



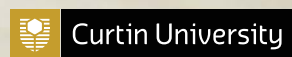
DC12

JULY 5-8 2017

**Developmental Coordination Disorder
FREMANTLE WESTERN AUSTRALIA**

Book of Abstracts

Proudly supported by:



Welcome

Dear Colleagues,

Welcome to the 12th Developmental Coordination Disorder Conference running 5th to 8th July 2017 in Perth, Western Australia at the Esplanade Hotel Fremantle. We welcome you to our beautiful State, and, even though it is our winter time, you will still enjoy a beautiful mild Mediterranean climate.

We have a very strong group of multidisciplinary DCD researchers in Western Australia representing three Universities. In 2012 we formed the research collaboration MoveGrowEngage and subsequently have embarked on a series of research projects, published papers and together developed the successful bid to host DCD12. Several world renowned interventions for children and adolescents with movement difficulties, such as Unigym, AMPitup and the Animal Fun program are based here (UWA; UNDA; CU).

DCD12 will build on previous themes and issues as well as take into account broader, new and innovative research of relevance ranging from etiological factors underlying movement problems to diagnosis/assessment and intervention. Its aim will be to highlight the importance of multidisciplinary research, the influence of comorbid and associated cognitive and social-emotional difficulties, as well as low physical participation, and the implications of these for translation into practice. It is anticipated that these broad aims will be approached with a consideration of the developmental aspects and life-span outcomes for these individuals.

Based on these premises, the Organising Committee has put together an exciting program, including keynotes from world renowned experts in DCD and other related clinical populations. They have been selected for their breadth of experience and relevance to current research interests. The preconference and conference programs also offer a series of practical workshops for professionals including clinicians, researchers, educators, students, parents and community members.

We hope you enjoy your time on the west coast of Australia and embrace this opportunity to connect with colleagues from around the world in order to strengthen our knowledge and practice for the benefit of the many affected by DCD.

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Organising Committee

Convenors

Prof Beth Hands (Conference Chair)	The University of Notre Dame Australia
Emeritus Prof Jan Piek	Curtin University, Western Australia
Dr Melissa Licari	The University of Western Australia

Organising Committee

Dr Paola Chivers	The University of Notre Dame Australia
Prof Beth Hands	The University of Notre Dame Australia
Ms Louisa Smith	The University of Notre Dame Australia
Associate Prof Fleur McIntyre	The University of Notre Dame Australia
Ms Sue McLaren	Curtin University, Western Australia
Emeritus Prof Jan Piek	Curtin University, Western Australia
Dr Daniela Rigoli	Curtin University, Western Australia
Dr Melissa Licari	The University of Western Australia
Dr Ashleigh Thornton	The University of Western Australia

Scientific Committee

Emeritus Prof Jan Piek (Chair)	Curtin University, Australia
Dr Melissa Licari (Chair)	The University of Western Australia

Anna Barnett	Oxford Brookes University, UK
Rainer Blank	University of Heidelberg, Germany
John Cairney	McMaster University, Canada
Chantel Camden	Sherbrook University, Canada
Marja Cantell	University of Groningen, The Netherlands
Sharon Cermak	University of Southern California, USA
Mary Chambers	University of Leeds, UK
Paola Chivers	The University of Notre Dame Australia
Jane Clarke	University of Maryland, USA
Deborah Dewey	University of Calgary, Canada
Reint Geuze	University of Groningen, Netherlands

Scientific Committee Continued

Dido Green	University of Oxford Brookes, UK
Beth Hands	The University of Notre Dame Australia
Sheila Henderson	University College, London, UK
Elisabeth Hill	Goldsmiths, University of London, UK
Christian Hyde	Deakin University, Victoria, Australia
Leanne Johnston	University of Queensland, Australia
Marie-Laure Kaiser	University Hospital of Lausanne, Switzerland
Amanda Kirby	University of South Wales, UK
Pek Ru Loh	James Cook University, Singapore
Fleur McIntyre	The University of Notre Dame Australia
Cheryl Missiuna	McMaster University, Canada
Motohide Miyahara	University of Otago, New Zealand
Jorge Oliveira	University of Sao Paola, Brazil
Marcio Oliveira	University of Maryland, USA
Anita E. Pienaar	North West University, South Africa
Mandy Plumb	University of Ballarat, Victoria, Australia
Helene Polatajko	University of Toronto, Canada
Mellissa Prunty	Brunel University, UK
Daniela Rigoli	Curtin University, Western Australia
Marina Schoemaker	University of Groningen, Netherlands
Bouwien Smits-Engelsman	University of Cape Town, South Africa
David Sugden	University of Leeds, UK
Ashleigh Thornton	The University of Western Australia
Hilde van Waelvelde	Ghent University, Belgium
Suzanne Wakefield	Monash University, Victoria, Australia
John Wann	Royal Holloway, University of London, UK
Jill Whittall	University of Maryland, USA
Jackie Williams	Victoria University, Australia
Kate Wilmut	Oxford Brookes University, UK
Peter Wilson	Australian Catholic University, Victoria, Australia
Stefania Zoia	S.S.Tutela Salute Bambini Adolescenti, AAS, Italy
Jill Zwicker	University of British Columbia, Canada

5.00PM - 6.00PM REGISTRATION

6.00PM - 8.00PM WELCOMING COCKTAIL PARTY – University of Notre Dame Australia

Thursday Morning 6th July

8.00 AM - 8.30 AM REGISTRATION and Tea / Coffee

8.30 AM KEYNOTE ADDRESS: **JILL ZWICKER** Brain Differences in Children with Developmental Coordination Disorder

STREAM A	Neural basis/comorbidity	STREAM B	Processes
9.30am	*Jess Reynolds , Melissa Licari, Siobhan Reid, Catherine Elliott, Anne Winsor, Michael Bynevelt & Jac Billington Reduced relative volume in motor and attention regions in developmental coordination disorder: a voxel based morphometry study	9.30am	Peter Wilson , Bouwien Smits-Engelsman, Karen Caeyenberghs, Bert Steenbergen, David Sugden, Jane Clark & Nicholas Mumford Toward a unified, multilevel framework for Developmental Coordination Disorder: New insights from a systematic review of recent research
9.45am	*Mélody Blais , David Amarantini, Jean-Michel Albaret, Yves Chaix & Jessica Tallet Inter-hemispheric communication is altered during learning of a new bimanual coordination in teenagers with developmental coordination disorder	9.45am	Frederik J.A. Deconinck Anticipatory awareness in adults with Developmental Coordination Disorder
10.00am	Karen Caeyenberghs , Peter Wilson & Deborah Dewey Topological patterns in the structural connectome of children with motor and attention disorders: A diffusion MRI network analysis	10.00am	Anita E Pienaar , Dane Coetzee & Elna De Waal Visual perception contributes substantially to maths performance in children with and without DCD
10.15am	Charles Wigley & Beth Hands Examining EEG auditory and visual MMN responses in adults with and without DCD	10.15am	Lauren Cox , Elizabeth Harris, Megan Auld, & Leanne Johnston Impact of tactile function on upper limb motor function in children with Developmental Coordination Disorder

10.30 AM - 11.00 AM MORNING TEA

11.00am	*Daniel Brady , Xavier Job, Elisabeth Hill & Jose van Velzen An investigation into the electrophysiological correlates of the early stages of motor learning in adults with and without DCD	11.00am - 12.00pm	Poster Viewing
11.15am	*Liat Hen-herbst & Sara Rosenblum Handwriting measures as reflectors of executive functions among adolescents with Developmental Coordination Disorder (DCD)		
11.30am	*Melody Grohs , I. Robu & Deborah Dewey Static Balance in Children with Motor & Attention Deficits		
11.45am	*Ece Kiratli , Jacqueline Williams & Alexia Pavlis Motor reinvestment and executive functioning in Developmental Coordination Disorder.		

Thursday Afternoon 6th July

12.00 PM - 1.00 PM LUNCH

1.00 PM **KEYNOTE ADDRESS: ANDREW WHITEHOUSE** Very early identification and intervention for Autism Spectrum Disorder: How close are we to the new frontier?

STREAM C	Comorbidity (continued)	STREAM D	Symposium
2.00pm	Amanda Kirby & Miri Tal-saban Empathy in adults with DCD in comparison with young adults with ASD and TD population	2.00pm - 3.00pm	Weintraub N, Kirby A, Barnett A & van Waelvelde H Working with adolescents and adults with DCD: An international perspective
2.15pm	Haylie Miller, Priscila Caçola , Gabriela Sherrod & Nicoleta Bugnariu Visuomotor integration and postural stability in children with DCD and ASD.		
2.30pm	Holly Duchow , Sylvia Schell, Kayla Roth, Alanna Lindsay, Carol Boliek The prevalence of possible Developmental Coordination Disorder in suspected childhood apraxia of speech		
2.45pm	Gerda van der Veer, Marja Cantell , Alexander Minnaert & Suzanne Houwen MELLE-Project: Early development of motor, executive, and language functioning in 3 to 5-year old children with and without developmental risk		

3.00 PM - 3.30 PM AFTERNOON TEA

3.30pm	* Amanda Timler , Fleur McIntyre, Caroline Bulsara, Elizabeth Rose & Beth Hands The development of a healthy identity is compromised in adolescents with LMC: The who.i.am study	3.30pm - 4.30pm	Symposium: (Continued)
3.45pm	* Vincent Mancini , Lynne Roberts, Daniela Rigoli, Brody Heritage & Jan Piek An empirical investigation of the elaborated environmental stress hypothesis: a summary of preliminary findings		
4.00pm	* Leanne Maria McAllum , Kevin Moore & Roslyn Kerr Examining narratives about DCD in relation to the lived experience of DCD individuals		
4.15pm	Elizabeth Harris , Lauren Cox, Megan Auld, & Leanne Johnston Visual perception and upper limb function in children with Developmental Coordination Disorder		

4.30 PM - 5.30 PM PANEL DISCUSSION: When is DCD not DCD but pDCD or sDCD? Cairney J, Dewey D, Getchell N, Smits-Engelsman B, Wilson P & Zwicker J.

5.30 PM - 6.30 PM DCD-ISR OPEN MEETING

“DCD¹² will build on previous themes and issues as well as take into account broader, new and innovative research of relevance ranging from etiological factors underlying movement problems to diagnosis/assessment and intervention”

Friday Morning 7th July

8.00AM - 8.30AM REGISTRATION and Tea / Coffee

8.30AM - 9.30AM KEYNOTE ADDRESS: PETER ANDERSON Are the brains of very preterm children with Developmental Coordination Disorder different in the neonatal period?

