was measured as average counts per minute over a maximum of 7 consecutive days. Analysis of the difference between the level of PA of children with (n=189) and without DCD (n=4447) was explored. A series of multivariable regression models also explored the associations between the 15 point Alspac Coordination Score and time in moderate and vigorous physical activity, accounting for potential confounding factors including socioeconomic factors and fat impedance. Findings: Children with DCD had a significantly lower level of parental reported vigorous physical activity than controls (p<0.001). There was no difference in girls with and without movement problems. Conclusion: This study has shown that DCD, especially in boys, is a potential risk factor for reduced physical activity using prospectively collected data and accounting for potential confounding factors. The implications of reduced PA should be considered in the assessment and management of children with DCD.

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Physical activity of children with Developmental Coordination Disorder in the presence of Attention Deficit Hyperactivity Disorder: Does gender matter

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Children with Developmental Coordination Disorder (DCD) have difficulties in motor coordination. Attention-deficit hyperactive disorder (ADHD) is co-morbid with DCD at approximately 50%. Children with DCD are less physically active (PA) than their peers, while children with ADHD are often more physically active. The primary objective of this research was to contrast physical activity patterns between children with DCD, DCD-ADHD, and healthy controls. A secondary objective was to determine if gender moderated the association between groups and physical activity. A sample of males (n=66) and females (n=44) were recruited from the Physical Health Activity Study Team (PHAST) longitudinal study. The Movement Assessment Battery for Children (2nd Ed.) identified probable cases of DCD, and Connors Revised Parent Rating Scale-Short Version identified ADHD. Subjects (mean age=12.8±.4 yrs) were allocated to three groups; DCD (n=32), DCD-ADHD (n=30) and control (n=48). Physical activity was monitored for seven days with the Actical® accelerometer (activity count, step count and energy expenditure), and children completed the Participation Questionnaire (PQ). Analysis of variance showed significant group differences for activity count (F(2,56)=5.36, p=.007) and PQ (F(2,44)=6.71, p=.003) in males, and a significant group difference for step count (F(2,37)=3.55, p=.04) in females. Post hoc comparison tests (Tukey) identified significantly lower PQ and activity count between males with DCD and controls (p=.004) and males with DCD-ADHD and controls (p=.003). Conversely, females with DCD-ADHD had significantly more step counts than their controls (p=.01). Analysis of covariance demonstrated a gender by DCD groups negative interaction for males (activity count) (F(2,92)=3.11, p=.049) and a positive interaction for females (step count) (F(1,92)=4.92, p=.009). Hyperactivity in females with DCD-ADHD appears to contribute to more physical activity, whereas DCD may contribute to decreased activity in males with DCD and DCD-ADHD. Further research is needed to examine gender differences in physical activity within the context of DCD and ADHD.

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Trajectories of cardiovascular risk in children with and without Developmental Coordination Disorder: Results from a large, prospective cohort of children

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Rationale: Obesity and poor physical fitness are risk factors for cardiovascular disease, and high prevalences of both have been documented in cross-sectional studies of children with DCD. However, remarkably few studies have examined the association between DCD and these risk factors over time. Method: We assembled a large cohort of children from the population of grade 4 students enrolled in public schools in the Niagara Region of Ontario, Canada in 2004-05. Permission from 75 of 92 possible schools (83%), and informed consent from the parents of 2262 of 2378 children (95.4%) within these schools was obtained. Formal data collection began in the spring of 2005, with complete re-assessments carried out in each of the fall of 2005, spring and fall of 2006, and spring of 2007. Children scoring below the 6th percentile (n=103) on the short form of the Bruininks-Oseretsky Test of Motor Proficiency were classified as probable cases of DCD (pDCD). At each time point, height and weight were measured directly, physical fitness was assessed by a 20-metre shuttle run test, and self-reported physical activity was obtained from a standardized self-report measure. Results: We examined change over time in BMI, physical activity, and physical fitness using mixed effects modeling. For physical activity, we found a significant interaction between gender, time, and pDCD status, with self-reported activity levels declining among affected girls but not affected boys. For physical fitness and BMI, we found interactions between time and pDCD status, with children with pDCD showing poorer development of physical fitness and higher BMIs than their peers. Discussion: To our knowledge, this is the largest community-based study to examine the association between motor coordination problems and cardiovascular risk in children over time. Similar to the results of cross-sectional studies, children with pDCD are at greater risk than their peers for overweight/obesity, physical inactivity and poor physical fitness. These differences are persistent, and in some cases increase, over time. Implications for interventions and future research are discussed.

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DCD VIII – International Conference Baltimore 24 – 26 2009
Can group interventions be effective in improving activity of daily living skills for children?

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This study examines the effectiveness of group-based interventions in improving activities of daily living (ADL). Two separate groups are presented, one for bike riding and the other for a range of self-care, schoolwork and play activities. Fifty-three children with a range of diagnoses including DCD attended a bike-riding group on four consecutive days and eight children with DCD attended an ADL task orientated, group intervention of eight sessions delivered over a two-week period. Fifty-three children identified bike riding as a goal plus 56 ADL goals were identified by a sub-group of eight children. The children could set several goals and sub-goals. The ADL goals were tying laces (8), handwriting (24), ball skills (2), scissors (2) and other (9). The intervention methods took a similar approach for both the ADL and bike riding groups. Two occupational therapists ran the ADL group and the bike group by a cycling coach, occupational and physical therapists. The evolving, eclectic, cognitive-motor approach (initially described in the Movement ABC (1992) manual and expanded in the second edition) was used to enable children to achieve their goals. Therapists and the coach used dynamic performance analysis to break the tasks down and practice the skills required. A range of methods is described to establish whether the goals had been met. Results showed 34 of the ADL goals were totally met, 12 partially met and 9 unmet. Forty-seven (89%) of the children learned to ride a bike independently with 2-16 hours of intervention with 29 (63%) learning in four hours. The eclectic, cognitive-motor approach and dynamic performance analysis are effective methods of enabling children to achieve functional tasks. Bike riding is more readily taught in a group that just focuses on that skill, whereas other ADLs can be remediated together in a group setting. Different scheduling regimes may be required for specific tasks.

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The effects of synchronized timing training on timing accuracy and consistency, attention, motor function, and self-perception in children with Developmental Coordination Disorder

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Children with Developmental Coordination Disorder (DCD) exhibit timing deficits, specifically decreased accuracy and consistency, which contribute to their known difficulty in carrying out functional activities of daily living. This pilot RCT was designed to investigate the effects of synchronized timing training (STT) on timing accuracy and consistency, attention, function and self-perception in children with DCD. Method: Thirteen participants, ages 9-12 years, identified by their parents as having coordination difficulties similar to those seen in children with DCD, were recruited. All participants were randomly assigned to 1 of 2 groups: an experimental group which received STT via a computerized metronome program 2-3 times weekly for 6 weeks; or a control group who received weekly correspondence for 6 weeks. All participants were evaluated before randomization and then again 6 weeks and 3 months later. Both groups demonstrated similar performance on timing accuracy and consistency, attention, the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) and Self-Perception Profile for Children (SPPC) at baseline. Results: Following STT, children exhibited significantly improved timing accuracy and consistency and had significantly fewer inattentive errors. Although there were no significant group differences in motor performance on the short term retention test, on the long term retention test the training group showed significantly greater improvements in gross motor composite scores, gross and fine motor percentile ranks, and a trend toward significant differences in battery composite percentile rank than the control group. There were no training differences in self-perception. Conclusion: The results of this study provide evidence that synchronized timing training enhances timing, attention and motor function in children with dyscoordination. Additionally, it provides evidence that children with DCD can learn to perform repetitive movements with high degree of accuracy and consistency.

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Developmental coordination disorder - do personnel and environment impact on intervention outcomes for this condition?

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Intervention for DCD has been shown to be better than no intervention, however there is scarce information on the delivery of all types of intervention. This study compares different environments and personnel in service delivery. Ninety-three children from 13 South Australian schools, aged 5-9 years were recruited to participate in this RCT. Participants received a group intervention running for 13 weeks, working on fine and gross motor skills. Schools were randomised using cluster randomisation to receive one of three modes of delivery. Group one schools received the program at school run by a school assistant, group two received the program in school run by a physiotherapist and group three received the intervention in a health clinic run by a physiotherapist. Group three was considered the control group for delivery as the literature concludes group programs run by health professionals in a health setting have success in treating children with DCD. Participants were assessed pre and post intervention, and 6 months after the program completion. The Movement ABC (MABC), Test of Gross Motor Development (TGMD-2) and Pictorial Scale of Perceived Self Competence and Social Acceptance (PSPSCSA) were used to assess participants, while a parent questionnaire was used to gain information on more practical aspects of service delivery. For time effects the participants demonstrated a significant improvement in motor skills, statistically (p=0.000) and clinically, following the intervention, for all modes of delivery, as tested by MABC and TGMD. This effect was maintained at the six month follow-up. There was no significant group effect. The results for the PSPSCSA show the participants to have a better self perception of physical abilities, but poorer self perception of peer acceptance following intervention for all groups. Group two were found to have a significant improvement of perception of cognitive abilities. A summary of parent questionnaire data found parents to prefer programs to be run in schools by health professionals. The study showed that the program can be run by either a professional or school assistant in the school or health environment and provide successful outcomes, however consideration needs to be given to practical and financial aspects of service delivery as highlighted by parents.

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Poster Presentations

Wednesday June 24, 2009
1. Single error analysis of representational gestural production in different sample of children with DCD

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Introduction/Aims: The aim of this study was to examine the underlying mechanisms that characterize the disorder by examining the errors produced during praxic performance in the following group comparisons: i) between two groups of children with DCD, one selected from schools (sDCD) and another from clinics (cDCD) with typically developing age-matched children (AMC); ii) between sDCD and cDCD and iii) between DCD groups with two younger typically developing groups. Methods: Children aged 9-11 years were selected from schools to form the AMC (n=24) and the sDCD groups (n=26), and clinics to form the cDCD group (n=19). The two younger typically developing groups within the age ranges of 5-6 years (n=23) and 4-5 years (n=25) acted as motor age groups (MA1 and MA2 respectively) were also selected from schools. All children were assessed on the MABC and fulfilled DSM IV criteria. Praxis was assessed through the use of representational (transitive and intransitive) gestures. Praxic performance was analyzed used a single error taxonomy previously documented mainly in adult apraxic patients. Results: All groups showed a lower proportion of errors in intransitive than intransitive gestures. Both DCD groups produced higher proportion of errors than their typically developing peers that was mainly evident for the transitive than intransitive gestures and in the cDCD than the sDCD groups. Differences between the two DCD groups were significant for both types of gestures with higher number of types of errors for transitive than intransitive. Higher proportion of errors was produced by the DCD groups when compared to the younger ones in some cases and this was more evident in the cDCD group. Discussion: Overall the analysis indicated that children with DCD have a deficiency in planning, together with evidence of problems in execution and the these are discussed with respect to the cause being due to delay or pathology.

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2. Do task complexity and type of scoring influence the performance in DCD children? Insights from unimanual and bimanual hand postures

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Introduction/Aims: In this study the aim was to examine the performance in unimanual and bimanual hand postures produced from memory and visual representation in the following group comparisons; i) between two groups of children with DCD, one selected from schools (sDCD) and another from clinics (cDCD) with typically developing age-matched children (AMC); ii) between sDCD and cDCD. Across these aims it was investigated whether the difficulty of a task influenced the performance in children with DCD, and for this reason bimanual hand postures were employed as more complex tasks. In addition, there was an examination as to whether discrimination on performance was dependent on two different scoring systems. Methods: Children aged 9-11 years were selected from schools to form the AMC (n=24) and the sDCD groups (n=26), and clinics to form the cDCD group (n=19). All children were assessed on the MABC and fulfilled DSM IV criteria. Hand postures were analyzed using two different scoring systems: the first evaluated the accuracy which the posture was reproduced whereas the second accuracy and how the movement was completed. Results: Overall the sDCD group showed a level of performance similar to typically developing peers only for the reproduction of unimanual hand postures. On the other hand the cDCD group performed worse in most cases than the AMC group. Although the sDCD group showed superior performance than the cDCD group across postures and trials, the differences were not statistically significant. Task complexity and scoring influence the performance in both DCD groups and this was particularly evident in the cDCD group. Discussion: The patterns of performance observed here are discussed surrounding views on the nature of the disorder. The research and clinical implications of task complexity and the application of different scoring systems are also considered.

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3. Examining an underlying problem for children with DCD - Forming an action representation

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Examining an Underlying Problem for Children with DCD - Forming An Action Representation Motor programming theory suggests that an integral component in an effective outcome is an adequate action representation of the movements. One view contends that action representation is a component of an internal forward model, which is a neural system that simulates the dynamic behavior of the body in relation to the environment (e.g., Wolpert, 1997). This theory proposes that internal models make predictions (estimates) about the mapping of the self to parameters of the external world; processes that enable successful planning and execution of action. The literature indicates quite clearly that children with DCD display deficits with an array of perceptual-motor skills. It has been hypothesized, based on limited research, that an underlying problem is a deficit in generating and / or monitoring an action representation termed the internal modeling deficit (IMD) hypothesis (e.g., Deconinck et al., 2008; Lewis et al., 2008; Pettit et al., 2008; Van Waaelvelde et al., 2006; Williams et al., 2006, 2008; Wilson et al. 2004). According to the hypothesis, children with DCD have significant limitations in their ability to accurately generate and utilize internal models of motor planning and control. This presentation will highlight the key findings supporting this notion including research methods and possible brain structures involved. An addition, a paradigm unique with this population - estimation of reachability (distance) via motor imagery, will be described. Estimating reach, a form of action representation, requires efficient use of allocentric cues (target and surrounding information) and a mapping to the body via body-scaling to establish egocentric coordinates. Studies using typically developing children and this paradigm have shown interesting developmental differences associated with (for example) spatial recognition and planning reach movements in peripersonal and extrapersonal space.

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4. Dynamic touch in typically developing children and children with DCD

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In daily life we wield objects- scissors, kitchen implements, gardening tools and sports equipment providing information about the spatial and weight characteristics of the object. This type of perception is called dynamic touch and variables such as the role of inertia tensor are proposed as providing this information. (Reviews: Carello & Turvey, 2004; Turvey, 2004). Here the aim was to examine the differences in dynamic touch, as operationalised by estimation of rod length, between typically developing children (TDC) and children with developmental coordination disorder (DCD). Fifty eight children, 9-11 years of age, participated: 45 TDC, 21 male and 24 female; 13 children with DCD, 10 male and 3 female. Of the children with DCD, 11 scored in the lowest 5% on the Movement ABC Test and Checklist; one child was at the 8th% on the Test and in the lowest 5% on the Checklist and one child only had a Checklist score which was in the lowest 5%; all fulfilled other DSM IV criteria. The children were asked to wield unseen, 6 rods of differing lengths 30-105cms (steps of 15cms), in random order and estimate their length by a marker on a trolley rolled by the other hand to where they thought the end of the rod was located. The results showed that both groups placed the rods correctly in order of length although they consistently underestimated the length. This underestimation increased with the length of the rod but as a percentage of the rod length, it remained constant. No differences were found between the children with DCD and the TDC irrespective of the error score utilised. These results are discussed in terms of the differences between purely psychophysical tasks such as this and those with a meaningful context where with the same children major differences have been found.