STREAM A	Aetiology/Impact of Preterm birth	STREAM B	Workshop
9.30am	Alicia Spittle , Kate Cameron, Lex Doyle, & Jeanie Cheong Increasing rates of motor impairments at 8 years in extremely preterm or extremely low birth weight children born between 1991-2005	9.30am-10.30am	Motohide Miyahara How to meet the criteria for high quality evidence in intervention studies, systematic reviews, and meta-analysis
9.45am	Tegan Grace , Beth Hands, Max Bulsara & Monique Robinson Maternal gestational stress and longitudinal motor development		
10.00am	*Tara FitzGerald , Alicia Spittle, Lex Doyle, Amanda Kwong, Jeanie Cheong & Jennifer McGinley Body structure, function, activity and participation in 3-6-year-old children born preterm. A systematic review and meta-analysis using the ICF framework		

10.30 AM - 11.00 AM MORNING TEA

11.00 AM - 11.30 AM STUDENT POSTER BLITZ

11.30 AM - 12.00 PM POSTER VIEWING

“Its aim will be to highlight the importance of multidisciplinary research, the influence of comorbid and associated cognitive, and social-emotional difficulties as well as low physical participation, and the implications of these for translation into practice”

Friday Afternoon 7th July

12.00PM - 1.00PM LUNCH (includes Advisory Board meeting 12.30-1.00)

1.00PM - 2.00PM KEYNOTE ADDRESS: **JOHN CAIRNEY** Motor coordination problems, physical activity and health-related fitness: skill-gaps and activity-deficits from a life course approach

STREAM C	Physical activity/Fitness/Assessment	STREAM D	Handwriting/Dysgraphia
2.00pm	*Wendy Aertssen , Emmanuel Bonney, Gillian Ferguson & Bouwien Smits-Engelsman Physical fitness profiles of children with and without Developmental Coordination Disorder	2.00pm	Naomi Weintraub , Tali Rosenberg & Ruth Bar-Ilan Traub Do students with handwriting dysgraphia also have "keyboarding dysgraphia"?
2.15pm	*Kemi Wright , Melissa Licari, Ashleigh Thornton, Ben Jackson, James Dimmock, Louise Naylor, Siobhan Reid & Bonnie Furzer Physiological characteristics and generalised self-efficacy of children with low movement proficiency and the impact on physical activity	2.15pm	Miri Tal-saban & Naomi Weintraub Motor performance among students with dysgraphia
2.30pm	*Sara King-Dowling , Sarah Wellman, Tuyen Le, Christine Rodriguez, Cheryl Missiuna, Brian W. Timmons & John Cairney Longitudinal examination of physical activity levels in children with and without motor coordination difficulties during early childhood	2.30pm	Mellissa Prunty An Examination of the Long Writing Pauses in Children with Developmental Coordination Disorder using Eye and Pen Movements
2.45pm	Daniele Chirico , Sara King-Dowling, Maeghan James, Tuyen Le, Christine Rodriguez, Cheryl Missiuna, Brian W. Timmons & John Cairney Longitudinal assessment of aerobic and anaerobic fitness in young children at risk for DCD: Preliminary results from the CATCH study	2.45pm	Jeremy Danna, Jean-Luc Velay & Marianne Jover Graphomotor adaptation in children with Developmental Coordination Disorder and/or Dyslexia
3.00pm	Matthew Kwan , Sara King-Dowling, Alessandra Ceccacci, Christine Rodriguez, Cheryl Missiuna, Brian Timmons & John Cairney Parental influences on physical activity behaviour in very young children at risk for DCD	3.00pm	*Emily Öhlund Dyspraxia in the Workshop, qualitative research exploring the impact of Dyspraxia on skilled applied artists (work in progress)
3.15PM - 3.45PM AFTERNOON TEA			
3.45pm	Gillian Ferguson, Emmanuel Bonney & Bouwien Smits-Engelsman What does a mean standard score mean? Profiles of children in "at risk" and "impaired" range of MABC-2	3.45pm - 5.00pm	Workshop Bouwien Smits-Engelsman, Anna Barnett, Peter Wilson & John Cairney DCD - International clinical practice recommendations
4.00pm	Fleur McIntyre , Paola Chivers & Beth Hands Functional fitness can be improved and sustained over time in adolescents with DCD		
4.15pm	Stefania Zoia , Marina Biancotto, Sheila Henderson, Anna Barnett, David Sugden, Marco Guicciardi & N. Canale. A comparison of Movement ABC-2 data from Italy and the UK		
4.30pm	Rudolf Psotta & Ondřej Brom What the MABC-2 Test assesses: Factorial analysis on three age versions of the test		
4.45pm	Paola Chivers , Timo Rantalainen, Fleur McIntyre, Beth Hands, Benjamin Weeks, Belinda Beck, Nicolas Hart & Aris Siafarikas Suboptimal bone status for adolescents with movement difficulties – it's gender specific		
6.00PM	BUS DEPARTS FOR CONFERENCE DINNER FROM THE ESPLANADE		
7.00PM	CONFERENCE DINNER AT THE UNIVERSITY CLUB OF WESTERN AUSTRALIA		
10.00PM	BUS DEPARTS FOR THE ESPLANADE HOTEL		

Saturday Morning 8th July

8.30AM	REGISTRATION and Tea / Coffee
9.00AM – 10.00AM	KEYNOTE ADDRESS: JANET EYRE Unleashing the power of play for rehabilitation of the upper limb after stroke across the lifespan
10.00AM - 10.30AM	MORNING TEA
STREAM A Intervention Symposium	
10.30am	* Chloe Bedard , Emily Bremer, Wenonah Campbell & John Cairney The Effectiveness of a Motor and Pre-literacy Community-based Program in Preschool Aged Children
10.45am	* Emmanuel Bonney , Eugene Ramekers & Bouwien Smits-Engelsman Exergames as an additional tool for training children with DCD, a feasibility report
11.00am	Amity Campbell , Anne Smith, Lynn Jensen & Leon Straker The effect of an active electronic games intervention on running biomechanics in children at risk of Developmental Coordination Disorder
11.15am	Bouwien Smits -Engelsman, Emmanuel Bonney, Dorothee Jelsma & Gillian Ferguson Children with development coordination disorder have normal rate of learning when trained with either a variable and repetitive practice protocol
11.30am	Sarah McCoy , Lin-Ya Hsu, Robert Price, Lizbeth Arias, Tracy Jirikowic & Deborah Kartin Sensorimotor Training to Affect Balance, Engagement, and Learning for Children with Developmental Coordination Disorder
11.45am	Presenting Recent Resources for DCD Research, Diagnosis and Intervention
12.00PM	FINAL VIEWING OF STUDENT POSTERS
12.30PM	ANNOUNCEMENT OF THE STUDENT PRIZE AWARDS* PRESENTATION BY HOST OF NEXT DCD CONFERENCE
STREAM B	
10.30am - 12.00pm	Siobhan Reid , Ashleigh Thornton, Bonnie Furzer, Claire Willis, Kemi Wright, Jess Reynolds & Melissa Licari We Like to Move-it, Move-it... Exercise Prescription for Children with DCD

Note: *student presentation eligible for the Henderson Award for the best student oral presentation.

DCD12 is being hosted by the Western Australian Developmental Coordination Disorder Research Group MoveGrowEngage. The group is led by Professor Beth Hands, Emeritus Professor Jan Piek and A/Professor Melissa Licari.

1.00PM – 2.00PM LUNCH

STREAM C	Knowledge translation/participation
2.00pm	Sylvia Schell , Kayla Roth, Holly Duchow & Deb Massey DCD and Knowledge Translation in Alberta, Canada: A Grassroots Initiative
2.15pm	Paulene Kamps DCD and mental health outcomes: The linkages made clear and the process defined
2.30pm	Marie-Laure Kaiser Reaction to intervention model and motor skills: Transfer from knowledge to practice
2.45pm	Anna Barnett & Mellissa Prunty Teaching bike- riding skills in a community setting: Perspectives of trainers and parents
3.00pm	Jill Zwicker , Gelareh Ghafooripoor, Nikki Ryan & Jane Shen Participation of Children with DCD in Home, School, and Community Settings
3.15pm	Lin-Ya Hsu & Sarah McCoy Participation in children with Developmental Coordination Disorder

SESSION D	Symposium
2.00pm - 3.30pm	Mandy Plumb , Helen Parker, Fleur McIntyre & Beth Hands Fundamental Motor Skills (FMS), DCD and current interventions..... What more could we be doing from a global perspective?

3.30PM - 4.00PM AFTERNOON TEA
 4.00PM - 5.00PM LATE BREAKING RESEARCH
 5.00PM CLOSE

For more information
 visit our website:
dcd12.com.au
 and follow us on facebook:
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Program Summary & Session Chairs

Thursday, 6 th July		
ROOMS	PLEIADES	SIRIUS
8.30-9.30am	Keynote: Jill Zwicker Chair: B Hands	
	Stream A	Stream B
9.30-10.30am	Neural basis/comorbidity Chair: J Williams	Processes Chair: M-L Kaiser
11.00-12 noon	Neural basis/comorbidity Chair: D Dewey	POSTER VIEWING IN LOBBY
	Stream C	Stream D
1.00-2.00pm	Keynote: Andrew Whitehouse Chair: M Licari	
2.00-3.00pm	Comorbidity Chair: S Zoia	Symposium Chair: A Barnett
3.30-4.30pm	Comorbidity Chair: J Piek	
4.30-5.30pm		Panel discussion Chair: B Hands Panel: J Cairney, D Dewey, N Getchell, B Smits-Engelsman, P Wilson & J Zwicker
5.30pm		DCD-ISR Open meeting

Friday, 7 th July		
8.30-9.30am	Keynote: Peter Anderson Chair: P Wilson	
	Stream A	Stream B
9.30-10.15am	Aetiology/Impact of Preterm birth Chair: S Cermak	Workshop Chair: M Miyahara
10.45-11.30am	Student Poster Blitz Chairs: A Thornton & M Licari	
11.30-12 noon	POSTER VIEWING IN LOBBY	

Friday, 7 th July - Continued.....		
1.00-2.00pm	Keynote: John Cairney Chair: J Piek	
	Stream C	Stream D
2.00- 3.15pm	Physical activity/ Fitness/Assessment Chair: F McIntyre	Handwriting/Dysgraphia Chair: D Rigoli
3.45-5.00pm	Physical activity/ Fitness/Assessment Chair: F Deconinck	DCD - International clinical practice recommendations Chairs: A Barnett, B Smits-Engelsman, P Wilson & J Cairney