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5. Automatic attention orienting by social cues in children with Developmental Coordination Disorder

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Background: Recent studies have revealed the exogenous control of visuospatial attention with arrow cues in children with developmental coordination disorder (DCD), but have not yet investigated such a mode with social cues. Purpose: The aim of the present study was designed to examine further the automatic attention orienting in children with DCD and determine how generalized deficits are in this domain. Methods: Fourteen children with DCD and 14 controls aged 9-10 years old were identified with the Movement Assessment Battery for Children test. All children were tested on the automatic attention orienting by social cues appeared at the center of the screen with the stimulus onset asynchrony of 500 ms. Each child received 300 trials which were grouped into three separate 100-trial blocks. The probabilities of four conditions were 30% valid, 30% invalid, 30% neutral, and 10% catch trials. Results: Children with DCD had a significantly longer reaction time than controls for all conditions. They were more disadvantaged by invalid cues as compared to controls. Conclusions: Children with DCD appear to manifest an abnormal control in automatic attention mode. However, the result has been somewhat inconsistent with the previous studies. Future research efforts should continue to address this uncertainty.

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6. What reaching movements can tell us about children with DCD

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The reach-to-grasp action is commonly described in terms of a proximal to distal distinction, dependent on two neural channels activated simultaneously and in parallel, functionally coupled, for goal-directed action by a higher order coordinative structure. The reaching channel, via the dorsal stream, obtains information about the spatial location of objects and is involved in the execution and on-line control of action programs. The grasping channel acquires information about the properties of objects to produce suitable grasping patterns and relies mainly on the ventral stream involved in action from memory. The purpose of this study is to determine whether kinematic analyses of upper limbs are useful procedures to identify key characteristics of children with DCD. Longitudinal data of two children with DCD are compared with those of 25 typically developing children and results from the first observations of 10 children with DCD are also discussed. In this work, participants were asked to reach and grasp objects of three different sizes, positioned at two distances, in vision and no-vision conditions for a total of 72 movement situations each time. Results in all groups are discussed with respect to three variables demonstrating that the reach-to-grasp action needs a long time to be refined, shows a non linear development and reflects the maturation of neural patterns. In typically developing children, reaching seems to refine around 8 years of age, however the variable distance from the target causes uncertainty and is still difficult to retain. On the other hand, grasping shows ample variability until 9 years of age, however after this age object size seems to be efficiently retained for motor planning. These results were not confirmed in children with DCD. In particular, the kinematic profiles, obtained from the two longitudinal studies on DCD, show more than just the well documented need for longer movement time; they also reveal different strategies and suggest different underlying deficits, which may be related to the functionality of the two distinct neural streams.

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7. Kinematic analysis tool for the evaluation of treatment effectiveness in children with handwriting disorders

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Using a digitizing tablets to describe hand movements produces objective quantitative analysis that can be useful in the study of writing quality disturbances as well as for the effectiveness of a rehabilitation treatment. In this work a set of kinematic parameters (number, duration, length, peak and mean velocity of components and strokes) are proposed and discussed to demonstrate the potential of a kinematic analysis in providing quantitative and automated measures of handwriting performance, useful for an objective treatment assessment. Twenty-five scholar-aged children with handwriting disorders performed writing tasks consist of a cursive sequence (i.e. ‘lelele’) and of a transcribed sentence in two different conditions (best and fastest) before and after a treatment program, one which promotes the acquisition of domain specific movements. The results show that after the treatment the handwriting legibility of all the children had improved. In particular, component and stroke mean durations showed a significant increase, while stroke mean and peak velocities decreased. The significance level is higher in the sentence task (p<0.0001) than in the cursive sequence (p = 0.02) while the number of strokes (normalized for task duration) and their mean length do not change significantly. The handwriting speed had slowing down, supporting the hypothesis that greater attention in stroke production is required in order to formulate a new correct motor sequence. More precisely, the peak velocity decreases less than the mean velocity during the same stroke, that is, the motor capability remains almost intact while the treatment mainly operates on a different strategy, one that modifies the velocity profile. Furthermore, children, who required only a minimum program adjustment or an increased attentional level, present a small increment in the mean velocity and a reduction of stroke durations that might reflect an automated motor program that is already consolidated. These results do not only permit to monitor the progress of a rehabilitation program but also provide relevant information to better understand processes and strategies involved in handwriting disorders.

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8. The effectiveness of exercise intervention on inhibitory response capacity in children with Developmental Coordination Disorder

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Background: In several experimental studies, children with developmental coordination disorder (DCD) have been demonstrated that they displayed a deficit in volitional shifts of attention. However, there seem to have been no studies on exploring the effectiveness of exercise intervention for the deficit in the inhibitory response capacity in children with DCD. Purpose: The aim of this study was to investigate the efficacy of table-tennis training on inhibitory response capacity in children with DCD. Methods: Forty-three children aged 9-10 years were screened using the Movement Assessment Battery for Children test and divided into DCD (n=27) and normal (n=16) groups. Children with DCD were then randomly assigned to either an exercise-intervention group who underwent a ten-week table-tennis training program or a non-exercise-intervention group. Before and after training, the inhibitory response capacity was examined with the endogenous Posner paradigm task for all children. Results: Repeated measures ANOVA of pretest-posttest scores showed that intensive table-tennis training resulted in significant improvement on inhibitory response capacity for the children with DCD. Conclusions: The study has demonstrated that exercise training can be effective to improve the inhibitory response capacity in children with DCD. However, future research efforts should continue to clarify whether the performance gains can be maintained over time.

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9. Tentative proposals towards a framework for understanding DCD

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In recent years there has been an increase in the number of studies that have been published concerning developmental coordination disorder (DCD). Relatively little work has focused on the causal mechanisms at work in this condition. This is, at least in part, due to the narrow focus of experimental studies in this population, and its specialisation on a narrow age range of individuals. Such theoretical work as exists has reflected these restrictions. In this poster we use Morton's (1995; 2004) causal modeling framework to unify the available models of DCD and to highlight the interactions among biological, cognitive and behavioural characteristics of the disorder, as well as the role of environmental influences in its elaboration. We use the Causal Modeling framework to link the experimental developmental literature with general theories of motor control. In particular we utilize the distinction between motor response schema and motor program, as elaborated in Schmidt's theory of motor control. It emerges that a number of proposals concerning DCD can be subsumed within this picture. In particular, there seems to be some consensus concerning a possible endophenotype that can be expressed in terms of translating from a kinaesthetic code to a spatio-motor code. More specifically, we hypothesise that the key problem is a lack of adequate mapping between otherwise intact schemas in these two codes. The resulting comprehensive, but unified framework has falsifiable components, and we suggest future lines of enquiry to this effect. It is likely that our analysis only applies to a sub-type of the diagnostic category.

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10. Effects of prenatal testosterone on lateralization in children

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This study explores the hypothesis that prenatal testosterone contributes to individual differences in cerebral lateralization, as reflected by handedness and language lateralization. According to the Geschwind and Galaburda hypothesis, high levels of testosterone lead to atypical brain lateralization, which shows itself in higher prevalence of non-right handedness and a lesser degree of language lateralization. Sixty-seven children (32 girls, 35 boys; age 6.5 years) born from women referred for amniocentesis because of their age (31 to 41 years) participated in this study. Amniotic fluid samples collected between the 16th and 18th week of pregnancy had mean T-levels of 63 nmol/L (range: 40-1.40) for girls and 1.36 nmol/L (range: 0.81-2.10) for boys. All children were tested for handedness, that is hand preference in 10 different tasks (see poster by R.H.Geuze et al). Language lateralization was estimated from a dichotic listening task. The present results could not be explained by the theory Geschwind and Galaburda. We found that increased prenatal T-levels were highly related to (a) a decrease in the strength of hand preference, irrespective of its direction (right-handed, left-handed), and (b) an increase of left hemisphere language lateralization. This implies that prenatal testosterone differentially affects the development of different lateralized functions within the hemispheres. Gender did not influence these findings. The assessment of laterality as presented above is a useful approach for children with developmental disorders because many of these disorders including DCD have been anecdotally reported to show higher incidence of ambidexterity. Testosterone may play a role in the etiology of enhanced ambidexterity.

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Motor learning is a prerequisite for participation in everyday physical activity and leisure. The purpose of this study was to investigate motor learning processes during eccentric bicycle pedalling in adolescents with and without Developmental Coordination Disorder (DCD). Ten male adolescents (14-16 yrs.) participated in a five week pilot study. Motor learning intervention consisted of eight 15 minute training sessions with a motor driven eccentric bicycle. Participants were divided into three groups based on the Movement Assessment Battery for Children (M-ABC2). The results are represented as means±sd. DCD-group (n=3) M-ABC2 52±19, non-DCD (n=3) M-ABC2 76±4, and active athletes (n=4) M-ABC2 90±3. The task was to resist the movement of pedals by producing a constant and steady force in a regular and continuous manner. Two indicators of successful performance were applied. The coefficient of variation (CV = [sd/mean*100]) of peak forces (CVF) and the accurate timing of peak forces. (CVt) were calculated from a 30 second period of force production in the beginning of the 1st, 2nd, 4th, 6th and 8th training sessions. The results showed that the initial CVF for the participants was 27±5, while CVt was 13±8. In the first training session CVt was higher (p<0.01) for the DCD-group than for other participants. CVF improved for all participants (p<0.01) between the 1st and 2nd, 2nd and 4th training sessions, but there were no improvement between the 4th and 6th training sessions. CVt improved between the 1st and 2nd as well as between the 4th and 6th training sessions for all participants. In the progression of CVF, groups differed only in the final training phase. DCD and non-DCD groups reached the best performance in the 8th training session (DCD 9.0±4.7; non-DCD 7.7±1.7). The active athletes reached their best performance in the 6th training session 7.5±0.7. It was concluded that when learning a new motor skill, adolescents with a mild form of DCD achieved equal skill levels to their peers. However, they had some difficulties in the first training session with the timing of resistance to the pedal suggesting they may be slower at the initial phase of learning. These results should encourage professionals to offer motor learning interventions for adolescents with DCD. However, it has to be noted that the more severe the DCD, the more likely the motor learning processes are impaired and thus, personalized training programs are needed. Increasing our knowledge of motor learning in children and adolescents with DCD is important in order to find strategies to support their participation in everyday activities and promotion of physically active lifestyle. This pilot study was followed by a motor learning intervention with a larger participant group (n=22); results are in progress.

11. Developmental Coordination Disorder and its association with motor learning in eccentric ergometer training of adolescents: Pilot study

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The purpose of this study was to examine factors that contribute to poor bimanual performance in children with DCD. Children were recruited from a school population of 10- and 12-year-olds and were assigned to the DCD or the control group based on their Movement ABC test scores (8th percentile or below, DCD; 65th percentile and above, control). Unimanual and bimanual coordination was measured using an index finger tapping task. Participants completed four conditions: rhythmic unimanual and bimanual tapping sequences (500, 500, 300, 300 ms), a bimanual 2:1 alternating sequence (400:800 ms), and a bimanual rhythmic tapping sequence (800, 800, 800, 400, 400 ms). They tapped using an instrumented piece of thin spring metal mounted on a small platform connected to a computer to record tap intervals. Analyses of variance indicated that the long intervals within each of the unimanual and bimanual non-alternating patterns more clearly differentiated the two groups than did the short intervals. In addition, the 800 ms alternating pattern was more difficult for the group with DCD than the 800 ms symmetrical tapping. These results indicate that inhibition (whether slowing of their movement or inhibiting one hand from tapping while the other tapped) was problematic for the DCD group. Secondly, 2:1 tapping was most sensitive to group differences; in fact, the 10-year-old subjects with DCD frequently had to slow down the rate of the 2:1 task in order to perform correctly. These data support the position that children with DCD have difficulty with movement inhibition, and this contributes to poorer bimanual control, especially when the hands are required to perform different tasks. Additional analyses are being conducted to examine the linkage between the dominant and non-dominant hands.

12. Rhythmic bimanual performance in children with Developmental Coordination Disorder

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The purpose of this study was to examine factors that contribute to poor bimanual performance in children with DCD. Children were recruited from a school population of 10- and 12-year-olds and were assigned to the DCD or the control group based on their Movement ABC test scores (8th percentile or below, DCD; 65th percentile and above, control). Unimanual and bimanual coordination was measured using an index finger tapping task. Participants completed four conditions: rhythmic unimanual and bimanual tapping sequences (500, 500, 300, 300 ms), a bimanual 2:1 alternating sequence (400:800 ms), and a bimanual rhythmic tapping sequence (800, 800, 800, 400, 400 ms). They tapped using an instrumented piece of thin spring metal mounted on a small platform connected to a computer to record tap intervals. Analyses of variance indicated that the long intervals within each of the unimanual and bimanual non-alternating patterns more clearly differentiated the two groups than did the short intervals. In addition, the 800 ms alternating pattern was more difficult for the group with DCD than the 800 ms symmetrical tapping. These results indicate that inhibition (whether slowing of their movement or inhibiting one hand from tapping while the other tapped) was problematic for the DCD group. Secondly, 2:1 tapping was most sensitive to group differences; in fact, the 10-year-old subjects with DCD frequently had to slow down the rate of the 2:1 task in order to perform correctly. These data support the position that children with DCD have difficulty with movement inhibition, and this contributes to poorer bimanual control, especially when the hands are required to perform different tasks. Additional analyses are being conducted to examine the linkage between the dominant and non-dominant hands.

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13. Coordination differences in jumping: A contribution to the identification of DCD subgroups

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Efficiency of locomotion is underpinned by the storage and release of elastic energy during the transition from eccentric to concentric phases (Komi, 2003). This mechanism is known as the stretch-shortening cycle (SSC) and characterised by a distinct pre-planned coordination pattern and use of the stretch-reflex. Previously, DCD children under controlled conditions were found to exhibit high levels of muscle co-activation relative to controls, which led to reduced power output (Raynor, 2001). From our preliminary work, similar findings were found for vertical jumping, although large variation in the data sets was observed. DCD can be a measure of general impairment, covering a full range of motor skills, however, for some DCD children the impairment may be limited to a single domain. This study divided a group of DCD children (Movement-ABC total score <15th Percentile) into those who scored zero for the dynamic balance items (n = 29) and those who scored one or above (n = 33). The task performed was vertical jumping for maximal height and the primary outcome measure was leg stiffness (KLeg). Forceplate and video data were both analysed. ANCOVA, with mass as the covariate, found a significant but small effect between the groups (F(1,53) = 4.814, p = 0.033, \( \eta^2_p = 0.083 \)). This difference in Kleg reflects the poor coordination employed by those DCD children characterised with dynamic balance difficulties. Based on this and our previous findings, DCD should always be considered as a multi-dimensional impairment of motor skill and the dimensions pertaining to each individual need to be accounted for if diagnosis and any subsequent remediation are to have value.

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14. Postural constraints on mental rotation in children with DCD

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Psychophysical studies have found that the time to decide whether a rotated hand image is left or right is similar to the time taken to execute a corresponding movement (Parsons, 1987). The mental simulation of the motion involved in this laterality judgment shares crucial pathways with the actual motor execution and is referred to as motor imagery. In children with DCD the relationship between the timing of imagery tasks and actual task is less clear. It is suggested that they make use of an alternative, non-motor imagery strategy to solve laterality judgments of rotated hand images (e.g., Wilson et al. 2004). The aim of our study was to test this hypothesis by examining the role of posture on mental rotation in children with DCD. Thirteen children with DCD (11 boys, 2 girls, mean age: 9.0 ± 0.7 y) and 13 matched TD children (mean age: 9.3 ± 0.7 y) were instructed to judge the laterality of rotated hand images in two posture conditions: (1) keeping their own hands with palms up, or (2) with palms down. Analysis of response times (RsT) and accuracy demonstrated that children with DCD were generally slower and made more errors than TD children. However, in both groups a similar RsT trade-off was found, showing longer RsT for larger rotations. Clockwise rotations of right hands resulted in slower judgments as compared to counter clockwise rotations, whereas the reverse was true for left hands. Moreover, hand laterality was rated slower when the posture of the hands on display was opposite to the posture of the participants’ hands. This effect of posture, together with the RsT trade-off, indicates that response times were a function of the biomechanical complexity of the task, a crucial characteristic of motor imagery. In conclusion, our findings suggest that children with DCD are able to make hand laterality judgments on the basis of motor imagery. However, the poor accuracy and slowness of their performance reflect motor imagery that lacks quality and is likely to compromise perceptual-motor control.

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15. Strategy use during motor learning in children with Developmental Coordination Disorder

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Introduction: Martini, Wall and Shore (2004) compared the use of strategies in children with differing motor abilities during a throwing task. Their results showed significant between-group differences in the type and proportion of strategies verbalized. Since children with DCD are well known for their motor learning difficulties, the logical next step that will build on these findings and shed light on the motor difficulties of children with DCD is to investigate their cognitive strategy use during motor skill learning. Objectives: The purpose of this study was to compare cognitive strategy use in 10 children with DCD and 10 matched, typically developing children, when learning to perform a complex, novel motor task. Methods: During a computer game, children were asked to use three cursor controls of differing levels of complexity to move a shuttle to a planet. While learning the task, children were asked to 'think-out-loud' and verbalize the strategies they were using to achieve their goal. Following thematic coding of their comments, type and frequency of strategies used were compared between groups. Associations between cognitive strategies used, task performance and learning stages were explored. Conclusions: Despite years of research attempting to better understand the difficulties of children with DCD, little is still understood about the nature of their motor learning issues. This study will improve our understanding of how children with DCD learn to perform novel motor tasks and may help to elucidate the mechanism by which CO-OP improves performance in this population and refine the approach.

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A number of interventions for children with Developmental Coordination Disorder (DCD) are task-oriented and provide task-specific training. Among these, the Cognitive Orientation to daily-Occupational Performance (CO-OP) approach is unique. Unlike traditional approaches which provide direct, task-specific instruction, CO-OP uses a global cognitive strategy and guided discovery techniques to enable the child with DCD to identify his or her own cognitive strategies. Such self-discovery of strategies is claimed to improve retention and self-efficacy; however, no study to date has investigated the differential impact of given versus self-generated strategies. This study therefore examines the differential impact of strategy provision and strategy guidance on motor skill acquisition, retention and self-efficacy in children with DCD. A two group pilot study was conducted. Ten children with DCD were given verbal, task-specific directions by a therapist to learn the task, while ten were guided to develop their own strategies. An ANOVA was conducted to investigate group differences in skill acquisition and retention. Findings from this study contribute to a better understanding of skill acquisition and retention among children with Developmental Coordination Disorder and will inform clinicians on how to assist children with DCD to acquire motor skills.

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17. The attentional brain network and motor preparation in adults with Developmental Coordination Disorder: An EEG study

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Individuals with Developmental Coordination Disorder (DCD) often present with dysfunctional motor skills associated with impaired attention and executive functioning. The objective of this study was to examine the impact of DCD on attentional cognitive processes and motor preparation. Relationships between spatial attention and motor responses were investigated by means of electroencephalogram (EEG). Measurements involved EEG potentials elicited by covert shifts of attention as well as by the selection of a hand/target location for responding. Adult participants with (N=15) and without DCD (N=15) performed a stimulus compatible or incompatible go-nogo task during which covert visual probes were presented to the effector or target location. Lateralisated ERP components indicated that individuals with DCD exhibit a distinctive difference regarding activation and a decision-related function of the frontoparietal attention network as compared to the control group. This may suggest a deficiency in the ability of DCD individuals to modulate spatial attention during the motor programming phase of coordinated unimanual movement.

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18. Bimanual coordination dynamics in children with Developmental Coordination Disorder

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The study explored the intrinsic characteristics of rhythmic inter-limb coordination in children with and without Developmental Coordination Disorder (DCD). Eight children with DCD (mean age: 10 yrs) and eight age-matched controls were instructed to rhythmically flex and extend both forearms in the horizontal plane to a 1 Hz metronome beat in one of two coordination modes (in-phase / antiphase), and under conditions of different combinations of weight loading of the limbs (300g-0g, 150g-0g, 0g-0g, 0g-150g, 0g-300g). A particular pattern of displacement of relative phase (Ø) from perfect in-phase and antiphase was observed when coordinated limbs had different preferred frequency (Δω≠0) depending on physical characteristics of the limbs. We predicted that the manipulating weights of coordinated limbs would be differentially affected on relative phase, a measure of coordination between the limbs, in the children with DCD and typically developing children. The result showed greater Ø shift and coordination variability when Δω≠0 than when Δω=0. Also, there was a greater mean Ø; and SD Ø; for antiphase than the in-phase coordination mode. These findings were increased in the children with DCD. Here we observed phase shift in direction and magnitude of Δω. However, we could not find systemic changes in phase shift dependent on the magnitude of Δω for the DCD group. This suggests that these children have a problem in organizing temporal and spatial control. Less stable coordination would be due to a deficit in parameterizing the coordination dynamics.

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Dyscoordination, particularly in children diagnosed with Developmental Coordination Disorder, is often distinguished by movement instability or variability, often manifested as inability to coordinate and appropriately time motor actions; however a substantial degree of variability is inherent in typical development. In this study we used a cyclical reach and grasp task to explore the establishment of upper limb coordination in typically developing children ages 5-10 (n=30) years, as compared to a control group of adults ages 18-31 (n=10). The task entailed repetitive reach and grasp and placing of an object between two shelves in time to an external auditory stimulus (electronic metronome at 60 bpm). Kinematic data were collected to track movement of the upper limb and to note temporal consistency in maintaining a given pace. Raw EMG activity from six superficial muscles controlling the neck, shoulder girdle and arm were sampled (1 KHz) using multi-channel electromyography (EMG). Neuromuscular activation strategies were derived from temporal-spatial and amplitude correlations of physiological muscle pairs. An assessment of the smoothness, thereby implying better coordination, of segment translations during the movement was derived using a novel measure of effort based on space curve acceleration. Our results indicate that the ability to match a multi-joint movement as complex as reaching to an auditory pulse train is present in children as young as five. Group differences were found in performance quality and consistency. Adults exhibited highly correlated activity between muscle pairs responsible for arm transport and the ability to optimize modulation of muscle activity to accurately complete the task in time to the pace. Furthermore they showed less overall movement effort suggesting, at least for this task, optimal coordination of their upper limb. In comparison the youngest group of children showed the lowest temporal consistency with consequent inappropriate control of upper limb musculature. The results from this study indicate a possible transition period of repetitive upper limb coordination according to continued development of neuromuscular and temporal control. Children aged 9-10 begin to exhibit more adult-like levels of variability in timing, albeit with a level of movement effort and neural strategy more similar to younger children. In fostering a clearer understanding of the timeline for typical motor development, we hope to form a basis for future inquiry into the neural roots of coordination disorders.

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20. Motor preparation and execution in an aiming task in children with Developmental Coordination Disorder

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The purpose of the present study was to investigate the effect of precue information in the preparation and execution of a motor action in children with Developmental Coordination Disorder (DCD). Participants were 15 children with DCD (mean age 7.94 yrs, SD = 0.37) and 15 typically developing (TD) children (mean age 7.97, SD = 0.31) matched with DCD group by age and gender. The experimental task consisted of discrete aiming movements executed on a digitizing tablet to one of two targets presented on a computer screen. Participants performed the experimental task in three different conditions of precue information: valid precue (i.e., correct precue); invalid precue (i.e., incorrect precue); and neutral condition (i.e., no precue). The results of dependent variable related to motor preparation (reaction time, RT) showed that both children with DCD and DT tend to diminish RT for the valid precue condition compared with no precue condition \[F(1, 28) = 4.08, p = .053]\.

Furthermore, the comparison between the valid and invalid precue conditions indicated that for both groups (i.e., DCD and DT) RT was significantly higher for the invalid condition than for the valid precue condition \[F(1, 28) = 43.3, p < .001]\). However, children with DCD exhibited higher RT in the invalid condition than TD children \[F(1, 28) = 3.41, p = .075]\). With respect to motor execution, although significant differences were not found for movement time, results of deceleration time (DT) showed that children with DCD were significantly slower than TD children for all precue conditions. In summary, the findings of the present study indicate that children with DCD displayed more difficulties for motor preparation and execution of a simple action. However, children with DCD are capable of using the advance information to prepare a motor action similarly to their peers.

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21. Control of sequential actions in children with DCD

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Introduction: The present study investigates the nature of motor control deficits in children with Developmental Coordination Disorder (DCD), concerning control of sequential actions when reaching to grasp or lift an object. We hypothesized that children with DCD would not integrate their planning for sequential movements as early as children without DCD. Methods: We identified 5 children with DCD (age range: 9-10 years) using a Movement Assessment Battery for Children (cut off of less than 5% and confirming diagnosis by pediatrician). We also tested a developmental landscape of typically developing (TD) children in the age range of 6-10 years (n=25) plus 10 young adults. All subjects performed the following conditions, with each arm, in a randomized order: an isolated reach, a reach-to-grasp, and a reach-to-grasp and lift action in a modified discrete Fitts Law paradigm. Subjects were asked to move as fast and accurately as they could. We also calculated separate indices of difficulty for each subject to enable ease of comparison. Results: Scaling the experiment tasks to body proportion yielded similar indices of difficulty values across the subject groups (4.5-5.5). As compared to adults and older children, 6-year-old TD children were slower, showed increased delay and more variable onset of the lift phase, which suggests a sequential planning mode. Children with DCD showed increased variability in the deceleration times and, increased variability in the latency of lift onsets as compared to their age-matched controls. Our results suggest that children with DCD are similar to 6-year-olds, in their inability to execute a movement sequence as a whole. Instead, they break down the movements into separate units suggesting a lesser degree of ballistic control in these two groups. We discuss these results in relation to current models of motor control as well as potential underlying mechanisms of DCD.

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22. Performance in a simple rhythmic task improves relative to age in children with Developmental Coordination Disorder (DCD)

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Current literature suggests that children with developmental coordination disorder (DCD) are highly variable during rhythmic motor tasks. However, it is not known if a child with DCD improves, deteriorates, or remains unchanged with age relative to typically developing (TD) peers during such tasks. In this prospective study, we investigated a bilateral rhythmic finger tapping task in children with DCD. We enrolled children with DCD between the ages of 5-10 years (n = 11) and re-tested them after 2 years. We compared their performance to that of TD children between the ages of 4-10 years (n = 35). Prior to the experiment, a psychophysical staircase method was used to determine the phasing difference at which the change in rhythms was perceptible. This experiment had 2 conditions: 1. Children performed bilateral anti-phase finger tapping in synchrony with auditory beats (baseline trials); and 2. They synchronized their taps to a perceptible change in rhythm brought about by changing the relative phasing by 45° between the auditory beats (adaptation trials). There were twelve 25s trials with the first and last two trials being the baseline trials. The main variable of interest was the within-trial standard deviation (SD) of the relative phasing. Regression analyses were performed on the data from the typically developing children and 95% prediction intervals (PI) were determined. We found 4 children with DCD were beyond the 95% PI boundary, however only one child did not fall within the PI when re-tested 2 years later. Similar results were found during the adaptation trials and the same child remained outside the PI after 2 years. However, individual trajectories showed a more complex story in terms of improving, deteriorating, and maintaining performance. We interpret our findings from both, a developmental and a task-specific perspective.

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23. Multilimb coordination pattern of clapping and jumping in children with Developmental Coordination Disorder

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The purpose of the present study was to examine the stability of multilimb coordination patterns. Twelve children with typical development (TD) and 12 children with developmental coordination disorder (DCD) performed a jumping and clapping task during 15 seconds in two different surfaces, on the floor and on the mini-tramp. Children were required to clap while jumping: a) when the feet touched on the surface (clapping-surface); b) when the body reached the maximum jumping height (clapping-jumping); and c) when the feet touched the surface and when the body reached the maximum jumping height (clapping-both). Analyses of variances were employed on the relative phase (RP) and on the standard deviation of relative phase (SDRP). The results showed that children with DCD exhibited lower RP in the clapping-surface condition on the mini-tramp surface than on the floor. With respect to the SDRP, the results indicated that SDRP was significantly higher for children with DCD in clapping-surface and clapping-jumping conditions compared with children with TD. Both children with DCD and TD consistently displayed higher SDRP in the clapping-jumping compared with clapping surface. In summary, the results indicated that children with DCD demonstrated more difficulties to coordinate the jumping-clapping action than their peers. It is suggested that children with DCD lack the ability to exploit the physical properties of the mini-tramp surface used in the present study.

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24. Investigating heterogeneity in children with Developmental Coordination Disorder during sensorimotor adaptation: The use of a Random Coefficient Model

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Although the underlying mechanisms of Developmental Coordination Disorder (DCD) remain unknown, one potential hypothesis posits that children with DCD have difficulty transforming the available sensory information into the appropriate motor output to efficiently and accurately perform a motor task (Kagerer et al., 2006). This sensori-motor relationship has been investigated by exposing participants to a visuo-motor distortion, during which a conflict is created between the visual feedback of hand position and actual hand position during the execution of discrete aiming movements. Although the existing research examining this adaptation process has contributed to our understanding of the sensori-motor deficits in children with DCD, it has failed to adequately examine: 1) the non-linear performance changes as a function of repeated observations; and, 2) the heterogeneity of the behavioral deficits evident in children with DCD. Thus, the current research utilized a flexible, non-linear statistical technique (Cudeck & Harring, 2007) to provide a more comprehensive examination of the time course of visuomotor adaptation in typically-developing (TD) children and children with DCD. Results demonstrated that the rate of adaptation of the TD children was significantly faster than that of the children with DCD during the end of the exposure phase only (i.e., the slow adaptation or ‘fine-tuning’ component). This suggests that the children with DCD have difficulty detecting and correcting small movement errors and potentially indicates impaired cerebellar functioning in these children (Robertson & Miall, 1999). Moreover, by employing a random coefficient model to explore the heterogeneity of the behavioral deficits, the children with DCD who struggled to perform the task were easily identified. These findings have implications not only for understanding the underlying sensori-motor deficits in children with DCD, but also for identifying and addressing behavioral impairments at the individual level. We conclude with a discussion of how future research on children with DCD could utilize similar statistical techniques that focus on individual data and how this information may contribute to the design and implementation of interventions.