Saturday, 8 th July		
ROOMS	PLEIADES	SIRIUS
9.00-10am	Keynote: Janet Eyre Chair: A Thornton	
	Stream A	Stream B
10.30-12 noon	Intervention Chair: M Cantell	Symposium Chair: S Reid
12.00-12.30pm	Final viewing of student posters	
12.30pm	Announcement of student prizes Chairs: B Hands, J Piek & M Licari Presentation by host of DCD13	
	Stream C	Stream D
2.00-3.30pm	Knowledge translation/ participation Chair: B Smits-Engelsman	Symposium Chair: M Plumb
4.00-5.00pm	LATE BREAKING RESEARCH Chair: B Hands	
5.00pm	Close	

Keynote Presentations



Assistant Professor Jill G Zwicker

Brain Differences in Children with Developmental Coordination Disorder

Introduction: Our group and others have reported differences in brain activation and brain development in children with developmental coordination disorder (DCD). This session will describe our studies that extend this work to examine white matter differences throughout the brain, functional connectivity between brain regions, and brain changes associated with rehabilitation intervention. Method: We are recruiting 30 children with DCD, 30 children with DCD and co-occurring attention deficit hyperactivity disorder (ADHD), and 30 typically-developing children (8-12 years). This presentation will highlight results of diffusion tensor imaging (DTI) and functional connectivity MRI comparing children with and without DCD and comparing brain differences before and after intervention in children with DCD. For our preliminary DTI analyses, our primary outcome was fractional anisotropy (FA), a measure of water diffusion along axons that indirectly reflects white matter microstructure. We used tract-based spatial statistics to compare the children with and without DCD, with age and attention scores on the Conners-3 ADHD Index as covariates. Pearson correlation coefficients examined the relationship between FA and total motor scores on the Movement Assessment Battery for Children-2 (MABC-2). Functional connectivity data analyses are ongoing, using independent component analyses. Results: To date, we have recruited 27 typically-developing children and 31 children with DCD+/-ADHD. Results reveal that, compared to typically-developing children, children with DCD show poorer microstructural development in the thalamocortical pathway, posterior limb of the internal capsule, corticospinal tract, and cerebellar peduncles. Altered development in these brain regions is significantly associated with poorer scores on the MABC-2 ($r = 0.36-0.51$, all $p < 0.05$). Other data analyses are ongoing. Conclusions: Children with DCD show altered microstructural development in sensorimotor pathways, which correlates with poorer motor function. The next phase of research is to determine if improvements in motor skills with rehabilitation intervention is associated with changes in brain microstructure and functional connectivity.



Professor Andrew Whitehouse

Very early identification and intervention for Autism Spectrum Disorder: How close are we to the new frontier?

Autism Spectrum Disorder (ASD) is typically diagnosed between 2 and 5 years of age, which is currently thought to be the earliest that the behavioural symptoms are able to be identified without ambiguity. A significant problem with this relatively 'late' age of diagnosis is that by the time a child has been identified and diagnosed with ASD, many of the best opportunities for therapies to capitalise upon brain plasticity very early in development are not realised. Andrew's presentation will provide an overview of the benefits and drawbacks of the current clinical pathway that places primacy on a diagnostic assessment for triggering the commencement of therapy. The presentation will then presents an alternative clinical pathway – the identification and provision of therapy to infants at risk of ASD – and provides a critical review of current evidence supporting this model. . He will also outline the trials of 'very early interventions' (i.e., in the first year of life) conducted within his own research clinic. The aim of the presentation is to outline a vision for the future of early identification and intervention of individuals with ASD, and the research goals that need to be addressed to achieve this vision.



Professor Peter Anderson

Are the brains of very preterm children with Developmental Coordination Disorder different in the neonatal period?

Motor impairment is a significant concern for many children born very preterm (VP), with approximately 10% developing Cerebral Palsy and up to 40% exhibiting balance and coordination difficulties consistent with Developmental Coordination Disorder. We have been studying DCD in a group of VP children (n=224), with a focus on 1) developmental trajectories of motor functioning, and 2) brain MRI markers of DCD. This unique cohort was recruited shortly after birth, had a brain MRI scan at term equivalent age (ie. expected due data), and been followed continuously for the past 13 years including motor assessments at 2, 5, 7 and 13 years and repeat brain scans at 7 and 13 years. In this presentation I will examine the stability of DCD symptoms across childhood in this VP cohort, as it has been speculated that many of the concerns associated with prematurity reflect developmental delay rather than an ongoing impairment. I also present data that demonstrates that the brains of VP children with DCD at birth differ from those of VP children without a motor impairment. For example, we have found that DCD children are more likely to have white matter pathology, reduced brain volumes in specific cortical regions, and reduced microstructure integrity. I will also discuss recent analyses examining brain growth from birth to 7 years of age in VP children with DCD. Our initial results indicate that while brain growth trajectory is similar between VP children with and without DCD, children with DCD start with smaller brains and fail to show catch-up. Thus, VP infants who develop DCD have structural brain alterations in the neonatal period, which has important implications for targeting high-risk infants for surveillance and early intervention.



Professor John Cairney

Motor coordination problems, physical activity and health-related fitness: skill-gaps and activity-deficits from a life course approach

Current evidence on the associations among motor coordination problems, physical activity and health-related fitness will be reviewed, along with the implications of this work. In particular, this presentation will discuss the understanding of these associations as linked processes that unfold over time and consider how this perspective influences our understanding of long-term health risks as well as the implications for intervention. Data from a longitudinal study of children will be presented in support of these considerations, as will evidence from other published studies. Finally, I will present new data from the Coordination and Activity Tracking in Children (CATCH) project, a longitudinal case-control study. In CATCH, children, ages 4 and 5 at baseline (n=588), were selected into the cohort based on initial assessments using the M-ABC-2. Approximately half of the children (n=288), scored at or below the 16th percentile. Children in CATCH are assessed annually with the M-ABC-2 and a battery of fitness and body composition assessments. Accelerometry is also used to measure free-living physical activity, both in terms of duration and different levels of intensity. The study is designed specifically to examine the pathways connecting motor coordination problems to physical activity and health-related fitness from early childhood to adolescence. Preliminary data from the inception cohort will be presented and discussed.



Professor Janet Eyre

Unleashing the power of play for rehabilitation of the upper limb after stroke across the lifespan

Ischaemic stroke involving the middle cerebral artery is the most common cause of long term neurological disability, occurring throughout the lifespan from fetus to old age. Stroke evokes plasticity and reorganisation of the corticospinal system, even into old age, but the factors governing the pattern of reorganisation are not the same at different ages within childhood and adulthood. Hemiparesis, a detrimental consequence that most stroke survivors face, is the partial or complete paralysis of one side of the body from injury to the corticospinal system. Unfortunately, despite corticospinal plasticity, upper limb recovery is unacceptably poor, with persisting impairments in 50-70% of stroke survivors. Long term impairment of upper limb function significantly decreases independence and quality of life. It is well established that recovery of upper limb function can be significantly improved with intense and challenging rehabilitation, but limited resources, specifically lack of therapist time, and poor patient compliance are the main barriers to implementation of this evidence-base. Video games can overcome this barrier by delivering home-based therapy programmes, independent of a therapist. Importantly video games are highly engaging and fun, not only providing the incentive for patients to complete a demanding therapy programme without supervision, but also promoting plasticity and synaptic reorganisation within the motor system even years after the initial stroke. In this paper I will present the evidence from our research of the patterns of corticospinal plasticity at different ages and the evidence that video games can provide effective rehabilitation for patients aged from 6 to 90 years.

Symposia/Workshops

THURSDAY, 6TH JULY 2.00PM-3.00PM - STREAM D

Working with adolescents and adults with DCD: An international perspective

Barnett A, Kirby A, van Waelvelde H, Weintraub N

A range of studies have demonstrated the persistence of DCD beyond childhood. This is also formally acknowledged in DSM-5, and recent extensions to the European Academy of Childhood Disability (EACD) guidelines now include recommendations for working with adolescents and adults.

Although a growing body of work focuses on the nature and extent of difficulties experienced by adults with DCD, many aspects remain poorly understood and little is known about how best to assess and support these individuals in both the short term and to prevent long term morbidity. Furthermore, there is likely to be considerable variation between countries in the amount and level of information available, practices adopted and the support services and resources at hand.

This workshop is aimed at adults with DCD, parents, educators, clinicians, researchers, service providers and commissioners of services. There will be two parts to the workshop: Firstly we will disseminate current guidelines relating to DCD in adulthood. Secondly we will facilitate a webinar discussion about key aspects of differences in service delivery of adult services from different countries.

Delegates from around the world, representing different regions and nations are invited to participate and share their knowledge and practices. A poll will be sent out to registrants beforehand asking some key questions relating to this. This information will then also create the focus of the workshop. We will be asking attendees from different countries to make brief presentations and share their experiences, either face-to-face or online. The workshop will be designed to allow participants to join the discussions remotely through a conference call.

Workshop facilitators will attempt to establish commonalities and differences between the practices, services and resources available in different nations to support adolescents and adults with DCD. The discussions will help to establish the range of practices in relation to methods of assessment for adolescents and adults, which agencies are involved, and the nature and extent of support in education and in employment settings. The webinar will be recorded and a synopsis of the workshop produced after the event by the convenors. The result of this will be to produce a position statement to outline the current status of the field taking an international perspective. This statement will help to identify areas in need of attention and provide suggestions for future avenues of research and to influence current and future clinical services.

FRIDAY, 7TH JULY 9.30AM-10.30AM - STREAM B

How to meet the criteria for high quality evidence in intervention studies, systematic reviews, and meta-analysis

Miyahara, M

This workshop aims to familiarise participants with the key ingredients of high-quality evidence in intervention studies, systematic reviews, and meta-analysis by going over the criteria of assessment tools to evaluate the levels of evidence. Anyone who is planning to conduct an intervention study, a systematic review or a meta-analysis on the intervention effect for children with DCD would benefit from this workshop by potentially producing higher quality evidence with nearly the same time, effort, and resources to be put into the study. The participants will learn the hierarchy of evidence, research designs, and the items of assessment tools to evaluate the quality of evidence.

FRIDAY, 7TH JULY 3.45PM-5.00PM - STREAM D

DCD – International clinical practice recommendations

Smits-Engelsman B, Barnett A, Wilson P, Cairney J & Blank R

The international clinical practice recommendations for DCD will be discussed with respect to **new knowledge or experiences** that influence clinical practice. The panel include members from the European Academy for Childhood Disability.

Discussions will highlight how international clinical practice recommendations are progressing in terms of the original CPG-DCD goals.