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25. Decreased motor cortical excitability in Developmental Coordination Disorder: A TMS pilot study

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Recent studies in adults and children have demonstrated that cortical inhibition is altered in attention-deficit/hyperactivity disorder (ADHD). Little is known whether and how other developmental dysfunctions such as Developmental Coordination Disorder (DCD) show altered characteristics of cortical excitability and inhibition, even though certain motor behavioral patterns - increased movement times, or increased occurrence of mirror movements - would support this notion. Using transcranial magnetic stimulation (TMS), the present study investigated whether cortical excitability parameters in children with DCD are different from those in typically developing children. Three typically developing children (between 8.5 and 11.6 years old) and two children with DCD (9.9 and 10.9 years old) were assessed with single- and paired-pulse TMS, using a Magstim 200 magnetic stimulator (Magstim, UK), and a figure 8-shaped coil (45 mm inner diameter). Electromyogram (EMG) signals were recorded from the abductor pollicis brevis (APB) muscle in both hands with a sampling rate of 2kHz, amplified, and filtered at 30 Hz and 1 kHz. During stimulation, the APB was activated with 25% of the maximum voluntary contraction. Using the single pulse paradigm, active motor thresholds for both hands were determined. Using the short-interval cortical inhibition (SICI) paradigm, intracortical inhibition and facilitation were determined, using interstimulus intervals of 2ms and 16ms, and conditioning and test stimuli at 20% below and 20% above the active motor threshold, respectively. The preliminary findings indicate that children with DCD show substantially higher active motor thresholds than the typically developing children in both hemispheres. Assessment of SICI in the typically developing children showed that a 2ms interstimulus interval between conditioning and test stimulus produced a suppression of the motor evoked potential (MEP) amplitude, compared to MEP amplitudes resulting from single pulse stimulation at the same stimulation intensity. In the children with DCD, suppression was found only for the dominant hand, whereas stimulation of the non-dominant hand (or hemisphere) did not show this clear pattern. Supported by NIH R03HD050372 and NIH R01HD42527.

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26. Finger independency and visual force control in children with Developmental Coordination Disorder (DCD)

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Children with Developmental Coordination Disorder (DCD) show marked difficulties in manipulative skills using fingers (e.g., handwriting) which affect their performance in daily and school activities. Deficit in finger force control Finger independency and visual force control were investigated in children with DCD. Five children, 9 to 10 years of age, diagnosed with DCD and five age-matched typically developing (TD) children performed two isometric tasks, maximum voluntary force production (MVF) and visual force control (VFC), in seven different finger conditions [Index (I), Middle (M), Ring (R), Little (L), IM, IMR, and IMRL]. For the VFC tasks, the participants were asked to continuously control their finger forces at 20% of the MVF. To examine finger force independency, maximum voluntary force (MVF), force enslaving (FE) and force sharing (FS) values were computed. To analyze the ability of children with DCD to visually control their finger forces, the following performance measures were calculated: rate of force change, initial overshoot, coefficient of variation (CV), root mean square error (RMSe), and inter-trial variability. The results from the MVF task showed that children with DCD as compared with TD children (a) produced similar levels of maximum finger force; (b) demonstrated less finger independency; (c) had similar finger-force sharing patterns. In addition, from the VFC task we found (d) larger performance errors in children with DCD; (e) and lower inter-trial consistency as compared to their TD peers. Our findings suggest that the impairments in manipulative skills often observed in children with DCD during everyday activities may be related to deficits in finger independency, as well as the inability to integrate well the use of feedback and feedforward strategies. Additionally we found that children with DCD do not have difficulties in reducing the number of joint/muscle-level degrees of freedom in order to achieve a common motor task.

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27. Sleep behaviour in children with Developmental Coordination Disorder: An exploratory study

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Background. Impaired sleep has repeatedly been seen to be associated with a range of negative effects on children’s quality of life and their behavioral, emotional and cognitive functioning at home and school. Previous research has shown a higher rate of sleep disorders in children with a range of developmental disorders including ADHD and Autism Spectrum Disorders in comparison to the general population. However, little is known about sleep behavior in Developmental Coordination Disorder (DCD). Children with DCD are less physically active than their typically developing peers and also have higher rates of anxiety and depression. Such factors are known to be associated with sleep problems in other clinical populations and could potentially impact on the sleep behavior of children with DCD. Information about the frequency and nature of sleep problems in children with DCD will aid our theoretical understanding of this developmental disorder. It may also be clinically helpful, alerting parents and clinicians to potential difficulties so that these can be identified early on and appropriate support offered.

Objective. The aim of this exploratory study was to examine the sleep behavior of children with DCD compared to typically developing control children.

Methods. Two groups of children aged 6 to 12 years participated in the study: (1). Children in the DCD group had a diagnosis of DCD with performance on the Movement ABC test and/or checklist below the 5th percentile. (2). An age-matched control group of typically developing children had Movement ABC Checklist scores above the 15th percentile. Parents of children from both groups completed the Child Sleep Habits Questionnaire.

Results & Discussion: The total sleep disturbance score was significantly higher for children with DCD compared to the control group. Sub-scale scores indicated particular problems with bedtime resistance, sleep anxiety, parasomnias and daytime sleepiness. There were no differences between the groups for sleep onset delay, sleep duration, night wakings and sleep disordered breathing. These preliminary results suggest that sleep patterns of children with DCD may be of clinical relevance and are worthy of further investigation.

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1. Oro-motor function in children with Developmental Coordination Disorder

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Recent research suggests a high co-occurrence between Developmental Coordination Disorder (DCD) and speech/language disorders (e.g. Hill 2001; Bishop 2002; Valtonen et al. 2004). However, the exact nature of oro-motor function in children with DCD has received little attention. We conducted a small scale pilot study which looked at the control of the mouth in a group of children with DCD (N=5) and a typically developing group (TD; N=5). Diadochokinetic Rate (DDK rate) did not differ across these two groups; for TD children DDK rate ~3.2 iterations/second and for DCD children DDK rate ~3.0 iterations/second. Movements of the upper and lower lip were recorded during: non-verbal movements (opening and closing the mouth); single and repeated monosyllabic utterances (e.g. pa, ta, ka); single and repeated tri-syllabic utterances (e.g. pataka); and multiple syllabic sentences (buy bobby a poppy). Across all conditions the children with DCD tended to generate smaller movements both temporally and spatially, however, in the baseline condition (single utterance/normal speed) this did not result in a different pattern of movement compared to the typical controls. In the complex conditions (repeated utterance/fast speed) we saw an altered pattern of movement in children with DCD; however, this often failed to achieve the demands of the complex conditions (i.e. faster speed). In contrast, the TD children reduced duration and movement extent to achieve the demands of the complex conditions (repeated utterance/fast speed) but maintained the pattern of movement from the baseline condition. These results indicate that children with DCD show poor motor control of the mouth when more complex tasks are demanded, whether this is coupled with an atypical speech/language production deficit remains to be seen. It is hoped that this small scale pilot study will inform future research considering oro-motor function in children with DCD and in children with atypical speech/language production.

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2. Construct validity of the Gross Motor Quality Scale for Preschooler (GMQSP): Preliminary study

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Background and Purpose: Motor skills have great impact to children in the adaptation of environment and development of interpersonal interaction, cognition and social behavior. Children with developmental coordination disorder (DCD) have impaired quality of movement. However, most motor tests contain very little quality evaluation in the items or criteria. Gross Motor Quality Scale for Preschooler (GMQSP) which includes 17 items in three subscales was developed to evaluate the quality of fundamental motor skills for preschooler. The purpose of this study was to examine the construct validity of GMQSP. Methods: Ninety two children aged three to six (45 boys and 47 girls) were recruited from twelve randomly-selected kindergartens in Taichung area. Two independent evaluators who were unaware of the results of each other evaluated all the children separately in their kindergartens using standardized setting and procedures of GMQSP. All the evaluators were the first rated the performance of all children by watching the video type afterward. One week later, the first evaluator rated again by watching the video type. Intraclass correlation coefficients (ICC) were used to examine the interrater and intrarater reliability of GMQSP. Results: Discriminative analysis showed that significant differences were found between different ages and genders (Wilks' Λ=0.21, p<.001 and Wilks' Λ=0.57, p<.001 respectively). Total scores and raw scores in three subscales of GMQSP increased as age increased. Over-hand throwing, kicking and batting were significantly different between genders. Confirmatory factor analysis revealed 3 factors which including locomotion, manipulative ability and balance together explaining for 49.68% of the variance. The correlations between GMQSP and PDMS-2 were moderate to high (r=0.54-0.86, p<.01). Analysis at the subscale level indicated that the strongest correlation was between the locomotion of the GMQSP and the locomotion subtest of the PDMS-2 (r=0.86, p<.01). Conclusion and Implication: The preliminary results showed the construct validity of GMQSP was satisfied. GMQSP can be used to evaluate the development and quality of fundamental motor skills for preschooler. Future studies will establish the norm in Taiwan and investigate the predict validity for children with DCD.

3. Reliability of the Gross Motor Quality Scale for Preschooler (GMQSP): Preliminary results

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Background and Purpose: Children with developmental coordination disorder (DCD) have impaired quality of movement. Gross Motor Quality Scale for Preschooler (GMQSP) which includes 17 items in three subscales was developed to evaluate the quality of fundamental motor skills for preschooler. The aim of this study was to examine the interrater and intrarater reliability of GMQSP. Methods: Twenty five typically developing children (mean age 4.24 years, range 3 to 6 years) were recruited from three kindergartens. The first evaluator evaluated and rated all the children in their kindergartens using standardized setting and procedures of GMQSP. All the evaluation procedures were video-typed by an assistant. The second evaluator who’s not aware of the result of the first rated the performance of all children by watching the video type afterward. One week later, the first evaluator rated again by watching the video type. Intraclass correlation coefficients (ICC) were used to examine the intrarater and interrater reliability of the GMQSP. Results: Intrarater and interrater reliability values of the total scores and subscales were mostly high, ICCs varied from 0.76-0.98 with only two coefficients below 0.89. ICCs for intrarater reliability revealed that 3 items of GMQSP were in the “fair” category (ICC=0.52-0.69), 8 items were in the “good” category (ICC=0.78-0.88), and 6 items were in the “excellent” category (ICC=0.90-1). High variability was found in interrater reliability for 17 items of GMQSP. ICCs for running, horizontal jumping, leaping, kicking and walking line forward were lower and varied from 0.31-0.35. ICCs for hopping, galloping, catching, batting and down stairs were good to excellent and varied from 0.75-1. Conclusion and Implication: This study demonstrated that intrarater reliability of GMQSP was mostly acceptable and interrater reliability was unsatisfactory. Future study will investigate how to improve the stability of GMQSP.

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4. Analysis of reliability of Taiwan Children Coordination Questionnaire

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Although a local evaluation tool for children with developmental coordination disorder (DCD) had been developed in Taiwan, we still required a questionnaire for teachers or parents to quickly screen children with suspected motor incompetence. In order to early identify children with DCD, a local and systematic evaluation instrument—the Taiwan Children Coordination Questionnaire (TCCQ) was developed to observe the motor coordination of children. However, it was necessary to establish an excellent reliability for a preliminary evaluation questionnaire. Therefore, the aim of this study was to examine the reliability of the TCCQ. The TCCQ was used to evaluate 403 children (195 boys and 208 girls) aged nine to twelve years in Taiwan. Seven days later, 114 children chosen randomly were assessed again. The internal consistency and the test-retest reliability were used to represent the reliability of the TCCQ. The internal consistency and the test-retest reliability were determined using the Cronbach’s alpha coefficient and the Intraclass Correlation Coefficient (ICC), respectively. The Cronbach’s alpha coefficients of the TCCQ were 0.907 for the girl norm and 0.933 for the boy norm, indicating a strong internal consistency. The ICC values of the TCCQ were 0.431-0.914 (p< .01), indicating a fair-to-excellent test-retest reliability. In summary, the reliability of the TCCQ was considered as an acceptable level.

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5. The motor performance profiles of children with Developmental Coordination Disorder: Effects of referral source and gender

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Purposes: The purposes of this study were 1) to compare the motor performance profiles of preschool children with developmental coordination disorder (DCD) referred from two difference sources (clinic and community), and 2) to determine if there were gender differences in the profiles. Methods: One hundred and twelve children at the age of 4-6 years old were identified to have DCD. Fifty-eight DCD children (boys: 34, age 6.14 ± 0.48 years old; girls: 24, age 6.05 ± 0.52 years old) came from communities and fifty-four children (boys: 39, age 5.28 ± 0.78 years old; girls: 15, age 5.46 ± 0.91 years old) were referred from a hospital developmental center. Motor performance was assessed in the areas of manual dexterity, ball skills and balance using the Movement Assessment Battery for Children Test (MABC Test). Two-way ANCOVA with age as covariate were used to examine the effects of gender, source of referral and their interaction. Findings: Except for the ball skills, no gender differences were noted. Boys performed better in ball skills than girls. Significant differences between children of different referral sources were observed in manual dexterity, balance, total impairment scores and total percentile rank scores, but not in ball skills. Children of clinical referral were more impaired than children referred from the communities. However, the effect of referral source was not different between genders. Conclusions: The results of the present study demonstrate the common knowledge that clinically referred children were more impaired than community referred ones. Overall, preschool boys and girls of developmental coordination disorder show more similarities than differences in motor profile.

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6. Co-occurrence of motor and language impairments in preschool children

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Purposes: The purposes of the study were to examine the relationship of motor and speech and language skill of preschool children and to examine the motor profile and co-morbidity of preschool children with developmental speech and language disorder (DSLD) and developmental coordination disorder (DCD) at the preschool age.

Methods: Four hundred and ten children (boys: 228, girls: 182) from two municipals at the age of 5-6 years old participated in the study. They were first screened with a simple medical and physical examination and an IQ test (C-TONI, Test of Nonverbal Intelligence 3rd ed., Chinese version) to rule out any neurological, musculoskeletal, cardiopulmonary system impairment and the condition of mental insufficiency. Finally, 363 (boys: 218, age 6.04 ± 0.48 years old; girls: 176, age 5.98 ± 0.53 years old) passed the screen and were individually assessed with speech and language tests and motor coordination test. Findings: The results showed that there was a significant correlation between motor and speech/language performance in children, especially the manual dexterity subtest which was significantly correlated and predictive to all the speech/language scores. Twenty-two children (22/363, 6.1%) were identified to have DSLD, 45 (45/363, 12.4%) DCD, and 6 had both DSLD and DCD (6/363, 1.7%).

Conclusions: Children with DSLD have worse performance in manual dexterity subtest score and total impairment score of M-ABC than children without DSLD. Moreover, children with DSLD had a higher percentage than children without DSLD to co-occur the condition of DCD (27.3% vs. 11.4%). It is important to pay attention to the motor difficulty of children with DSLD at the preschool age and investigate the mechanism of co-occurrence of speech and motor impairment in certain children.

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7. The urban-rural difference of motor performance in Taiwanese children

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There were limited studies discussing the urban-rural difference of motor performance in children. Therefore, the aim of this study was to investigate whether the motor coordination abilities of children living in urban areas were different from those in rural areas. 335 children (213 urban children, 122 rural children) aged 9 to 12 were recruited randomly from the eastern and southern cities in Taiwan. The Movement Assessment Battery for Children test (MABC test) was used to identify children with developmental coordination disorder (DCD). The chi-square test and the independent sample t-test were used to examine the prevalence of DCD children between urban and rural areas and the difference of motor performance for children living in different environments. 80 children were identified as DCD (≦5th %tiles) in this study. The prevalence of the children with DCD in urban area was 18.8% (40/213), and in rural area was 32.8% (40/122). In addition, the prevalence of children with DCD between urban and rural areas was significantly different (p<.05). In the aspect of motor performance, the urban children performed significantly better than those in rural area in balance ability (p<.05) and total impairment score (p<.05). The motor performance of urban children was better than rural children in Taiwan. It seemed that the prevalence of children with DCD in the urban area was higher than in the suburban area. However, due to the restriction of smaller sample size, it should be cautious to explain the current situation in Taiwan. We suggest strongly that it is essential to enlarge the sample size and to discuss the relationship between motor performance and the living environments in future.

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8. A hand preference test for children age 6 to 7 years

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Aim: Characteristics of a test that measures the direction and strength of hand preference in children aged 6 to 7 years are presented. The relevance of determining hand preference (both direction and strength) during development is threefold: 1) In research on the development of lateralisation hand preference is the most important behavioural characteristic; 2) In case of treatment for delay or deficits in fine motor development one should carefully sort out for each skill to be trained 'which hand should do what', to acquire a proper hand role and a certain amount of proficiency; 3) Weak or inconsistent hand preference, or a change in hand preference (in direction or strength) may be an indication of neurological or developmental disorder (e.g. dyslexia, DCD). We argue that current questionnaires are unsuitable for children. Method: hand activity tasks were selected that matched representative daily life activities and interests of children of the target age range. The items were actively performed, hand-use observed, and the test was given twice to enhance reliable assessment of hand preference. Sixtyseven healthy children performed the test. Results: The test shows good internal consistency and retest reliability. The data show that the ratio of strong left- versus right-handedness is similar between children and adults. Among the children, however, 25% had not yet developed a strong hand preference, whereas in young adults this is only 10%. Conclusion: The test proved to be suitable for the assessment of handedness of children aged 6-7 years. It seems a promising tool for younger and older age groups (4-5 and 8-9 y) and for clinical samples such as DCD, but that is still open to further exploration.

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9. Development of a Motor Skill Checklist for 3- to 5-year-old children

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Objective: Early identification of children with developmental coordination disorder (DCD) is important. Teachers may be very useful in this identification process. The objective of this study was to develop a questionnaire to identify motor difficulties in children, to evaluate user-friendliness, internal consistency, test-retest reliability, inter-rater reliability, and criterion-related validity. A standardisation group offered norms for the Flemish population. Method: a Motor Skill Checklist (MSC) of 28 functional items was constructed in close consideration with clinical experts and teachers. A standardisation group of 366 children from regular schools was investigated. An evaluation of the user-friendliness was done by 111 teachers. Teachers of 97 children were asked to fill in the MSC again, 4 weeks later. For 82 children the MSC was filled in by two teachers, both involved with the same child. Two hundred fifteen children from regular schools and 36 children in clinic were assessed with the Movement-ABC and the MSC. Results: Most teachers (93 %) judged the MSC as easy or rather easy to complete and the median time needed was 5 minutes. The Cronbach's alpha coefficient of internal consistency was 0.97. The test-retest correlation coefficient was very good (ICC = 0.94). The intra-rater correlation (ICC) was good 0.80. The Pearson correlation coefficient between the Movement-ABC and the MSC in regular schools was 0.43. In the clinical group, 5 children were diagnosed as children with DCD, the specificity of the MSC was 70% and the sensitivity was 100%. Conclusion: The MSC is a reliable and valid instrument to identify and assess young children with motor difficulties. The sensitivity and specificity still need to be studied in a larger group and predictive validity still need to be investigated.

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10. Cross-cultural adaptation of the Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07) for Japanese children

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Background & Purpose: Developmental Coordination Disorder (DCD) is a common childhood condition; its prevalence is estimated to be between 5 to 9 percent of school children worldwide. Although English questionnaires are available, there is no questionnaire to identify DCD in Japan and therefore no information on its prevalence in Japan is available. The Developmental Coordination Disorder Questionnaire '07 (DCDQ) is a parent questionnaire consisting of 15 items and designed to screen for coordination disorders in children, aged 5 to 15. This presentation will describe the adaptation of the DCDQ into Japanese and preliminary results of its use.

Method: The questionnaire was translated according to the guidelines for cross-cultural translations of instruments (i.e., translation, back-translation and analysis by an expert committee). There is no identical idiom for one term in Japan and the phrase was changed to more familiar words and examples to be easily understood by parents. The Japanese version is being administered to 5 to 6 year-old children, preliminarily. The process of adaptation, item consistency of the Japanese version and concurrent validity with the Motor Observation Questionnaire for Teachers (MOQ-T) are being assessed and will be reported. Comparison of the performance of these measures in Japan to reliability and validity in other countries will also be reported. Conclusions: Translations of the DCDQ and other measures of motor performance enables cross-cultural collaboration and comparison of diverse populations of children. Future studies are planned to validate the use of this questionnaire and other tests in Japan.

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11. Prevalence of Developmental Coordination Disorder in Taiwanese 9- to 12-year-old Aboriginal children

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No study has examined the motor coordination ability of Taiwanese aboriginal children. Some research had shown the high motor ability and fitness of them comparing with common Taiwanese children. Therefore, this study explored the motor coordination of Taiwanese 9- to 12-year-old aboriginal children and investigated prevalence rates of children with developmental coordination disorder (DCD). The total 261 children were divided into two age-band groups including 136 nine- to ten-year-old and 125 eleven- to twelve-year-old Taiwanese aboriginal children (152 boys, 109 girls). All children were assessed using the Movement Assessment Battery for Children (M-ABC) test to examine their motor coordination ability. Results revealed that total DCD prevalence rate was 11.9%. The prevalence rates were 16.2% in 9- to 10-year-old children and 7.2% in 11- to 12-year-old children. The DCD prevalence rates were similar in different genders (boys: 11.8%; girls: 11.9%). In three domains of the MABC test, the ball domain had lowest mean impairment scores (1.42±1.84). The mean scores of the balance domain and the manual domain in Taiwanese aboriginal children were 2.04 and 3.75, respectively. In addition, boys in ball skills and balance were significantly different from girls, except the manual items (p< .05). In conclusions, the DCD prevalence rates in Taiwanese aboriginal children were lower than common Taiwanese children. Furthermore, aboriginal children were much better at ball skills than common Taiwanese children.

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12. Relationships between DCD, learning related difficulties and ADHD among 6–7 year old school children

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Relationships between DCD, learning related problems and ADHD seem to exist (Geuze & B¨rger, 1993; Schoemaker & Kalverboer, 1994). Although attention deficit disorders, with or without hyperactivity, are not considered learning disabilities in themselves, such problems can gravely interfere with school performance, and are often associated with problems concerning academic skills. This study examined the relationship between Developmental Coordination Disorder (DCD), learning disabilities and ADHD in 6 to 7-year-old children (N = 99). Two grade one classes were randomly selected from three selected schools proportionally representing the different racial groups [white (n = 37), black (n = 50), Coloured (n = 12) in Potchefstroom, South Africa. Forty eight boys and 53 girls completed the Movement Assessment Battery for Children (MABC) (Henderson & Sugden, 1992), the Aptitude Test for School Beginners (ASB) (Swart et al., 1994), the Modified Conners abbreviated teacher and the Taylor Hyperactivity Checklist (Lowenberg & Lucas, 1999). The lowest ASB sub scores (indicating the poorest performance in the sub tests) were found in the severe DCD group and this group differ significantly (p < 0.00) from the group without DCD. No significant differences were found in the mean ADHD totals of the DCD and without DCD groups. A multiple regression analysis further showed a statistically significant interaction between DCD, learning related problems and ADHD which varied between 22% and 36%. It was concluded that children with DCD will find academic tasks and performing age-appropriate motor skills more difficult than their peers.

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13. Overlapping cognitive-behavioural profiles in children diagnosed with DCD and children diagnosed with Autism

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It is now recognised that children with a diagnosis of DCD may not necessarily present with difficulties of exactly the same nature, and that they also may present with additional difficulties such as dyslexia, or attention-deficit hyperactivity disorder. Likewise, the emotional difficulties experienced by many children with a diagnosis of DCD have increasingly become more apparent. Conversely, it has been confirmed that many children with a diagnosis of autism, essentially a disorder related to social, communication, and emotional difficulties, appear to have problems with motor skills. So whilst these two disorders are diagnosed in relation to very different difficulties (either in the movement or social domains), new research highlights the need to investigate systematically the potential overlap between certain characteristics observed in the two groups.

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Introduction: The consequences of Developmental Coordination Disorder (DCD) are particularly evident in Activities of Daily Living (ADL), and contemporary treatment methods are focused on ADL. However, research concerning performance in ADL in DCD is limited and an instrument for assessment of ADL is lacking. Therefore, the aim of this study is to develop a standardized instrument for the assessment of performance of ADL in children with DCD: the DCDDaily. Method: A literature review was conducted and expert interviews were held to create a theoretical framework and to compose the items of the DCDDaily. A pilot study was conducted in which 10 children diagnosed with DCD, and 26 control children were assessed with the DCDDaily. To determine the preliminary validity and reliability of the DCDDaily, content, construct, and criterion validity, internal consistency, test-retest correlations, and the underlying factor structure were investigated. At present, data for a larger group of children with and without DCD are gathered. These results will be presented at the conference. Results: In the pilot study, children with DCD scored significantly lower than children from the control group on the total score of the DCDDaily and on all separate items. A significant correlation ($\rho = 0.75$) and substantial agreement ($k = 0.61$, sensitivity = 80-81%, specificity = 92-94%) with the Movement Assessment Battery for Children were found. Internal consistency of the instrument was good ($\alpha = 0.899$) and test-retest correlations showed acceptable reliability for 10 out of 13 items. The factor analysis revealed four components of related activities that explained 75% of the total variance. Conclusions: The DCDDaily is the first objective and systematic instrument for assessment of ADL in children with DCD. Preliminary results regarding validity and reliability are promising. At the conference, the data of a larger group of children with and without DCD will be presented and the clinical significance of the test will be discussed.

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15. Body Mass Index and performance on the Movement Assessment Battery for Children

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In a previous study Wilson, Lythgo and Maschette (2004) have reported an over-representation of overweight children amongst those classified as motor impaired (MI) and balance impaired (BI) according to the Movement Assessment Battery for Children (MABC). The present study aimed to further investigate this relationship with an increased sample size ($n = 265$). Sixty-one children were classified as overweight (Cole et al, 2000). Of these twenty-one (34.4 %) were also classified as MI. In comparison 29.9 % of children in the normal BMI range were classified as MI. Comparison of those who scored error points on the balance sub-scale revealed 70.5% of the overweight group compared with 61.3 % of those in the normal BMI range. No differences were found between the groups for performance on the manual dexterity and ball skills sub-scales. Findings are consistent with previously reported data suggesting that overweight children perform worse on both the Bruininks-Oseretsky balance test and the Kortkoordinatertest voor Kinder (KTK) (Graf, et.al., 2004; Kretschmann, et.al., 2001 & Goulding, 2003). It may be hypothesised that these findings are related to the overweight children having greater difficulty in moving a larger body mass around the environment, rather than the presence of an underlying coordination deficit. Further investigations including biomechanical assessments of fundamental motor skills (Williams, 2008; Wilson, 2009) may shed additional light on mechanisms that can explain lower levels of performance by the overweight children when assessed on common motor skill batteries. Alternatively it may simply be that overlap between the domains of overweight/obesity and motor/balance impairment is just another dimension of the ‘vicious cycle’ (Wilson, 2009) facing contemporary children of poor skill > low self esteem > less activity > less opportunity to practice > and less skill development.

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16. The development of the Japanese version of the Motor Observation Questionnaire for Teachers (MOQ-T)

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Background: The problems of children with Developmental Coordination Disorder (DCD) are characterized by clumsiness and coordination difficulties at school and at home. The prevalence of DCD is estimated to be 5 to 9 percent in the general population, worldwide. DCD interferes with academic performance, self-esteem and participation in play or physical activities at school. Teachers have many opportunities to observe a variety of motor skills at school. However, “clumsiness” in children has hardly attracted attention in Japan. Even though some screening tests are available in English, there is no suitable questionnaire to identify DCD by teachers in Japan. Purpose: The aim of this study was to conduct a cross-cultural adaptation (translation) of a questionnaire, the Motor Observation Questionnaire for Teachers (MOQ-T), into Japanese, and to compare data gathered with the MOQ-T with the data of a comparable questionnaire for parents (Developmental Coordination Disorder Questionnaire '07 (DCDQ). Method: The MOQ-T consists of 18 items. The questionnaire was translated according to the guidelines for cross-cultural translations of instruments (i.e., translation, back-translation and analysis by an expert committee). The adapted version has been administered to Japanese children, as the pretest, together with the Developmental Coordination Disorder Questionnaire 2007 (DCDQ'07). Preliminary results of the relationship between the MOQ-T and the DCDQ in Japan will be reported during the conference. Conclusions: The Japanese version of the MOQ-T is expected to be a useful screening instrument to identify and assess motor coordination difficulties of school children by teachers in Japan, and it enables the cross-cultural comparison of DCD as measured with the MOQ-T with data from other international questionnaires, such as the DCDQ and the Checklist of the Movement Assessment Battery for Children (M-ABC).

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17. How Am I Doing, a new pictorial scale for perceived motor competence for children aged 6 to 12 years

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It is well known that children's perceived motor competence (PMC) influences their mastery motivation in motor skill learning. Although a PMC scale for eight- to twelve-year-old children (CBSK-M) is available in the Netherlands, it does not take into account manual dexterity, is not suitable for six- and seven-year-old children, and even older children often have difficulty in completing this linguistic scale. Therefore, a new PMC scale with pictures ("How Am I Doing") has been developed for six- to twelve-year old children. The scale consists of 14 items covering manual dexterity, gross motor, and ball skills. In addition to PMC, for seven items the competence-importance was measured. The new PMC scale was assessed in 305 children from regular schools and 78 children with DCD that were referred to a rehabilitation centre. Internal consistency of the instrument was sufficient for global PMC (Cronbach alfa = .76), PMC manual dexterity (.60), PMC gross motor skills (.63), and PMC ball skills (.64). Internal consistency for competence-importance was also sufficient (.66). Exploratory factor analysis (principal component, varimax rotation) revealed four factors (manual dexterity, ball skills en two separate gross motor skill factors) explaining 63% of the variance. Test-retest reliability was acceptable (PMC rp = .76; competence importance rp = .63). Boys (N=158) scored significantly higher on PMC ball skills and lower on PMC manual dexterity compared to girls (N=147). For competence-importance no effect of gender was found. Ten- to twelve-year-old children scored significantly lower on global and subscale PMCs, and on competence-importance compared to six- to nine-year-old children. The DCD group scored significantly lower (p < .001) on global and subscale PMC's compared to the "regular" group. Results suggest that the "How Am I Doing" scale is a reliable and valid instrument to measure perceived motor competence.