These goals were to:

- *improve the identification of children with DCD;*
- *increase the use of effective treatments and reduce the use of ineffective treatments;*
- *decrease the burden of the disorder and increase quality of life;*
- *improve performance of everyday activities and participation at home, school, and at leisure;*
- *improve personal and environmental resources;*
- *improve access to services, in particular healthcare services; to help clarify responsibilities and propose models of cooperation among the various relevant professionals, for example by defining clinical pathways; to help prevent long-term consequences of DCD, for example by timely, effective intervention; to raise community awareness of DCD.*

(1.2 General Goals of the CPG-DCD. Blank et al. 2012)

Blank, R., Smits-Engelsman, B., Polatajko, H. And Wilson, P. (2012), European Academy for Childhood Disability (EACD): Recommendations on the definition, diagnosis and intervention of developmental coordination disorder (long version). *Developmental Medicine & Child Neurology*, 54: 54–93. doi:10.1111/j.1469-8749.2011.04171.x

SATURDAY, 8TH JULY 2.00PM-3.30PM - STREAM D

We Like to Move-it, Move-it... Exercise Prescription for Children with DCD

Reid S, Thornton A, Licari M, Furzer B, Willis C, Wright K, Reynolds J

Objectives:

1. This workshop will provide participants with best practice evidence for the prescription of exercise interventions in children and adolescents with DCD.
2. Participants will gain a practical understanding of the main considerations when prescribing exercise interventions for children with DCD using developmentally appropriate progressions, from early intervention through to adolescence.
3. Attendees will gain experience in the interpretation of assessments for children with DCD, and the translation into appropriate exercise interventions.

Summary: Using developmentally appropriate progressions, the presentation team will outline the current evidence for best practice exercise prescription for children with DCD. Commencing with early engagement in movement, using models of play based fun. To the development and training of Fundamental Movement Skills, which are the foundations of physical activity. Progressing to the development of motor proficiency and a fitness base for sport and physical activity, which are the pre-requisites for participation in community based physical activity and recreation.

The team will present the current literature, and emphasize the translation pathways from evidence into clinical practice. The workshop will involve practical components including interpretation of assessments, case studies, strategies for success and the design and implementation of training programs specifically adapted to each developmental stage. This will provide attendees with practical strategies and tools to use in their professional practice.

Target Audience: Professionals who work with children to improve their movement outcomes, in particular exercise physiologists and allied health professionals. Material will be delivered to appeal to all experience levels.

About the Authors: This collaborative group of clinicians and researchers has extensive experience in research and the delivery of evidence based best practice in paediatric exercise health. Additionally, the team delivers a number of community based paediatric exercise programs at UWA catering for children across a range of ages and clinical presentations.

Fundamental Motor Skills (FMS), DCD and current interventions.....What more could we be doing from a global perspective?

Plumb M, McIntyre F, Parker H, Hands B

The purpose of this symposium is to discuss and critique the teaching of FMS in its broadest context, and to develop knowledge of the current delivery of FMS programs within schools around the world. FMS are building blocks of the many games and sports we participate in as adults. They are commonly developed in childhood then subsequently refined into context and sport-specific skills, which include locomotor, body management and object control skills. The mastery of these FMS develops along a continuum yet not all children will develop at the same rate nor to the same level of proficiency. Consequently different components or milestones are used to identify children who may struggle with mastering FMS. However, within an education context it is often a 'one size fits all approach and teaching is focussed on where the majority sit. Current estimates suggest that up to 10% of children have FMS below that expected for their age. Many of these could be diagnosed with DCD.

Another aspect we will be exploring in this symposium is whether poor FMS development is related to teaching approaches not being effective due to a failure to accommodate the range of movement competencies in any class. Should we be shifting our focus to a more holistic physical literacy model? Would this work for children with DCD?

The final question the symposium would like to consider is whether we should develop a more global approach to FMS intervention programs. Is there a best practice gold-standard model of delivery that each group working in this area could implement? This would enable a more unified approach, particularly from a research context.

Oral Presentations

THURSDAY MORNING STREAM A

Reduced relative volume in motor and attention regions in developmental coordination disorder: a voxel based morphometry study

★Reynolds J, Licari M, Reid S, Elliott C, Winsor A, Bynevelt M, Billington J

Introduction:

It is now well established that the motor difficulties associated with DCD are in some way neurologically based. Despite this, very little is known about the possible underlying neurological mechanisms at a structural level. Although differences in grey matter (GM) volumes have been found in related developmental disorders, no such evidence has been linked with DCD to date. This cross sectional study assessed structural brain differences in children with and without DCD.

Methods:

High-resolution structural images were acquired from 44 children aged 7.83-12 years, including 22 children with DCD (≤ 16 th percentile on MABC-2; no ADHD/ASD), and 22 typically developing controls (≥ 20 th percentile on MABC-2). Structural Voxel Based Morphology analysis was performed to determine group differences in focal GM volumes.

Results:

Children with DCD were found to have significant, large, right lateralised reductions in grey matter volume in the medial and middle frontal, and superior frontal gyri compared to controls. There was an absence of relative grey matter volume differences following the addition of motor proficiency scores as a covariate, suggesting that GM volumes in motor regions are reflective of the level of motor proficiency. A positive correlation between motor proficiency and relative GM volume was also identified in the left posterior cingulate and precuneus.

Conclusions:

GM volume reductions in pre-motor, frontal regions may underlie the motor difficulties characteristic of DCD. It is possible that intervention approaches targeting motor planning, attention, and executive functioning processes associated with the regions of reduced GM volume may result in functional improvements in children with DCD.

Inter-hemispheric communication is altered during learning of a new bimanual coordination in teenagers with developmental coordination disorder

★Blais M, Amarantini D, Albaret J, Chaix Y, Tallet J

Introduction

Several studies reported impairment of motor learning skills in Developmental Coordination Disorder (DCD). Some hypotheses emerged regarding the neural mechanisms of motor learning deficit in DCD but, to date, functional brain imaging studies are scarce. The aim of this study is to assess the possible differences in communication between brain areas during learning of a new bimanual coordination in teenagers with DCD compared to matched control teenagers.

Method

Ten typically developing (TD, 13.49 +/- 1.76 yo) and 10 DCD (13.47 +/- 1.39 yo) teenagers were asked to learn a new bimanual coordination pattern: they had to tap with their thumbs on two required buttons in synchrony with a visual stimuli during a practice session of 5 Blocs x 5 trials of 15 seconds. Before and after practice, three coordination patterns were tested: the new pattern, and two pre-existing inphase and antiphase patterns that are supposed to be accurate and stable without practice. Electroencephalogram (EEG) was recorded during the Pre- and Post-Tests. Three behavioural and two EEG variables were computed: (1) the Absolute Error (AE) of the produced coordination reflecting accuracy and (2) its Standard Deviation (SD) reflecting stability, (3) the number of additional taps of both right and left thumbs (N) reflecting motor overflows and the Task-Related EEG Coherence (TRCoh) in the 13-30 Hz frequency band (4) over left and right hemispheres (FC3-FC4) reflecting inter-hemispheric communication and (5) over left (FC3-C3) and right (FC4-C4) fronto-central regions reflecting intra-hemispheric communication. The values obtained during the practice were analyzed with Group x Test x Patterns ANOVAs on all variables, and Group x Bloc ANOVAs on behavioural variables.

Results

At a behavioural level, AE, SD and N were higher for DCD compared to TD. AE of the new coordination decreased with practice for both groups. SD and N remained higher in the DCD group despite practice. At a neural level, TRCoh over FC3-FC4 regions was lower for DCD compared to TD. The TRCoh over right FC4-C4 regions increased between Pre- and Post-Tests for the new coordination for both groups.

Conclusion

Results reveal that practice a new motor coordination leads to the improvement of accuracy, associated with the increase of intra-hemispheric (right) fronto-central communication in both groups. However, practice did not decrease the persistent lack of behavioural stability and the inability to inhibit manual incorrect responses, associated with a difference in inter-hemispheric communication in DCD teenagers.

Topological patterns in the structural connectome of children with motor and attention disorders: A diffusion MRI network analysis

Caeyenberghs K, Wilson P, Dewey D

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common neurodevelopment disorders in childhood. The core symptoms of this disorder include inattention, hyperactivity, and impulsivity. Difficulties learning motor skills (Developmental Coordination Disorder, DCD) are also commonly found in children with ADHD. Previous diffusion MRI studies in ADHD and DCD, comparing these clinical groups with typically developing children, have not only demonstrated regional alterations of white matter microstructural integrity in frontostriatal and sensorimotor pathways (Brown-Lum and Zwicker, 2015; Weyandt et al., 2013), but also changes in topological alterations of large-scale brain networks (connectomes) (Cao et al., 2014; Debrabant et al., 2015). Recently, a few studies have emerged comparing connectomes among developmental disorders (Bernhardt et al., 2014; Caeyenberghs et al., 2016; Di Martino et al., 2013). However, no studies have directly compared the structural networks between ADHD and DCD. Here, we want to assess the distinct and shared topological patterns of ADHD and DCD and the relative contribution of these disorders to motor and cognitive functioning.

Methods

Using Network Based Statistics toolbox (NBS), we investigated connectivity strength of structural brain networks in 112 children (83 males, mean age = 10.82, range 8 to 17y): 26 ADHD+DCD, 30 ADHD only, 18 DCD only, and 38 typically developing children. We constructed separate structural networks based on number of streamlines derived from whole brain tractography of diffusion MRI scans. Children were classified as displaying DCD if they scored \leq 16th percentile on the Movement Assessment Battery for Children – 2. The Diagnostic Interview for Children and Adolescents Children was used to identify children as having ADHD. All children displayed IQs in the normal range. Children also participated in a detailed neuropsychological assessment that included the McCarron Assessment of Neuromuscular Development and the NEPSY-II.

Results

In brain regions known to be abnormal in ADHD, we revealed changes in connectivity strength in the ADHD+DCD group, mainly in the frontostriatal circuitry. We also found alterations in connectivity strength in ADHD+DCD in regions that are not often associated with ADHD but were similar to neural abnormalities in the DCD group (cerebellar regions). Furthermore, brain regions exhibited changes to hub-status, some common to both ADHD and DCD, whereas others were disorder-specific. Finally, significant relationships were found between connectivity strength and motor performance within each group.

Conclusion

This work supports changes in DSM-V that explicitly acknowledge the frequent comorbidity of these neurodevelopmental disorders.

Examining EEG auditory and visual MMN responses in adults with and without DCD

Wigley C, Hands B

Introduction

The aetiology of DCD is still unclear but some evidence suggests a problem may exist in the internal modelling of motor actions. The mismatch negativity (MMN) electroencephalogram (EEG) response to unexpected stimuli has been implicated in predictive error detection (e.g., forward modelling) and in updating internal representations (e.g., motor learning). Deficits in these areas are consistently demonstrated in individuals with DCD. We will compare auditory and visual MMN's in an initial sample of five adults with, and five without, DCD. Dynamic casual modelling (DCM) of the data will be used to investigate effective connectivity associated with the MMN response in both groups.

Method

Recruitment for this study has commenced. Four, 10 minute blocks of stimuli (two visual/two auditory) are presented using a roving-standard MMN paradigm. Target stimuli are randomised to 8-12 repetitions. Auditory block target stimuli are 1000Hz and 2000Hz sinusoid tones of 70msec duration, 5msec rise/fall times and SOA's of 500msec. The distractor task is a button-press for randomly inserted (5% probability in any sequence) spoken phonemes. Visual block target stimuli are horizontal and vertical grey-white gratings (250msec duration, SOA of 500msec) presented at the periphery of a TV news (distractor) segment. Post block multiple choice questions assess the success of this distractor.

Biosemi™ 64 channel EEG system (expanded 10-20) data will be pre-processed and analysed using SPM 12. Target responses (auditory $N \geq 190$; visual $N \geq 240$) will be epoched (peri-stimulus window of -100msec – 400msec), down-sampled (250msec) and band filtered (0.5-40Hz). SPM's of the averages from 6th (standards) and 1st stimuli occurrences (deviants) will be compared across groups. The DCM group analysis will be based on networks established in previous literature.

Results

Previous literature suggests that the TD group will show a significant MMN in the frontal electrodes in the 100-200msec range for the auditory stimuli and 160-300msec range for the visual stimuli. We anticipate the DCD group will show significantly attenuated MMN responses compared to the TD group. The DCM analysis will examine top down and bottom up influence in the MMN networks for both groups.

Significance

The ability to detect and attend to violations of expectation is central to error correction and task learning. As yet, no one has investigated both visual and auditory MMN in this population with DCM tools. This research has the potential to refine our understanding of the role early automatic neural responses play in the aetiology of DCD.

An investigation into the electrophysiological correlates of the early stages of motor learning in adults with and without DCD

★Brady D, Job X, Hill E, van Velzen J

Introduction

It is well understood that voluntary movements are accompanied by specific patterns of neural activity (Babiloni et al., 1999; Colebatch, 2007; Neuper, Wörtz, & Pfurtscheller, 2006; Shibasaki & Hallett, 2006). These patterns of activity change as movement become increasingly automatized during motor learning (Lang, Beisteiner, Lindinger, & Deecke, 1992; Niemann, Winker, Gerling, Landwehrmeyer, & Jung, 1991; Wright, Holmes, Di Russo, Loporto, & Smith, 2012). What is not as well understood is how these patterns of neural activity relate to individual differences in the early stages of motor learning; in particular, whether there are differences in these patterns of neural activity among individuals with developmental coordination disorder (DCD).

Thus, the aim of this study was to investigate the neural correlates of early motor learning in adults with and without DCD using electroencephalography (EEG).

Method

Twenty-four participants (twelve control and twelve DCD) undertook a novel motor learning task while EEG activity was recorded. A distribution fitting approach was taken to analyse the behavioral data, decomposing the reaction time distribution into the components of an Ex-Gaussian distribution.

The motor-related electrophysiological activity recorded was analyzed using both event-related potential and time-frequency representation approaches.

Results

The results of the study indicate that motor performance in the control group improved, primarily through a decrease in slower responses, and no change was observed for the DCD group. There was no change in motor-related electrophysiological activity was observed for either group over the course of the task.

Discussion

These results seem to indicate that while there is an improvement in performance in the motor task, there are no accompanying changes in EEG activity. However, this conclusion is not entirely clear due to specific methodological challenges, namely combining the distribution-fitting approach with a standard EEG processing pipeline. The results also indicate that motor-related activity in the DCD group is not significantly different than the control group, suggesting that the slower reaction times observed are due to differences earlier in processing the response.

Handwriting measures as reflectors of executive functions among adolescents with Developmental Coordination Disorder (DCD).

★Hen-Herbst L, Rosenblum S

Introduction

Deficient academic performance and handwriting difficulties represent two of the four criteria of the DSM-V for the medical diagnosis of Developmental Coordination Disorder (DCD). However, studies about adolescents with DCD in general and about their handwriting features in particular, are scarce. Furthermore, as individuals' with DCD are diagnosed based on their difficulties in acquiring and executing motor skills, the relationship between their motor and cognitive abilities is of interest. Executive functions (EF) are high level cognitive functions required for daily activities such as writing and home management. EF deficits are considered a possible underlying neuro-cognitive mechanism involved in DCD.

Aims: (1) To compare the handwriting process and written product legibility measures of adolescents with DCD to a matched control group, (2) to compare their EFs as measured through a self-report of their daily activities, and (3) to examine the relationship between the handwriting measures and executive functions of adolescents with DCD.

Method

The study group included 40 adolescents meeting the DSM-V criteria for DCD based on the Adult Developmental Coordination Disorder Checklist (ADC) and the Handwriting Proficiency Screening Questionnaire (HPSQ). The control group included 40 age and gender matched adolescents. The parents of all 80 adolescents completed a health status/socio-demographic questionnaire. All participants completed the Behavioral Rating of Executive Functions – Self Report Version (BRIEF-SR). The participants' handwriting process measures were obtained by their copying a paragraph from the Handwriting Assessment for Middle School Students (AHTAV) (product legibility) on a paper affixed to a digitizer comprising part of the ComPET computerized system.

Results

Significant group differences were found for handwriting legibility (AHTAV) and for the temporal and spatial measures of the paragraph copy task (ComPET). Significant group differences were also found for EF as reflected through the two indices of the BRIEF-SR; i.e., the Behavioral Regulation Index (BRI) and the Metacognition Index (MI). Significant high correlations were found between the ComPET measures, HPSQ subscale scores, ADC subscale scores and the BRIEF-SR indices scores. Mean stroke width (objective handwriting process measure), HPSQ subscale scores (handwriting proficiency) and EF accounted for 62% of the ADC-B subscale score (ADL) above and beyond group membership.

Conclusion

Deficits in both handwriting production and daily function among adolescents with DCD involve EF abilities, emphasizing the importance of considering EF components in the evaluation and intervention processes of this population. Handwriting deficits may mirror more global deficits in EF required for the daily functioning of adolescents.

Static balance in children with motor and attention deficits

★Grohs M, Robu I, Dewey D

Introduction

Developmental coordination disorder (DCD) and attention-deficit/hyperactivity disorder (ADHD) are commonly occurring childhood neurodevelopmental disorders. DCD is characterized by significant impairments in fundamental motor skills, including postural control. Among children with ADHD, poor postural performance has also been reported, becoming more apparent in studies which proprioceptive and/or visual information is reduced or not available to stabilize posture. It remains unclear, however, the impact of co-occurring DCD+ADHD on postural control. This is of particular importance as DCD and ADHD have been found to co-occur in up to 50% of affected children. The aim of this study was to examine postural control in children with DCD, ADHD and co-occurring DCD+ADHD under conditions in which proprioceptive and/or visual information was reduced or not available.

Method

Children with DCD (N=17), ADHD (N=19), DCD+ADHD (N=20) and typically developing (N=19), mean age of 9.97 ± 2.04 , participated in a standing balance task under four conditions: eyes open-hard surface, eyes closed-hard surface, eyes open-soft surface, and eyes closed-soft surface. Stability index, a product of sway displacement and velocity, was calculated for each condition and compared across groups.

Results

When compared to typically developing children, those with DCD showed significant impairments in postural stability on conditions with limited visual input. No differences in postural stability were found between children with ADHD and typically developing children on any of the four conditions. Children with co-occurring motor and attention problems presented with significantly greater impairments in postural control, relative to typically developing children, on conditions with reduced proprioceptive feedback.

Conclusions

Children with co-occurring motor and attention problems show more notable impairments in postural stability when compared to children with motor or attention problems alone and typically developing children. Although previous research has reported that children diagnosed with ADHD show impairments in postural control, the current study's findings did not show this. This lack of consistency could be due to previous research in children diagnosed with ADHD not screening these children for motor problems/disorders prior to their assessments. These findings show how essential it is that future research examining postural control and motor functions in children with neurodevelopmental disorders, including ADHD, screen children for motor impairments (i.e., DCD).

Motor reinvestment and executive functioning in Developmental Coordination Disorder

★Kiratli E, Williams J, Pavlis A

Introduction

Movement reinvestment (MR) is a theoretical framework referring to the tendency to consciously monitor movement and performance. MR is typically low when a skill reaches automaticity, but is increased when the skill is performed under pressure or in anxiety-provoking situations. Typically, MR will result in the recall and use of declarative knowledge stored for a particular skill, placing a large demand on working memory (WM). Children with low WM have reduced scores on MR, likely because they do not have the WM capacity to recall and use the stored information. This study aimed to explore the MR tendency of adults with motor impairment consistent with DCD – on the one hand, it might be expected that their low WM capacity would reduce their MR tendency, as with children; on the other, their history of negative movement experience would suggest an increase in conscious monitoring of their movements.

Method

Eighty-eight adult participants completed the Adult Developmental Coordination Disorder Questionnaire (ADCD-Q), the Behaviour Rating Inventory of Executive Function – Adult (BRIEF-A), and the Movement Specific Reinvestment Scale (MSRS). The sample was divided based on the ADCD-Q scores using quartile cut-offs, with the bottom and top 25th percentiles compared on the BRIEF and MSRS. The typically developing (TD) adults scored ≤ 15 on the ADCD-Q and included 26 participants (12 male, M age: 26.08 yrs). The motor impaired (MI) adults included 21 participants scoring ≥ 31 on the ADCD-Q (10 male, M age: 25.33 yrs).

Results

As expected, the MI group showed considerable deficits in self-reported executive function across all domains of the BRIEF-A, with working memory the most important for this study: for the TD group, the t-score was 48.54; for the MI group, the t-score was 62.05 ($p < .001$). The MI group scored significantly higher on the MSRS for total scores (TD: 20.46; MI: 32.05; $p < .001$) and both subdomains: Conscious Motor Processing (TD: 11.08; MI: 16.43; $p = .001$) and Movement Self-Consciousness (TD: 10.31; MI: 16.14; $p < .001$).

Conclusion

These findings highlight a problematic issue for individuals with DCD in that their negative movement experience is likely to increase their tendency to consciously monitor their movements, but their low WM capacity means that they cannot do this effectively. This will add further burden to their performance of skills. Implicit learning strategies, shown to reduce MR tendencies, are likely to reduce the load on WM in this population.