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18. The effects of attention on motor screening and testing

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Purpose: Uncertain impact of attention on motor testing results presents a challenge during assessment. Poor attention may influence standardized testing more than parent report. Parent report may be less influenced by attention as it represents an average of ability (trait) rather than a discrete performance at a particular time (state).

Methods: Between-group comparisons were undertaken on test scores of 4 groups of children (age 5-15 years): Attention Deficit Hyperactivity Disorder (ADHD)-only (n=13), Developmental Coordination Disorder (DCD)-only (n=35), ADHD+DCD (n=22), and controls (n=35). Age and gender did not differ between groups. Findings: The Movement Assessment Battery for Children scores showed ADHD+DCD and DCD children perform poorer than controls and ADHD-only children. Children with ADHD-only did not score significantly differently than controls. On the Developmental Coordination Disorder Questionnaire 2007 (DCDQ), children with ADHD+DCD had the lowest scores (x=41.7) compared to controls and children with ADHD-only (x=49.5) or DCD (x=46.7). Three factors of the DCDQ were compared to analyze whether profiles of motor performance might differentiate groups. The difference for all factors was significant: ADHD children were differentiated from others on Control During Movement where the mean score for children with ADHD-only (x=22.2) was similar to controls (x=23.5). On the Fine Motor factor, the mean scores of children with DCD, ADHD or ADHD+DCD were similar and lower than the controls. In General Coordination, children with ADHD-only scored similarly to children with DCD-only.

Conclusion: Standardized assessment appears minimally affected by attention deficit alone; children with ADHD-only performed much like controls on the M-ABC. Parent report differentiated children with ADHD from the others on one factor. A multifaceted approach should be used to ascertain whether children's motor scores are related to true movement difficulties or to attention issues to determine the best intervention. Other measures sensitive to this issue need to be identified.

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19. Description of motor, attention, and intellectual characteristics in a population-based sample of children screened for motor impairment

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Purpose: While it is widely accepted by researchers that Developmental Coordination Disorder (DCD) and Attention Deficit Hyperactivity Disorder (ADHD) often co-occur, DCD is far less recognized, even among clinical samples. Large epidemiological studies typically first select children with ADHD and only identify DCD as a second step. If we screen a population of children first for motor impairment, and concurrently include children with ADHD, what patterns of co-occurrence do we find? This poster outlines the results of assessments typically used to classify children with DCD, in a population-based sample of children who were screened in with motor impairment and/or ADHD. Methods: Children in Grades 4-8 completed the Children’s Selection and Predilection for Physical Activity scale (CSAPPA), a well-validated self-report measure that screens for DCD. Parents concurrently completed the DCD-Questionnaire (DCD-Q), a parent measure that identifies children who have everyday difficulties due to motor problems. Both measures were complete and valid for 2955 children. Children who scored in the bottom 5% on either measure (n=113), children who had been identified as having ADHD only (n=55), and a random sample of typically-developing children (n=89) were assessed individually by occupational therapists using the Movement Assessment Battery for Children, Kaufman Brief Intelligence Test-2, Connors Parent Rating Scales and a clinical interview. Data collection is now complete. Findings: Recruitment groups were compared with subsequent classification into groups of DCD only, ADHD only, DCD/ADHD, and typically-developing, according to widely accepted research criteria. Data will also be presented that illustrates the interesting patterns that emerge when motor, attentional and intellectual measures are considered along a continuum, without using predetermined cutoffs. Implications: Recruiting such a large sample of children from the community allows us to shed light on the screening and assessment methods currently being used in research studies to identify and examine relationships among children with DCD and ADHD.

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20. Developmental Coordination Disorder and its academic implications

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Research suggests substantial heterogeneity of cognitive profiles in children with DCD, for example, comorbid reading disabilities and general learning difficulties. Although there is some evidence that children with DCD tend to perform poorly in literacy, studies investigating DCD and numeracy are limited. However, it has been suggested that there should be careful evaluation of DCD as a possible comorbid diagnosis in children diagnosed with Mathematics Disorder which has been linked to the concept of nonverbal learning disabilities (House, 2002). Recent research found that extremely low birth weight (ELBW) children (aged 9 years) with DCD were more likely to have a learning difficulty in arithmetic than ELBW children who did not have DCD. However, no differences were found with reading or spelling abilities (Holsti et al., 2002). The authors suggested that the findings appeared to be consistent with the pattern of academic functioning in children with nonverbal learning disabilities, specifically, major difficulties in mechanical arithmetic and psychomotor skills (Holsti et al.). The current study aims to address the academic implications in an adolescent sample with DCD. Rodger et al. (2003) note that most of the research on DCD has been conducted with children aged 7 to 12 years. Thus, the functional implications in this older age group requires attention. This study compares a group of DCD and Control adolescents (as measured by the Movement Assessment Battery for Children-2) on the occurrence of arithmetic, spelling, and reading skill problems (measured by the Wechsler Individual Achievement Test-II). It is hypothesised that adolescents with DCD will display a greater frequency of arithmetic difficulties (but not reading or spelling difficulties) compared to controls without DCD. Data collection for this project is ongoing thus, preliminary analyses will be presented.

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21. Comparing the Short Form of the Bruininks-Oseretksky Test of Motor Proficiency and the Movement-ABC in a school-based setting

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Rationale: Among the most widely used tests to assess Developmental Coordination Disorder (DCD) in children are the Bruininks-Oseretksky Test of Motor Proficiency (BOTMP) and the Movement ABC (M-ABC). However, agreement between these tests, when administered to children in field-based settings by trained non-clinicians, is not known. This is unfortunate since epidemiological research requires standardized instruments of this type, and economic constraints often mean they must be administered by non-clinicians. Method: Ten schools were randomly selected from a total of 75 participating in a larger study. All children in grade 4 (n=340) in each of these schools were assessed with both motor tests (BOTMP-SF and the M-ABC) in May of 2005. The order of tests was balanced, and there was an average gap in time between tests of 10 to 15 minutes. Results: The correlation between tests was moderate (r=.50, p<.01). Kappas were low at the 5th (k=0.19) and 15th (0.29) percentile cut-points generally used to identify cases of DCD. Re-analysis using the relative improvement over chance (RIOC) statistic, however, revealed somewhat better agreement at both cut-points (5th percentile, RIOC=.29; 15th percentile, RIOC=.47). Children scoring below cut-points on both tests had higher BMI scores, poorer physical fitness, and lower levels of teacher-reported physical ability than those positive on one instrument only. Discussion: In general, the agreement between tests, even after adjustment for relative improvement over chance, was poor. Children identified by both tests are at particular risk for poor physical fitness, overweight/obesity, and physical inactivity. Because both tests clearly measure different dimensions of motoric ability, the use of both may increase the validity of DCD diagnoses under field-based conditions.

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22. Further validation of the DCDQ for Brazilian children

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Introduction: The relevance of identifying children with Developmental Coordination Disorders (DCD) is well recognized worldwide. In order to contribute to the identification of these children in Brazil, the Developmental Coordination Disorder Questionnaire (DCDQ), a parent questionnaire, was translated into Portuguese and two items were exchanged, to make the questionnaire more culturally relevant. Although the 15 item DCDQ-Brazil is slightly different from the Canadian original, it showed good psychometric properties and potential as a screening tool, therefore, further validation studies, with bigger samples, were recommended. Objectives: To apply the DCDQ-Brazil to typically developing children and advance towards the definition of norms and cut off points for Brazilian children. The reliability of the instrument was further examined. Methods: The DCDQ-Brazil was completed by the parents of 270 typically developing children, 5-14 years-old, distributed in groups of 20 to 40 children in each age level, with equal representation of genders. Data were collected in private and public schools to examine whether socioeconomic status had significant influence on test scores. Parents of 10 children completed the questionnaire twice, 14 days apart, to examine test-retest reliability. Data analyses were conducted using nonparametric tests. Results: Mann-Whitney’s test did not find significant difference in total scores by gender (p=.202) or social status (p=.539). Results of the Kruskal-Wallis test indicated that younger children, ages 5 to 8, scored lower than the participants ages 9 to 14 (p=.000), therefore, cut off points for each age group were identified. Test retest reliability (ICC) was .96 and internal consistency (Cronbach α) was .86. Conclusion: The results continue to support the strong psychometric properties of the DCDQ-Brazil. The cut off points, which are somewhat different form the Canadian norms suggesting further cultural differences, are not definite and should be tried with clinical population to examine the questionnaire’s utility as a screening tool.

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23. Performance on specific motor tasks in children with DCD with or without comorbid ADHD

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Background: ADHD is common among children with DCD, and children with each disorder often exhibit some symptoms of the other. Motor deficits in children affected by ADHD may, however, differ in degree or in kind from those in children with 'pure' DCD. Such differences may offer some insight into the nature of the relationship between the two disorders. Methods: As part of a school-based screening study, we identified 78 children with DCD only and 54 with DCD and comorbid ADHD. Presence of DCD was confirmed by the Movement-ABC, which was administered by an occupational therapist, while ADHD was identified from clinical or school records. We examined differences in M-ABC test items between the two groups using t-tests and logistic regression. Results: Total scores on the Movement-ABC were similar in both groups, but significant differences were observed on 3 of the 8 included tasks. After taking age, sex, and scores on other tasks into account, significant differences persisted for peg-shifting (p=0.01), which was better among children with ADHD, and trail-tracing (p=0.001), which was substantially worse. Discussion: The presence of ADHD appears to be associated with performance on certain fine-motor coordination tasks, but the effects of ADHD in this domain are not consistent. Although this may reflect very specific links between ADHD and motor tasks, it may also be the result of issues related to testing, since test items requiring careful effort may be adversely affected by the presence of inattentiveness or hyperactivity in children with ADHD.

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24. Using the perceived efficacy and goal setting system PEGS with Brazilian children with and without motor disabilities: strengths and limitations

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Background: Children with Developmental Coordination Disorder (DCD) usually receive a variety of therapeutic services. Engaging the child in intervention is facilitated by tools, such as the Perceived Efficacy and Goal Setting System (PEGS), which allow for the participation of the child and family in the identification of treatment goals.

Objectives: The PEGS was translated to Portuguese and the aim of this study was to examine the validity of the translated version and determine whether it would need to be adapted for clinical use with Brazilian children.

Method: Eighty typically developing children ages 6 to 9 years-old (40 public schoolchildren and 40 private schoolchildren) and 40 children with motor disabilities (ranging from cerebral palsy to DCD) ages 7 to 12 years-old, their caregivers and teachers completed the PEGS. Results: All children understood the pictures and interview procedures. The caregivers and teachers reported no difficulties understanding the questionnaires. Preliminary analysis indicated that gender, age and social background had no significant influence over the determination of the children’s scores, however, children with disabilities scored significantly lower. Stability in setting goals was confirmed and children, caregivers and teachers appear to share views regarding the abilities of the child performing most of the tasks described in PEGS. The internal consistency of the scales was adequate (Cronbach α ranging from 0.703 to 0.881). Multivariate CART analysis coefficient of determination was low but significant, and revealed interesting relationship between the variables (i.e., age, gender, type of school and diagnosis) on the determination of the children’s scores. Conclusion: Although limitations were identified, PEGS does not require further adaptations to be used in Brazil. The instrument seems clinically useful and should be further explored. Children with disabilities and from different ages and social backgrounds were able to identify relevant therapy goals and seemed to enjoy participating in the process.

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Background: The American Psychiatric Association suggests in their DSM-IV criteria for Developmental Coordination Disorder (DCD), that there is a relation between IQ and motor performance (APA, 1994). Especially criterion A and D refer to this relation. Nevertheless, there is little scientific evidence for this relation in children without a general medical condition. The purpose of this study is to scrutinize the relationship between motor performance and IQ in healthy children.

Method: To gather data over a broad range of performance 110 Dutch 7-10 year old children, attending mainstream schools or schools for special education (children with normal intelligence but with reading or math problems), were assessed within 2 weeks for motor performance and cognitive function. The MABC-2 and Kaufmann ABC (K-ABC) were used. The MABC-2 is subdivided into Manual Dexterity, Balance and Aiming & Catching. The K-ABC is subdivided into the sequential processing scale (for this age group: hand movements, number recall and word order) and the simultaneous processing scale (gestalt recognition, triangles, matrix analogies, spatial memory and photo series). For the K-ABC a correlation of 0.70 is reported with the WISC-R Full scale IQ. Results: One child was excluded because he did not meet the normal IQ criterion (IQ 69). For the total group, the mean K-ABC score was 101.8 (SD=13.6). Although in the normal range, the K-ABC scores of the special school children were significantly lower than the K-ABC scores of the mainstream school children, 92.0 (SD=9.4) and 112.6 (SD=9.4), respectively. A significant correlation between the K-ABC and the total MABC-2 standard score (r=.59; p<0.01) was found, which suggests a moderate relation between motor functions and intelligence. Moreover, a moderate relation with the MABC-2 total score was found with both subscales of de K-ABC; the simultaneous processing scale (r=.57; p<0.05) and the sequential processing scale (r=.49; p<0.01). The K-ABC values also correlate significantly with MABC-2 subscores: with Manual Dexterity (r=.48; p<0.01), with Aiming & Catching (r=.33; p<0.01) and with Balance (r=.55; p<0.01). Conclusion: In children within the normal IQ-range a moderate correlation between IQ values and motor performance is evident.

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26. Critical motor skills forming nursery school teacher’s impression of preschooler’s motor difficulties

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The present study aimed at examining which skills of everyday motor activities form nursery school teacher’s impression of preschooler’s motor difficulties. Movement-ABC has a checklist considering both environmental and child’s situations close to everyday activities. Although this checklist is practically useful for teachers to see whether or not a child has a motor difficulty, it is not sufficient to investigate specific skills. Thus, in order to develop a new checklist, we first categorized various activities in existing checklists, based on the view argued by Gentile (2000). Her taxonomy is constructed of 16 categories involving the environmental context and the functional role of each action. The results showed that existing checklists concentrate on static activities such as drawing, playing blocks, cutting paper with scissors. And then, we asked nursery school teachers and parents by what age each activity can be achieved. Finally, several items for each age were selected. Adding this new checklist, we conducted M-ABC to assess 5- and 6-year-old children’s motor ability. The checklist items included both dynamic and static activities. Some examples for those ages are ball activities, skipping, rope jumping, lacing a string, wringing out a rag. Beside that, the nursery school teachers were required to fill out the questionnaire which asked their impression about each child’s motor difficulties. We are analyzing the data in terms of the following three points. First we compare achievement age expected by teachers and parents with actual child’s motor difficulties. Secondly, we examine the relationship between child’s motor ability and teacher’s evaluation. Third, we specify which skill(s) form nursery school teacher’s impression. We hypothesize that teacher’s evaluation and child’s static motor ability relate to each other. Preliminary data showed assessors tend to value manual dexterity to determine child’s motor development. Eventually, we discuss how to treat motor difficulties within everyday activity.

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27. Developmental Coordination Disorder: Can one rely on parent information?