THURSDAY MORNING STREAM B

Toward a unified, multilevel framework for Developmental Coordination Disorder: New insights from a systematic review of recent research

Wilson P, Smits-Engelsman B, Caeyenberghs K, Steenbergen B, Sugden D, Clark J, Mumford N

Introduction

The number of experimental studies of DCD has continued to accelerate, the ultimate goal being to better understand its underlying basis. A number of prominent themes and hypotheses have emerged including internal modelling deficit (IMD), dysfunction to the mirror neuron system (MNS), aberrant perceptual-motor coupling, cognitive-motor dysfunction, and other issues. A large scale review of the literature is now timely for a number of reasons: no recent review has successfully spanned the full complement of experimental work across behavioural and neuroimaging studies, nor captured the proliferation of these studies over the past 5-6 years; as well, a review commissioned as part of the new International Consensus Guidelines on DCD. Hence, the broad aims of this paper are to describe a recently completed systematic review of the experimental work on DCD and, importantly, to embed its key finding within a multilevel framework for motor development.

Method

A systematic review of the experimental literature published between June 2011 and August 2016 was conducted using a modified PICOS framework. Studies were grouped by expert consensus into the dominant performance domains (e.g., gait, handwriting, catching, etc.) or core processes (e.g., sensory factors, internal modelling, executive function, and so on). Included were a total of 106 studies, 91 behavioural and 15 neuroimaging. Studies were rated for research quality using a CASP approach.

Results

Behavioural data showed clusters of deficit in the anticipatory control of movement, action representation, motor learning, perception-action coupling and perception of affordances, and cognitive control. Importantly, however, performance issues were frequently moderated by task-type and difficulty, and select environmental constraints. As well, we see new evidence of compensatory processes and strategies in children with DCD. Neuroimaging data showed reduced cortical thickness and hypoactivation across functional networks involving prefrontal, parietal and cerebellar regions, overlapping the MNS and perceptual-motor mapping. Structural MRI data also suggested a poorly integrated neural network involving sensori-motor structures.

Conclusions

Taken together, results support the hypothesis that immaturities in neural structure and function are evident in DCD. Behaviourally, these immaturities may impact anticipatory planning, action representation and perceptual-motor coupling, reducing automatization of movement skill and prompting greater reliance on slower feedback-based control and compensatory strategies. Critically, key findings are embedded in a multi-level account of DCD and implications for intervention are discussed. The paper will also provide an update on work published just prior to the conference in July 2017, expanding the discussion about key directions for future work.

Anticipatory awareness in adults with Developmental Coordination Disorder

Deconinck F

Introduction

Anticipatory awareness refers to the phenomenon that individuals judge the initiation of an action as being prior to the actual time of initiation of that action. Research shows that this awareness of action is critical for motor control and is neurophysiologically associated with the ability to plan and generate efference copies of action. These copies of motor commands are a key feature of predictive motor control. The aim of the current study was to investigate the anticipatory awareness of action in individuals with DCD, who are known to have difficulties with motor planning.

Method

Twelve young adults, 18-25 years of age, who were diagnosed with DCD in childhood and twelve adults without motor problems participated in this study. To determine anticipatory awareness a classic Libet paradigm was used in two different conditions. The first required participants to watch a rotating clock hand on a computer display, and to press a key spontaneously, whenever they felt like it. Within a few seconds after this event they were asked to recall and indicate the location of the clock hand at the moment of the initiation of their finger movement. In the second condition, the pursuit task, participants tracked a rotating clock hand that disappeared automatically after a random period of time. After this, the participant was instructed to indicate the location of the clock hand at the time of occlusion.

Results

In condition 1, individuals with DCD indicated the time of initiation to be 22 ms after the actual key press, which was not significantly different from the judgement by individuals without DCD (14 ms). In the second condition, where the task was to track a target and indicate the moment of occlusion, the participants with DCD appeared to perform better than the individuals without motor problems. The latter group judged the location where the target disappeared to be 30 ms after the actual occlusion, whereas this was only 3 ms in individuals with DCD.

Conclusions

In contrast to previous reports on anticipatory awareness, neither of the two groups demonstrated anticipatory awareness in this simple Libet task. Yet, individuals without DCD did show motion prediction in the pursuit task, which reflects forward or prospective control. It is remarkable that this fundamental ability, which is a prerequisite for many motor tasks, seems to be lacking in individuals with DCD, even in adulthood.

Visual perception contributes substantially to maths performance in children with and without DCD

Pienaar A, Coetzee D, De Waal E

Introduction

Developmental Coordination Disorder (DCD) is characterised by deficits in the acquisition and execution of motor skills with a negative impact on academic achievement and everyday activities. Academic problems in children with DCD are associated with visual-motor integration skills. This study examined the association between DCD and academic performance and determined which predictor variables had the largest contribution to academic performance in children.

Method

Coordination and visual-motor integration were assessed in 221, 10.05 year-old (SD 0.41), South African children using the MABC-2 and the Test of Visual-Motor Integration (VMI-4) while academic achievement was assessed using National and mid-year exams of each school in six learning areas.

Results

Visual perception had a strong association with maths performance ($r=.52$) and with the grade point average in typical ($r=.43$) and DCD ($r=.26$; $r=.31$) children. Stepwise regression analyses indicated that the highest contribution to the total variance (23.1%) in math performance was explained by visual perception (22.04%) in the National assessments, while contributing to 16.36% of 18.17% in the grade point average. DCD children displayed significantly poorer visual-motor integration and manual dexterity skills ($p<0.05$) with moderate to strong relationships between all the academic learning areas and especially manual dexterity.

Conclusions

Visual perception makes a significant contribution to academic performance of Grade 4 learners irrespective if children having coordination problems such as DCD. As visual perception is a developmental process it is necessary that educators and policy makers should provide adequate resources and opportunities to improve development but also to put intervention strategies in place for those children who are put at risk for academic failure based on these deficits in their development.

Impact of tactile function on upper limb motor function in children with Developmental Coordination Disorder

Cox L, Harris E, Auld M, Johnston L

Introduction

Poor fine motor skills are one of the most common coordination issues experienced by children with Developmental Coordination Disorder (DCD), impacting function and engagement in home, school and recreational environments. Understanding the role of tactile function is critical to understanding these deficits because tactile afferents override visual cues after initial contact emphasising their importance in manipulative tasks and handwriting. The paucity of literature investigating tactile function in the DCD population makes it difficult to determine the presence and patterns of tactile deficits in the hands of children with DCD and the corresponding relationship to upper limb motor function. Thus, the purpose of this study was to investigate the presence of, and relationship between tactile dysfunction and upper limb motor function in children with DCD compared to typical developing (TD) children.

Method

Participants were 36 children aged eight to 12 years. Presence of DCD (n=20) or TD (n=16) was confirmed using the Movement Assessment Battery for Children, second edition. All children participated in a comprehensive assessment of tactile registration (Semmes Weinstein Monofilaments); tactile spatial perception (Single Point Localisation (SPL) and two-point discrimination (2PD)) and haptic perception (Stereognosis). Children also completed assessments of fine motor skills including speed of simple everyday manual tasks (Jebsen-Taylor Test of Hand Function (JTTHF)) and handwriting speed and accuracy (Evaluation Tool of Children's Handwriting (ETCH)).

Results

Compared to children with TD, children with DCD demonstrated poorer tactile spatial perception (SPL non-dominant hand $p = 0.04$), slower speed of alphabet writing (ETCH $p < 0.05$) and less legible handwriting (ETCH $p < 0.01$). Localisation of touch in the hand (SPL) predicted handwriting legibility (ETCH $r = 0.11$) and speed of functional tasks (JTTHF $r = 0.33$).

Conclusion

Localisation of touch in the hand is a significant predictor of fine motor accuracy and speed. These results suggest that tactile function, specifically single point localisation, should be a primary tactile assessment employed to determine reasons for upper limb motor difficulties experienced by children with DCD.

THURSDAY AFTERNOON STREAM C

Empathy in adults with DCD in comparison with young adults with ASD and TD population

Kirby A, Tal-saban M

Introduction

Empathy is an important ability, it allows us to tune into how someone else is feeling, or what they might be thinking. Empathy allows us to understand the intentions of others, predict their behavior, and experience an emotion triggered by their emotion. 'Theory of mind' refers to the ability to attribute mental states to oneself and others and includes the ability to understand that it is possible for others to hold thoughts and beliefs that are different from your own which in some ways has similarities to empathy. Some studies have indicated problems in empathy in adolescence and young adults with ASD.

Problems in empathy have an impact on the formation of positive social relationships and interactions. In recent years a few studies have indicated problems with gaining positive social relationships for adolescents and young adults with DCD. However, there have been no studies relating to empathy among the DCD population and the influence of empathy on their social relationships.

The aim of this study was to compare the empathy of young adults with DCD, ASD and a TD population and to consider the impact this may have on social and emotional functioning.

Method

The study consisted of 113 young adults from the UK (Age 18-40 years). Fifty three adults with DCD (Mage=28.56[SD=10.21]; 27% males); 30 adults with ASD (Mage=27.17[SD=10.20]; 30% males) and 23TD adults (Mage=29.05[SD=7.0]; 22% males).The DCD and the ASD participants had been diagnosed by a professional in the past. Additionally, all completed the AAC-Q questionnaire (a screening tool for DCD); and the AQ questionnaire (a screening tool for ASD). The participation completed the Emotional Quotient questionnaire that assesses empathy.

Results

One-way ANOVAs revealed significantly differences between the study groups ($F[2,103]=25.13$) the DCD participants scored significantly lower than the ASD participation in the EQ questionnaire (lower scores indicate good empathy).Post-hoc analyses revealed no significant differences between the DCD and the TD participants ($p>.05$) and significant differences between the ASD and the DCD and TD participants ($p<.05$). These results indicate that the DCD scores are similar to the TD scores and different from the ASD scores when compared to EQ banding.

Conclusion

These results indicated that even if young adults with DCD and ASD (especially those with high functioning ASD) have similar social relationships difficulties the core deficit is different. The theoretical construct for this will be presented.

Visuomotor integration and postural stability in children with DCD and ASD

Miller H, Caçola P, Sherrod G, Bugnariu N

Introduction

Developmental Coordination Disorder (DCD) shares similar motor features with Autism Spectrum Disorder (ASD), as both groups have marked difficulty maintaining postural stability and coordinating body movement. However, few studies directly compare groups of individuals with ASD and DCD on visuomotor integration – the use of visual information to guide motor behavior.

Method

We conducted a preliminary investigation of visuomotor integration in three age-matched groups: ASD (n = 10), DCD (n = 10), and typical development (n = 5). Data were collected from mobile eye-tracking, motion-capture, virtual reality, and force plate systems. Participants completed 30 seconds of quiet standing with eyes open and eyes closed as a baseline. They then completed several tasks in the virtual environment that required integration of visual information with motor plans. Participants controlled an object in the virtual space by shifting their Center of Pressure (CoP) or leaning to move a marker placed on the C7 vertebrae, in order to match the position of a static or moving target.

Results

During quiet standing, individuals with DCD exhibited the greatest postural sway. Individuals with ASD followed, having greater instability than the TD group. Individuals with ASD, DCD, and TD also differed in their movement profiles during the visuomotor tasks. While individuals with DCD were able to more accurately employ eye movements to track visual motion, they struggled to produce accurate motor responses. Individuals with ASD had greater difficulty with directed pursuit eye movements, and a higher number of saccades, reflecting inability to consistently track the target object.

Conclusion

While DCD and ASD share similar functional movement symptoms, quantitative analysis of motor skills reveals key differences between the two disorders when tasks require integration of visual and motor information. Motor markers such as center of pressure displacement or speed may serve to differentiate between these two developmental disorders, and corresponding eye-tracking data supports the hypothesis that atypical eye saccadic and pursuit eye movements may influence the degree of difficulty and differences in postural stability in the two disorders.

The Prevalence of Possible Developmental Coordination Disorder in Suspected Childhood Apraxia of Speech

Duchow H, Schell S, Roth K, Lindsay A, Boliek C

Introduction

Childhood Apraxia of Speech (CAS) is a speech-language disorder characterized by difficulty planning and executing motor movements for speech. Developmental Coordination Disorder (DCD) is a neuromotor disorder that impacts the ability to plan and execute motor movements, affecting performance in activities of daily living, academics, and leisure. Speech and language disorders are known to co-occur with DCD; however, the prevalence of DCD in children with CAS is unknown. Recently, clinicians have gained a better understanding of CAS and are more likely to identify children suspected of having the disorder (sCAS). Moreover, new screening tools have been developed to identify children with possible DCD (pDCD). Thus, it may now be possible to examine the co-occurrence of the two disorders, leading to more effective multidisciplinary approaches to intervention.

The purpose of this pilot study is to describe the prevalence of pDCD in children with sCAS. Specifically, the present study aims to determine how many children (aged 3-15 years), receiving services for sCAS from speech-language pathologists (SLPs) in Alberta Health Services Central Zone East (AHS CZE), obtain scores on parent questionnaires that identify them as at-risk for DCD.

Method

A convenience sample of approximately 80 children with sCAS is currently being recruited. Demographic information collected includes co-morbidities (e.g., Attention Deficit Hyperactivity Disorder, specific language impairment) and other potential predictors of DCD (e.g., CAS severity, age at diagnosis,) will be used to provide a complete description of the population sampled. Parents of identified children are completing one of two questionnaires, the Developmental Coordination Disorder Questionnaire (DCDQ) or the Little DCDQ (based on child's age). Primary data analysis will include correlational statistics to determine the degree of relationship between children with sCAS and detection of pDCD.

Results

Data are being collected between October and December 2016. Data will be analyzed between January and April 2017. A full set of results will be available for presentation by June 2017.

Conclusion

By identifying pDCD in children with sCAS, we hope to establish a best-practice protocol for identifying the occurrence pDCD in sCAS. In doing so, we hope to advance opportunities for a multidisciplinary approach for intervention with this population. Moreover, we will inform future prevalence research on DCD in children with CAS and advance our understanding of the potential shared underlying neural mechanisms associated with both disorders.

MELLE-Project: Early development of motor, executive, and language functioning in 3- to 5-year old children with and without developmental risk

van der Veer G, Cantell M, Minnaert A, Houwen S

Introduction

There is a growing body of literature relating motor functioning to executive functioning (EF) and language. However, we know less about the developmental changes in these domains in early childhood. For example, how do early signs of developmental problems, be it in motor, language or EF domains, relate to each other? What is the developmental course of early problems? The MELLE-project seeks to untangle these questions by focusing on the developmental trajectories of preschool children at risk for developmental coordination disorder (DCD), specific language impairment (SLI) and typically developing children (TD) and the role individual and environmental factors play in these trajectories.

Method

The study design is a cross-sequential design. The study population consists of children aged 3 years and 0 months to 5 years and 11 months at risk for DCD, and/or at risk for SLI, and TD. The sample is recruited from play groups, daycare centers, schools, pediatric physiotherapists and social media. The exclusion criteria are physical disabilities, neurological disorders (e.g., intellectual disability or autism spectrum disorder), and sensory impairments. Every six months, the children are examined at home using two motor tests (M-ABC2-NL and ZNA 3-5); EF tasks (inhibition, working memory, shifting); and language tasks (production, comprehension, rapid automatized naming). Parents/caregivers are asked to complete questionnaires on demographics, home environment, physical activity, therapy (e.g., physiotherapy, occupational therapy, speech therapy), motor functioning (Little DCDQ-NL), temperament (CBQ), EF (BRIEF-P), and attention (SDQ and CBCL attention subscale).

Results

During the first phase of the study in April to July 2016 ninety seven children were tested (51 boys and 46 girls; 46 three year olds, 35 four year olds, 16 five year-olds; $M = 49.16$ ($SD = 9.91$) months). The M-ABC2-NL total score ($M = 49.03$ $SD = 29.46$) and range (1-100) suggest that our sample includes children from a whole spectrum of motor skills. The second phase begins in October 2016 when the children of the Phase 1 will be re-assessed, and new children recruited. The results of Phase 1 and 2 are complete and analyzed by June 2017.

Conclusions

Understanding how signs of different disorders co-occur in the preschool years is critical to the development of causal models of developmental disorders and enables us to understand how co-occurrence of problems affect children's developmental and learning outcomes. An improved understanding of developmental trajectories will improve targeting of interventions and streamlining of services to children at developmental risk.

The development of a healthy identity is compromised in adolescents with LMC: The who.i.am study

★Timler A, McIntyre F, Bulsara C, Rose E, Hands B

Introduction

Adolescence is a crucial period for the development of a healthy identity. Factors impacting this process include the extent of parental and peer support, identification with interests and personal goals as well as a feeling of security within oneself. Little is known about how level of motor competence (high and low) affects this process and whether this differs between males and females.

Method

An explanatory sequential mixed methods design was used to explore this issue. One hundred and sixty adolescents (64.4% males, Mage 14.44, SD = 0.750) completed the Adolescent Motor Competence Questionnaire (AMCQ) and the Assessment of Identity Development in Adolescents (AIDA) questionnaire. The AMCQ scores were used to group the sample into high motor competence (HMC) and low motor competence (LMC). The AIDA measures the degree of diffusion or coherence of identity, through sense of self, personally and by others. Two-way ANOVAs were used to analyse group differences. To further explore the questionnaire responses, interviews with HMC (n = 7) and LMC (n = 10) participants were conducted.

Results

Overall females ($p = .001$) and those with LMC ($p = .022$) had significantly more diffuse (less coherent) identities compared to males and those with HMC. The interviews revealed that issues associated with level of peer support, ability to develop and maintain close friendships and expectations of high academic achievement and future goals contributed to the less healthy identities, particularly for the LMC females. Interestingly, most males with LMC still participated in sporting activities and maintained strong friendship groups which may account for their more coherent identities compared to the LMC females. The HMC females placed pressure on themselves as they put a lot of planning and organization into their future goals. The HMC males formed the healthiest identities as they were the most relaxed group about their future plan, they had large friendship groups and enjoyed participating in a range of activities.

Conclusions

A higher motor competence may be protective for males but not for females in contributing to the development of a healthy identity. Females with LMC experience greater challenges that negatively impact on the development of their identity. Support strategies targeting their perceived level of social support, personal changes and level of stress are warranted.

An Empirical Investigation of the Elaborated Environmental Stress Hypothesis: A Summary of Preliminary Findings

★Mancini V, Roberts L, Rigoli D, Heritage B, Piek J

Introduction

There is an important link between movement and psychosocial wellbeing. Specifically, poor motor skills are associated with greater psychosocial problems, including internalizing problems (anxiety and depression). Despite being well-established empirically, our understanding of why poor motor skills lead to internalizing problems is comparatively underdeveloped. The recently proposed, Elaborated Environmental Stress Hypothesis (Cairney, Rigoli, & Piek, 2013) provides a promising framework to explain this association. According to this framework, poor motor skills give rise to a range of secondary interpersonal and intrapersonal psychosocial issues (e.g. poor social support, low self-esteem, poor social skills). These secondary issues may then lead to the development of increased anxiety and depression. While the Elaborated Environmental Stress Hypothesis provides a promising framework, further empirical investigation is required.

Method

Key pathways embedded within this causal framework were evaluated across four different populations. They were: pre-primary aged children, primary-school aged children, adolescents, and young adults. All participants resided in metropolitan Western Australia. Motor skills were measured using standardized motor assessments, and psychosocial measures were obtained via self-report, or informant-report (parents and teachers).

Results

The results of these four cross-sectional studies provide support for key pathways embedded within the Elaborated Environmental Stress Hypothesis. Specifically, the association between motor skills and internalizing problems in community populations is explained by a combination of interpersonal and intrapersonal factors.

Conclusions

The Elaborated Environmental Stress Hypothesis provides a promising theoretical framework in which the relationship between motor skills and internalizing problems can be understood. Furthermore, this research enlisted community populations rather than only those with significant motor difficulties. This suggests that the model has utility outside of only clinical populations of children. These findings also highlight the additional psychosocial impact of poor motor skills, which may be overlooked. Consequently, it is recommended that the treatment of motor difficulties target both physiological and psychosocial factors. The current research also indicates that the psychosocial correlates of motor skills may differ during different developmental stages, highlighting different targets for intervention. However, a limitation of these studies is their cross-sectional research design which limit the ability to make causal conclusions. Consequently, further longitudinal evaluation of this model is required.

Examining narratives about DCD in relation to the lived experience of DCD individuals

★McAllum L, Moore K, Kerr R

Introduction

Some researchers estimate that there is a 2% incidence of severe cases of DCD in the global population, with 5%-6% the most quoted estimate of those who have some degree of DCD. It is generally agreed that failure to diagnose and treat the more severe instances of motor coordination difficulties may have significant adverse consequences in both childhood and adulthood. This focus on the proportion of people who present with severe symptoms means that, currently, the framing of DCD, and research into this area, is dominated by a reliance on medically derived narratives. Arguably, this understandable focus omits consideration of the experiences of those with less severe symptoms. This research addresses gaps in the current literature by: investigating narratives concerning experiences of those with less severe symptoms; focusing on adults with DCD; and investigating similarities and differences between the various narratives pertaining to DCD. It is the aim of this DCD researcher to give a voice to other DCD individuals, not imposing current mainstream categories, but rather allowing those with DCD their own descriptions about their own lives.