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Screening for specific developmental disorders, such as Developmental Coordination Disorder (DCD), is unlikely to be feasible in a general clinic setting, but might be useful in clinics to which children are referred for learning- and/or behavioral problems, where high co-morbidity of DCD is expected, but not necessarily identified. Along with the putative "gold standard" assessment, the Movement Assessment Battery for Children (M-ABC), is a checklist designed to be used as an extension of the M-ABC. Data are published on the M-ABC Checklist when completed by teachers but not when completed by parents, who are the most accessible for a clinician. In the present study, we determined the relationship and concurrent validity of the M-ABC performance scores and the parent-completed Checklist. We also tested each section of the M-ABC checklist independently. Sixty four children were recruited through community referrals. Each child was assessed with the M-ABC, an independent assessment by a clinician and an evaluation by their parent using the M-ABC checklist. Results of 47 children diagnosed with DCD as defined by the M-ABC (<15th %) and clinician were used for analysis. The relationship between the parent's score on the checklist and the M-ABC test was analyzed using the Pearson’s product-moment correlation coefficient for those at the 5th and 15th percentile cut-offs. The overall correlation was r= 0.70 (p=0.0007). The parent's score of Section 2 (child moving, environment stable) was the strongest predictor of the total M-ABC score (r=0.73, p<0.0001). Overall, the M-ABC Checklist meets criteria as a screening tool for identification of children with motor coordination difficulties when completed by parents in a referred population for children with motor coordination concerns.

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1. **Goal Attainment Scaling (GAS) - A valid outcome measure for D.C.D. paediatric physiotherapy?**

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**Purpose:** The purpose of the study was to evaluate the use of goal attainment scaling (G.A.S.) as an outcome measure in our physiotherapy practice for children with DCD. **Method:** This was a quantitative study. Results were analysed using Microsoft Office Excel 2003 spreadsheet. 24 children with a diagnosis of D.C.D. were included in the study. All had completed a course of physiotherapy involving 8 individual weekly treatment sessions supplemented by a daily home programme whilst attending treatment. The home programme was reduced over the following 3 months. Parental consent had been given prior to assessment and treatment. No ethical permission was required as treatment took place in a private physiotherapy clinic. A physiotherapy assessment of motor skills was carried out and the scores used for G.A.S. The authors chose 50% as the principle goal as previous experience has shown this to be a realistic expectation. Therefore, on the 5 point ordinal scale the following applied: -2(no change), -1(+25%), 0(expected:+50%), +1(+75%), +2(+100%). The Movement ABC was also completed to provide a standardised comparison of change. All children were reassessed at the end of the 5-month treatment period using the same assessment methods. **Findings:** Improvement with motor skills was indicated using both G.A.S. and M-ABC. G.A.S. range of change was +0.7 to +1.77 with an average of +1.36. M-ABC impairment score range of change was 3 – 19.5 with an average of 8.88 and the M-ABC percentile range of change was 0 – 93 with an average of 39.04. **Conclusions:** Both systems confirm improvement indicating that G.A.S. is a valid tool for our practice. It can be used to show improvement in areas other than motor skills, which commonly affect children with D.C.D. (e.g. working memory and organisational skills). It is easy and quick to use and readily understood by parents and other professionals. It requires no training and there are no cost implications.

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2. **Changes in parents’ concerns - moving from child to adulthood**

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Only a few DCD studies have considered the views of the parent of the emerging adult (Missiuna et al, 2006; 2007). Parents are able to provide a perspective of their child’s daily experiences and also reflect on past educational experiences and what has changed over time. As young people move to adulthood parents may be seen as less important and their views may be sought less frequently by professionals supporting the individual. A semi structured questionnaire was used with 42 parent of children who had been seen in childhood with DCD who were now aged between 16-25 years of age in order to consider key themes at both home and in educational settings that continue to be a parental concern in emerging adulthood (16-25 years). A coding dictionary is devised to extract key themes and subthemes and the key areas are as follows: motor, executive functioning and social and communication difficulties. This paper will present the key findings including the continuing concerns identified by parents; co-ordination, independent living skills, learning a new skill, organisational skills, social and communication skills, emotional and psychological states. A key theme that emerged was the need to identify strengths or find ways of adapting or avoiding the difficulties faced by their children. Some parents reported spending extensive amounts of time working with their child in order to see skill gains; others accessed a variety of external support services. Lack of support and understanding and the need to fight for support for their child was frequently expressed. This study demonstrates the concerns that parents’ in their children at the stage of emerging adulthood. Listening to the voices of parents can give additional information which may be missed if histories are taken only from the individuals’ themselves. As students arrive at university/college, there is an assumption of competence and the ability to appropriately seek help. It is clear from the parent interviews that there are cases where parents need to be actively involved in supporting their children in everyday living skills. There was also a continuing need to support their children emotionally and this accentuated fears for their child’s future. There is a need to work with parents in order to help the child develop independence skills and so give the parent confidence to allow this to happen.

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3. A quantitative analysis of physical activity of Children with Developmental Coordination Disorder in Taiwan

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The purpose of this study was to compare physical activities of children with and without DCD in Taiwan. In this study, 125 children ages 11-12 years were examined by the Movement ABC test. Twenty children with DCD (10 boys and 10 girls) and twenty-two children without DCD (11 boys and 11 girls) took part in the measurement of physical activity. We used the RT3 accelerometer and the Children’s Lifestyle Questionnaire (CLQ) to measure 7-day physical activity. Results showed that children with DCD in the level of physical activity were lower than children without DCD in the period of 7 days. Boys with DCD in total 7-day, weekday, weekend, and free time in school of physical activities were significantly lower than boys without DCD. A significantly positive correlation was found between the activity counted by the RT3 and CLQ. We concluded that the levels of physical activity in children with DCD were significantly lower than those without DCD in Taiwan. We should pay more attention on physical inactivity of children with DCD and give them more supports in attending physical activities and exercises.

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4. Associations between obesity and motor coordination ability in children

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Aim: Past research studies had examined the relationships between obesity and motor ability but their results were lack of consistency. The purpose of this present study was to investigate the associations between obesity and motor coordination ability in Taiwanese children. Methods: 2029 children (1078 boys, 951 girls) aged nine to ten years were chosen randomly in fourteen elementary schools around Taiwan. We used bioelectrical impedance analysis to measure percentage of body fat (PBF) and the Movement ABC test to evaluate the motor coordination ability. According to cut off points in PBF from past studies, boys and girls were divided into the obese group, overweight group and normal weight group, respectively. Pearson correlation coefficient was used to examine the association between PBF and motor coordination ability. Results: In boys, balance and total impairment scores were significantly higher in the obese and overweight groups than normal weight group. Girls in the obese and the overweight groups had higher balance impairment scores than those of the normal weight group. There was weak correlation between PBF and total impairment scores of the Movement ABC test (r=0.11-0.14, p< .01). The correlation coefficients between PBF and balance impairment scores were slightly higher (r= 0.14-0.18, p< .001) than those between PBF and manual dexterity impairment scores (r= 0.04-0.07, p< .05). Conclusion: This study demonstrates that obesity may be associated with poor motor coordination ability among boys and girls, especially in the balance ability.

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5. Pulmonary function of children with Developmental Coordination Disorder in Taiwan

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The purpose of this study was to examine pulmonary functions of children with developmental coordination disorder (DCD) in Taiwan. The Movement Assessment Battery for Children (MABC) test was used to identify whether children have the problems in movement coordination. 90 children with DCD and 160 children without DCD aged from 9 to 11 years were recruited in this study. Using the KoKo spirometry, the pulmonary functions of children were measured. A field test, 800-meter run, was used to represent the aerobic ability of children. Independent t-test was used to compare pulmonary function and aerobic ability between children with DCD and non-DCD. There was a significant difference on the pulmonary function between children with DCD and non-DCD. In particular, the functional vital capacity (FVC) in children without DCD was significantly higher than children with DCD. No significant difference in forced expired volume in one second (FEV1) and 800-meter run between children with DCD and non-DCD was found, although children without DCD were better than children with DCD (p>.05). A significantly low correlation (r=-.132, p<.05) was found between the ability of movement coordination (MABC test) and FVC. However, the correlation between FVC and 800-meter run was low and there was not a significant difference. Pulmonary function in children with DCD was significantly lower than that of children with non-DCD. However, the field test, 800-meter run, may not be a good indicator to distinguish the aerobic ability between children with DCD and non-DCD. It is necessary to concern the pulmonary function of children with DCD due to less physical activities. Further studies in a laboratory setting should be conducted to examine the relationship between pulmonary function and cardiovascular function of children.

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6. Evaluation of a specific program for dysgraphia: Handwriting task program

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This study intends verify the efficacy of a specific intervention program (Handwriting Task Program) for dysgraphic disorders in children with DCD (Nunzi et al., 2007) and intends analyses the trend during the time of dysgraphic signs, divided up areas (Blason & coll. 2004), in children with different handwriting profiles. The study compares the efficacy of the same treatment in dysgraphic children with and without DCD. The sample is composed by 3 children, aged between 7 and 9 years, with clinical diagnosis of Dysgraphia and DCD. The efficacy of treatment has been valued through sperimetal plan on single subject AB, when each child is a study n=1. The independent variable was the score obtained during the sperimetal task that measures the quality of handwriting. The dependent variable was the treatment proposed to the children: Handwriting Task Program. Moreover it has been introduced a Systematic Parent Training. Grapho-motor abilities have been valued first of treatment, after three months and after one years, using VMI (Beery, 1997), and handwriting speed using three specific writing task (Tressoldi e Cornoldi, 2000). It has been carried out 8 measurements of the sperimetal task during the baseline phase and 12 measurements during the treatment phase. The results show that during the treatment all children improve the handwriting abilities. For the child which showed more difficulties in visual-spatial area, the Handwriting Task Program is efficacy and significant but the results obtained after 1 year are comparable to the results of disgraphic children without DCD after 3 months of treatment. For Disgraphic child with DCD which showed more difficulties in motor control area the efficacy of the Handwriting Task Program is not significant. It seems from these preliminary and very restrictive results that the efficacy of the treatment proposed (HTP) depends both by the association with DCD and by the specific handwriting profiles.

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7. How are motor learning strategies applied within physical and occupational therapy intervention approaches for children with DCD?

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Background: Children with Developmental Coordination Disorder (DCD) have difficulty learning, transferring, and generalizing new motor skills. Cognitive Orientation to Daily Occupational Performance (CO-OP), Neuromotor Task Training (NTT), and Task-Specific Interventions (TSI) are intervention approaches involving direct teaching of motor skills. Rather than focusing on temporary changes in motor performance, these interventions should promote motor learning: permanent changes in motor skill capability that can be transferred and generalized to similar tasks and environments. The application of motor learning strategies (MLS) by therapists within intervention sessions may promote this learning. MLS include structuring the context of the learning environment, using goal-setting to enhance motivation for learning, giving verbal instructions, organizing the structure, scheduling and amount of physical practice, and providing verbal feedback about task performance or outcomes. Little is known about how CO-OP, NTT and TSI apply these MLS.

Purpose: To identify and describe the application of five MLS (context structuring, goal-setting, instructions, practice, and verbal feedback) within three DCD intervention approaches.

Methods: A scoping review is a method of reviewing the literature that explores key concepts of interest in a field of study, utilizing the full range of available scholarly and grey literature. The review includes 18 references for CO-OP, 6 for NTT, and 2 for TSI. Three themes characterizing the application of MLS within the approaches are identified and described.

Findings: Application of a motor learning principle within an approach can be a defining component of the intervention or a means of enhancing generalization and transfer of learning beyond the intervention. Often, insufficient information limits full understanding of principle application within the approach. CO-OP applies more motor learning strategies than does NTT or TSI.

Conclusions: A greater understanding of the application, and perceived non-application, of MLS within intervention approaches for children with DCD has important clinical and research implications.

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8. What are the educational needs of health professionals who transfer knowledge about DCD to parents and teachers?

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Background: Developmental Coordination Disorder (DCD) is a common childhood condition that is poorly understood by parents and teachers. In Ontario, Canada, physical therapists (PT) and occupational therapists (OT) provide school-based services to children with DCD within a consultation model of practice. They consult with teachers and parents to transfer knowledge about DCD and enhance their capacity to manage the needs of these children. However, the skills required to effectively transfer knowledge to adult learners are not usually taught in professional curricula.

Purpose: A facilitator worked with a focus group of PTs and OTs to collaboratively develop the content and format of an educational workshop related to developing knowledge transfer skills in consultation practice for DCD.

Methods: A series of weekly meetings, structured by the Understanding-User-Context Framework, were held to explore the context of consultation practice for DCD and the educational needs of PTs and OTs. The group identified, appraised and summarized evidence from the literature, discussed the role of experiential evidence in this context, and developed the content and format of an educational workshop to be presented to their peers.

Findings: Therapists identified challenges related to the isolated nature of school-based consultation practice and lack of teacher and parent awareness of the implications of DCD and its consequences. They identified educational needs related to developing communication, knowledge transfer and conflict resolution skills, enhancing awareness of adult learning principles, becoming familiar with evidence supporting the consultation model of practice for children with DCD, and developing skills related to setting goals and evaluating the effectiveness of the knowledge transfer.

Implications: Enhancing the capacity of teachers and parents to support children with DCD is a sustainable and evidence-based approach to school-based practice. Health professionals whose goal is to transfer knowledge about DCD to adult learners may benefit from educational initiatives to promote effective knowledge transfer skills.

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9. Motor skills, psychological well-being and perceived difficulties in adults with DCD: A quantitative and qualitative study

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Previous research has suggested that individuals with Developmental Coordination Disorder (DCD) experience depression and anxiety in addition to their motor difficulties. However, these difficulties have not been investigated extensively. Furthermore, research has focused largely on children rather than adults. This is despite the fact that children do not grow out of DCD. The focus of the current study was on adults with and without DCD, with two aims: First, to evaluate the nature of psychological well-being and its relationship to manual dexterity skill. Second, to explore adults’ current perception of difficulty. To investigate the first aim, 17 adults with (and 40 without) DCD completed questionnaires concerning depression, state and trait anxiety, and quality of life satisfaction. They also completed a pegboard and two handwriting tasks. In comparison to their peers, the DCD group experienced significant differences on all tests of psychological well-being, performed significantly slower on the pegboard task and showed some differences from their peers on the handwriting tasks. These findings indicate that some degree of motor difficulty persists into adulthood and suggests a striking prevalence of depression and anxiety as well as poor quality of life satisfaction in this group. Semi-structured interviews were conducted with six of the DCD participants to evaluate the second aim of the study; the nature of the perceived difficulties that the adults with DCD report in their current daily life. Analysis of these interviews highlights the persistence of motor difficulties for these individuals, an acknowledgement that current motor difficulties differ in some ways from the motor difficulties experienced as children, and accentuates, in particular, the non-motor difficulties experienced such as anxiety, poor social relationships and difficulty maintaining employment. The implications for furthering understanding of the consequences of DCD in adulthood, and for providing suitable support for these individuals will be discussed.

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10. Investigating the social and emotional wellbeing and links to motor difficulties in children with DCD

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Although until recently the social and emotional wellbeing of children diagnosed with DCD has been overlooked, it now appears that these issues may be a problem for a large majority of children with DCD (e.g., Green, Baird, & Sugden, 2006). The current study investigated how varying levels of anxiety and self-esteem may be linked to severity and type of movement difficulties, as well as sports related activities. A group of parents with children diagnosed with DCD (n = 20) completed parental questionnaires relating to their child’s level of anxiety, general behaviour and well-being. A group of parents with typically developing children also completed the same set of measures (n = 35). Finally, parents completed a questionnaire designed to look at sports and creative activities participated in outside of school. Results will be discussed in terms of differences in anxiety levels between the two groups, and how these differences were related to extra curricular activities in both groups. Finally, the relationship between anxiety levels and severity of movement problems will be outlined by comparing questionnaire data with performance on the Movement-ABC 2 (Henderson & Sugden, 2007).

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11. Why worry? Stories from and trends within schools

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Abstract: Most children with undiagnosed DCD have a very different and troublesome journey through school than their classmates. The presenter is an educational psychologist who is aware of these students and has started to observe many ‘non-motor-related’ problems and patterns of behaviour within the school setting. At the present time, there seems to be a significant focus on the identification and treatment of the ‘motor’ and physical health needs of children with DCD. However, because these children also struggle with educational achievement and often self-isolate and/or ‘act-out’ because they are unable or embarrassed about their poor performances, many other psycho-social, behavioural, and educational problems arise. Unfortunately, there appears to be less research effort spent on needed psycho-social intervention and addressing the short and long-term impact of DCD on educational matters. DCD is truly a psycho-social condition that deserves recognition and support within the educational systems of North America. Indeed, while it is believed that all of us seek to identify students with DCD so we can help them learn and improve their self-help skills and motor skill performances, the true need of these students may be to help them improve motor functioning and learning in order to affect their general motivation, academic and career accomplishments, psycho-social well-being, and overall functioning. Purpose of this presentation: Show and explain the various ‘non-motor’ trends and patterns of behaviour observed within school-aged children with DCD, describe the psycho-social interventions used with these students, and show the changes in behaviour, attitude, attendance, and academic grades after intervention. Approach used: Applied research. Research method: Case study format and documentation. Conclusions: There are numerous ‘non-motor’ trends observed in school-aged students with DCD; these patterns seem to vary with the child’s age. However, once these students are identified and they have engaged in brief psycho-social intervention, changes in their attitude, motivation, academic achievement, attendance, and social interactions can be observed and measured – revealing significant improvements. Further implications: At the present time, DCD is not well-known in educational settings within Canada and the USA; however, because of the underlying psycho-social needs of students with DCD, additional study and research must be undertaken to document their ‘non-motor’ needs and determine why certain forms of psychological intervention seem effective.

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12. Is motor proficiency and limitations in ADL associated with current and past signs of DCD in young adults?

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The present study aims to explore the relationship between motor proficiency and past and current signs of DCD in a large student population. Three cohorts of psychology students (N=987) answered to questions presented as an obligatory part of their first year participation in research project through SONA-systems. There were 3 questionnaires on 1. motor proficiency at home, school, sport and other leisure activities, and motor milestones; 2. conditions of medical origin and limitations in daily life; and 3. hand and foot preference. The first asked retrospectively about motor proficiency at kindergarten age, primary school age, age around puberty and current status. With respect to the latter, the number of hours of active participation in sports(training) was additionally asked for. From the data the incidence of DCD as a child was estimated retrospectively (4.5%) and compared to the estimated incidence among these young adults (< 2%). Limitations in ADL are reported for half of these subjects at children’s age, but in adults these limitations are reported only in relation to medical conditions, not in relation to DCD. Surprisingly, quite a proportion of former or current “DCD” subjects are active sporters. Differences in strength of handedness between the subgroups will also be reported in the poster.

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13. Rehabilitation of graphomotor disturbances by means of the spatio-temporal Terzi’s method

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Many different treatment approaches, mainly based on perceptual-motor, visual-motor, motor control, individualized interventions/exercises, and supplementary handwriting instruction, have been applied for handwriting remediation in school-aged children. In this paper a new treatment protocol (Terzi’s method; www.metodoterzi.it), based on a motor-cognitive approach aimed to correctly process and integrate spatio-temporal information coming from different sensorial inputs (kinesthetic, proprioceptive, tactile, visual) is proposed, and its effectiveness is evaluated on 14 non-proficient handwriters children attending primary school. All children undergo the treatment for about 15 sessions of 45 min. each. The treatment affects the construction of mental images in order to organize both the personal space (bodily scheme, bilateral integration, fingers fine motor control) and extra-personal space (spatio-temporal geometrical analysis of each letter and its reconstruction by means of a suitable motor planning blindfold deambulation). The blindfold condition permits to reduce the processed information, boosts the mental representation of each letter as well as the learning of more efficient graphomotor patterns, with a consequent allographic recovery. In order to evaluate the treatment effectiveness, standard test protocols (Movement ABC, Test of Visual-Motor Integration (V.M.I.)) as well as a Letter’s Check-list, a sequence of ‘lelele’ and a sentence to be transcribed in cursive as better and as faster as possible, were administered, before and after the rehabilitation process. The writing was also acquired by a digitizing tablet and a series of static and kinematic parameters linked to pressure, trajectory and velocity features of each identified stroke was calculated. The effectiveness of the Terzi’s rehabilitation program was proved by significant improvements in visual-motor integration (by means of the V.M.I.), in motor control (by the Movement ABC) as well as in writing legibility. The latter was evaluated by means of the Letter’s Check-list parameters and confirmed by the mean velocity increment (p<0.01) during single stroke (that is an index of the old motor program substitution with a more automated one, able to produce a more fluent tract) as well as along the whole curvilinear written tract (p<0.02) and the mean width of a stroke (p<0.02).

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14. From identification to intervention

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This study concentrates on the years three to six, an age range that lacks specific guidance detailing assessment and management of movement delays and disorders. One of the aims of the project was to examine the efficacy of ‘low level’ intervention programmes for children identified with coordination difficulties and involved working with nurseries, schools and parents. Thirty six children (aged three to six years of age) participated in an intervention study designed to improve their coordination skills. All the children were initially screened using the Early Years Movement Skills Checklist (EYMSC) (Chambers & Sugden, 2006) and children who scored below the 15th percentile were selected for intervention. Individual profiles were developed for each child and priorities for intervention were established through semi-structured interviews with parents and teachers. Global, experiential, graded intervention guidelines were prepared to be carried out by teachers. This intervention was based on a class approach such that the individual child with difficulties was not specifically identifiable to the rest of the class or visitors and activities were presented in such a way that each child had the opportunity to learn them. This preparation stage is crucial as there is a delicate balance between not being specific enough to properly address any problem and being over prescriptive which places the child into an early prediction, self fulfilling mode, rather than a low key early preventative intervention. The teachers were given guidelines for working with the children which were updated every three weeks. Each child had three to four sessions a week lasting for approximately 20 minutes. Using the example of two cases, this presentation will explore the preparation of individual sets of activities for both children from initial assessment to developing individual profiles to the setting of priorities for intervention and, finally, to the development of appropriate activities. It will also report on recent assessment carried out by teachers using the EYMSC, two years after the intervention study.

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DCD VIII – International Conference  Baltimore 24 – 26 2009
15. Four year old children with motor skill difficulties: How effective is parent and teacher focused intervention?

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Aim: This study investigated the effectiveness of a parent and teacher focused intervention for 4 year old preschool children with motor skill difficulties not due to a neurological or pervasive developmental disorder.

Approach: Randomised controlled trial. Method: A two-step procedure identified children with motor skill difficulties. Each child’s parent and teacher completed the Children’s Activity Scale Questionnaire (Rosenblum 2006). Children who scored below the risk for motor skill difficulties cut-off for either questionnaire were assessed by a physiotherapist using the Movement Assessment Battery for Children (MABC) (Henderson & Sugden 1992) and invited to participate in the intervention study if their score was 10.5 or above. Fifty-nine children (46 boys:13 girls), their parents and teachers participated. Children were randomly allocated by preschool to intervention (26 boys:5 girls from 17 preschools) or usual care (20 boys: 8 girls from 18 preschools) groups. The intervention firstly involved a physiotherapist providing an informal education session about motor skill development and difficulties at each preschool. Secondly, each child’s parent/s and the physiotherapist collaboratively developed goals using the Canadian Occupational Performance Measure (COPM)(Law et al 2000). The physiotherapist then developed a number of written activity suggestions for each child’s five selected goals. Parents were asked to spend at least four 15 minute periods and preschools two 10 minute periods per week assisting the child with the suggested activities for a period of 12 weeks. During the intervention period, the physiotherapist aimed to encourage each parent with fortnightly telephone contact and review progress at each preschool twice. Findings: Intervention effectiveness was determined by blinded MABC assessment of all children, blinded review of intervention group COPM scores and parent and teacher satisfaction questionnaires. Analysis is currently being undertaken for 55 children who completed the study and results will be reported at the presentation.

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16. What are the effects of occupational therapy for children with Developmental Coordination Disorder?

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The goals of this study were to: (1) analyze the effects of occupational therapy on occupational performance and on motor coordination of 45 children, aged between 6-10 years, who had Developmental Coordination Disorder (DCD); (2) compare the relationship between the changes on the Canadian Occupational Performance Measure (COPM; Law, Baptiste, Carswell, McColl, Polatajko, & Pollock, 2005) and the changes at the Movement ABC (Henderson & Sugden, 1992; Soppelsa & Albaret, 2004). Those measures were administered before treatment, after treatment three months later and at a 9-month follow-up by two independent evaluators. A questionnaire was addressed to the children’s teachers. Treatment was performed through individual weekly sessions for a mean total of 26 hours per child. Objectives of treatment and activities realised during the sessions were described by the occupational therapists. The treatments were a mixed of bottom-up and top-down approaches. A repeated measure analysis of variance was used to assess within subjects changes while an analysis of correlation measured the relationships between the two scales. The Movement ABC showed significant results (F (1, 2) = 40.92, p < .00). The changes in occupational performance of the MCRO were found also to be significant (F (1, 2) = 39.13, p < .00). Most of the teachers (86%) observed changes at school in fine motor skills but also in self confidence and social relations. There was no significant relationship between the changes on the M-ABC and those on the COPM at follow-up. The implications of those findings underlined the relationships between motor coordination, occupational performance, social relations and self confidence. This study showed the need to administer a test of motor coordination as well as a measure of occupational performance to objectify the effects of occupational therapy.

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17. Difficulties of written expression in children with Developmental Coordination Disorder: Do they improve over time?

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Background: Many children with Developmental Coordination Disorder (DCD) experience difficulties with handwriting which (a) impact on the quality of written composition and (b) affect academic progress. Existing longitudinal studies show that motor difficulties associated with DCD may persist into adulthood. However, none focus specifically on handwriting and/or writing difficulties over time. This is the aim of this study. In typically developing children, the mode in which a child recounts a story has an effect on the quality of the output, which changes with age. Whereas younger children produce more complex texts in oral than in written mode, after the age of 9-10 years written texts become the more elaborate. In this study, comparison between oral and written story telling is a major focus. Method. In phase one of the study, 12 children, aged 10 to 11, meeting criteria for DCD, and 12 age matched controls composed stories in both oral and written mode. In addition to standardised tests of IQ, reading, spelling, motor competence, measures taken included legibility, speed of handwriting, number of words produced and quality of composition in each mode. Results showed that the children with DCD performed more like younger typically developing children in that their oral stories were longer than their written stories. Also, their written texts were objectively poorer than the controls in both word length and composition quality. In phase two of the study, the children are currently being re-tested four years later on equivalent, age-appropriate measures, to see if the pattern of performance on both standardized and non standardized results changed. The findings will be discussed in the light of what is known about maturational changes in both typically developing children and those with DCD.

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18. Feasibility and motor outcomes of intensive physical and occupational therapy for a child with motor coordination difficulties

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Purpose: Intensive therapy is reported to improve motor function in children with Cerebral Palsy. The aim of this case study was to examine motor outcomes following intensive Physical (PT) and Occupational Therapy (OT) in a 5 year old girl with motor apraxia who had coordination difficulties severe enough to impact ADL, sports and recreation. Approach: Intensive therapy was implemented to address poor carryover of learning and minimal change in function with once weekly therapy. Intervention was designed collaboratively by PT and OT to address overlapping goals and improve functional skills through guided practice and repetition. Methods: The program was divided into 2 six week episodes of intensive therapy (Episode 1: PT 2x week, OT 3x/week; Episode 2: OT 1x/week, PT 3x week) with 3 months of weekly OT between the 2 episodes. Goal Attainment Scaling (GAS) was used to track qualitative changes in functional skills in dressing, ball skills, playground skills and bilateral coordination. Motor skills were assessed using the Bruininks Oseretsky Test of Motor Proficiency-2 (BOT-2). Findings: A minimum of Expected Level of Performance or higher was achieved on all goals of the GAS following both intensive episodes. After the first episode, greater than 40% increase was noted on BOT-2 point scores in Balance and Running Speed & Agility. From parent report, the child performed skills learned (hopping, jumping rope, dressing) outside the clinic. Skills were maintained during the 12-week interval between the intensive episodes. Implications: Intensive collaborative PT and OT may be feasible for children with coordination difficulties and their families. The two disciplines by addressing different aspects of skill acquisition may provide adequate practice in various contexts needed for carryover of skills to everyday life. Tracking achievement of individual therapeutic goals using the GAS may be effective in examining the impact of intervention on function. Further studies should determine the effectiveness of this model across ages and levels of severity of coordination deficits.

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19. Physical fitness and motor coordination in 10-11 year old German children

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Introduction: The study presents data on the coordinative abilities of school children, using the Movement-Assessment Battery for Children-2 (M-ABC-2), which has been adapted for Germany recently. The results for coordination abilities are compared with data for the same children obtained with a standardized fitness test developed for German schools. In addition to compare the test criteria of the higher ageband from M-ABC-2, previous results on the relation of developmental coordination disorder (DCD) and physical fitness (Schott et al., 2006) were reassessed. In contrast to previous generations, differences in the development of motor competence generally are less evident in the early school age, but become more apparent in elder children. However, results on this issue are not consistent. For this reason the investigation of the age group 10 to 11 is of particular interest.

Method: The study has been conducted at a German comprehensive school with 170 children (84 girls and 86 boys) aged 10 to 11. The German adaptation of the M-ABC-2 developed by Petermann et al. (2008) was used. It comprises scales for manual dexterity, ball skills and balance. Furthermore a German physical fitness test, developed for 6-18 year old children (Boes et al., 2007) was used. This test includes items for endurance, strength, coordination and flexibility. Data on flexibility are not included in the general physical fitness score. In contrast to the M-ABC-2, the physical fitness test can be conducted as a group test. In addition, the body mass index was calculated for all children. Results: As expected, there was a significant correlation between the M-ABC-2 and the physical fitness test. All subscales of the M-ABC-2 correlated with the general fitness score with .23 < r < .44 (p < .001). Further, there was a correlation with (p < .001) for balance (M-ABC-2) with all parameters of the fitness test, as well as between ball skills and endurance. There was also a clear correlation between manual dexterity and strength (r = .23, p = .003), and between ball skills and strength (r = .24, p = .002). The BMI correlated with balance with r = -.217 (p = .005). A pronounced ceiling effect was observed for ball skills (M-ABC-2).

Discussion: The study confirms and extends previous results of Schott et al. (2007) indicating a correlation between motor coordination and physical fitness. The use of a physical fitness test for elder children on a routine base appears reasonable in order to enable appropriate measures to improve motor competence and physical skills in schools. The ceiling effects of the M-ABC-2 require further attention.

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