Method

A qualitative methodology was employed involving semi-structured interviews with adults with DCD and relevant professionals working in the field of DCD. Additionally blogs of adults with DCD were examined to triangulate the data and to explore as broad a set of narratives about DCD as possible.

Results

This paper reports on the main findings from the study, detailing the lived experience of adults with DCD. Critical psychology and the sociology of health are research areas that have critically examined the social and cultural construction of a number of diseases and disorders and so will provide the theoretical frame-work for analysing the results of this study.

Conclusion

It is concluded that detailed consideration of the narratives of adults exhibiting DCD-related behaviours provides a more comprehensive account of the lived experiences of those with DCD than that which is encompassed within current narratives, which represent those individuals with more severe symptoms of DCD. Further, incorporation of narratives about the lived experiences of the broad population of DCD individuals into policy decisions is necessary to promote the most positive life outcomes possible in an at risk population. Finally, the study findings support the need for further research into understanding the narratives of DCD individuals.

Visual perception and upper limb function in children with Developmental Coordination Disorder

★Harris E, Cox L, Auld M, Johnston L

Introduction

Poor upper limb coordination is one of the most common problems experienced by children with Developmental Coordination Disorder (DCD). Tasks such as writing, dressing, eating and sports are particularly problematic and result in significant participation restrictions. Researchers have identified that some specific visual perception deficits exist in this population and hypothesise that these contribute to the motor coordination problems experienced. However, little is known about the overall profile of visual perception performance (global visual perception) in children with DCD. In addition, the contribution that visual perception makes to types of upper limb function has not previously been measured, making it considerably difficult to accurately guide treatment of upper limb coordination deficits.

The aim of this study is to determine if global visual perception deficits exist in children with DCD, and if global visual perception can predict performance in various upper limb function tasks.

Method

Thirty two children aged six to 12 years, 17 with DCD and 15 typical developing (TD) children were included in the study. The presence of DCD was confirmed by performance on the Movement Assessment Battery for Children, 2nd edition (MABC2)). Visual perception was assessed using the Motor-Free Visual Perception Test-3 (MVPT). Upper limb function was assessed in terms of object handling speed (Jebsen-Taylor Test of Hand Function: JTTHF-Objects), handwriting speed and accuracy (Evaluation Tool of Children's Handwriting (ETCH), JTTHF-Handwriting) and manual dexterity ((MABC2-Dexterity)).

Results

Children with DCD demonstrated significantly poorer scores on global visual perception than TD children ($p=0.03$). Visual perception was most predictive of performance on object handling speed for the dominant ($p=0.005$), and non-dominant hands ($p=0.008$) and manual dexterity tasks ($p=0.003$). Visual perception also predicted handwriting accuracy for legibility of letters ($p=0.009$) and words ($p<0.05$). Visual perception was only related to handwriting speed for one subtest of the ETCH; uppercase alphabet writing ($p=0.03$).

Conclusions

Visual perception makes a large contribution to upper limb function for children with DCD, especially for dexterity and speed-based upper limb tasks involving hand trajectories and grasp, but also for accuracy of visually guided writing. These findings highlight the importance of providing formal visual perception assessment and treatment for children with DCD.

FRIDAY MORNING STREAM A

Increasing rates of motor impairments at 8 years in extremely preterm or extremely low birth weight children born between 1991-2005

Spittle A, Cameron K, Doyle L, Cheong J, on behalf of the Victorian Infant Brain Studies

Introduction

There are increasing numbers of survivors who were born extremely preterm (EP: gestational age <28 weeks) or extremely low birth weight (ELBW: birthweight <1000 g), but their long-term motor outcomes into school-age are unclear. The objective of this study was to compare rates of motor impairment at age 8 between three cohorts of EP/ELBW and term born children, and to determine the perinatal associations with motor impairment in EP/ELBW children.

Method

All children born EP/ELBW in Victoria, Australia in the calendar years of 1991-92, 1997 and 2005 were recruited. Randomly-selected normal birth weight (>2499 g) controls were matched for expected date of birth, sex and sociodemographic status. Infants were recruited at birth and perinatal data including gestational age, birthweight, neonatal surgery and brain injury on ultrasound recorded. Children were assessed by a blinded assessor at 8 years using standardized measures of motor performance. Motor performance was assessed using the Movement Assessment Battery for Children (MABC). The gross motor classification system was used to classify motor function of children with cerebral palsy (CP). Motor impairment was defined as CP or a score \leq 5th centile on the MABC.

Results

Motor impairment was significantly more likely in children born EP/ELBW in 2005 compared with children born at term in the same year. There was a significant increase in motor impairment in EP/ELBW children over the three eras from 24% in 1991-92, 30% in 1997 to 40% in 2005 (χ^2 trend=12.4; $p<0.001$). This was due to an increase in non-CP motor impairment (15% 1991-92; 20% 1997; 32% 2005; χ^2 trend=15.2; $p<0.001$) and not CP (11% 1991-92; 11% 1997; 12% in 2005). Increased motor impairment was independently associated with births in 2005 compared with 1991-92 (Odds ratio [OR] 2.76; 95% confidence interval [CI] 1.69-4.51; $p<0.001$), postnatal corticosteroids (OR 2.07; 95% CI 1.25-3.43; $p=0.005$), grade 3/4 intraventricular haemorrhage (OR 3.56; 95% CI 1.49-8.60; $p=0.004$), cystic periventricular leukomalacia (OR 6.35; 95% CI 2.36-17.10; $p<0.001$) and neonatal surgery (OR 1.96; 95% CI 1.25-3.08; $p<0.001$).

Conclusion

At 8 years, motor impairment is significantly more prevalent in EP/ELBW children compared to term controls. Furthermore, the rate of motor impairment in EP/ELBW children assessed at 8 years is increasing over time, an increase explained by non-CP motor impairment.

Maternal Gestational Stress and Longitudinal Motor Development

Grace T, Hands B, Bulsara M, Robinson M

Introduction

Changes in the structure and function of the developing fetal neurological system, due to maternal stress have been hypothesized to cause long term deficits in several developmental domains. While longitudinal studies have shown that maternal pregnancy stress affects behavioral, mental and cognitive development in middle childhood and into adolescence, few studies have investigated the consequences on motor development.

Method

The number and timing of stressors experienced during pregnancy were investigated using longitudinal data from the Western Australian Pregnancy Study cohort (N=2900). Motor development data were collected at 10 (n = 1622), 14 (n = 1584) and 17 (n = 1222) years using the McCarron Assessment of Neuromuscular Development (MAND). Linear mixed models were used to examine the effect of stress on motor development, accounting for repeated measures.

Results

Number of stressful events and mean Neuromuscular Development Index (NDI) were negatively related ($\beta = -1.197$, $p = 0.001$). Stressful events experienced in late pregnancy were negatively related with offspring motor development ($\beta = -.0541$, $p = 0.050$) while earlier stressful events had no significant impact.

Body structure, function, activity and participation in 3-6-year-old children born preterm. A systematic review and meta-analysis using the ICF framework

★FitzGerald T, Spittle A, Doyle L, Kwong A, Cheong J, McGinley J

Introduction

Children born preterm experience a myriad of challenges compared with their term born peers. The International Classification of Functioning, Disability and Health (ICF) is a valuable method of conceptualising the difficulties experienced by children born preterm across various domains. Significant motor impairment in children born very preterm (VPT) has been established from infancy to adolescence, however studies investigating motor outcomes at preschool age across the ICF domains are lacking. This review aims to systematically identify motor outcomes of preterm born children aged 3-6 years compared with term born peers within the ICF framework.

Method

Electronic databases (Medline, Cinahl, Embase and PsycINFO) were searched up to April 2016 using a detailed search strategy. Within each database, three discrete searches were conducted using search terms specific to motor body structure or body function, activity, and participation. Reference lists of key articles were also searched. Studies met inclusion if they compared motor outcomes of 3 to 6-year-old children born preterm (<32 weeks' gestational age or a birthweight <1500 g) with their term born peers (born ≥37 weeks' gestation and ≥2500 g). Outcomes needed to be specific to selected ICF child and youth version code sets, and children had to be born after 1989 (due to changes in neonatal care). Quality was assessed using the Newcastle-Ottawa Quality Assessment Scale. Two authors independently completed screening, quality assessment and data extraction

Results

35 studies met inclusion criteria. Of these, 12 had suitable data to be included in meta-analyses incorporating four outcomes: The Movement Assessment Battery for Children first edition (MABC) and second edition (MABC-2), The Beery Buktenica Developmental Test of Visual Motor Integration (VMI) and The Touwen Neurological Examination (TINE). Motor performance of VPT children was consistently poorer when compared with term born peers: MABC-2 SMD (standardised mean difference) -0.69; (95%CI [confidence interval] -0.84 to -0.53; $p < 0.001$), and VMI (SMD -0.72; 95% CI -0.89 to -0.55; $p < 0.001$). Furthermore, VPT born children had higher relative risk (RR) of impairment: MABC score <5th percentile RR 5.10 (95%CI 2.23-11.7; $p < 0.001$), MABC score <15th percentile RR 2.54 (95%CI 1.63-3.96; $p < 0.001$), and any neurological dysfunction on the TINE RR 4.81 (95%CI 1.82 - 12.7; $p < 0.001$).

Conclusions

Children born VPT experience significant motor impairment across ICF domains of body structure, body function, and activity compared with their term born peers at preschool age. There is limited evidence investigating participation in VPT preschool aged populations compared with controls which needs further research.

FRIDAY AFTERNOON STREAM C

Physical fitness profiles of children with and without Developmental Coordination Disorder

★Aertssen W, Bonney E, Ferguson G, Smits-Engelsman B

Introduction

Children with DCD are reported to have poor cardiorespiratory and neuromotor fitness (motor coordination, balance, and agility), decreased muscle strength and lower anaerobic capacity. These deficits may present in a heterogeneous fashion and exacerbate over time. Although subtypes of DCD have been previously examined, none have focused on physical fitness profiles. The purpose of this study was to determine whether subtypes of children with DCD, at risk (AR) and without DCD (Typically developing (TD) could be identified on the basis of physical fitness parameters.

Method

Children aged 6-10 years (n= 271) from Cape Town, South Africa were assessed for 1) coordination (Movement Assessment Battery for Children-2nd edition) 2) generalized anaerobic capacity (Muscle Power Sprint Test), 3) cardiorespiratory fitness (20m Shuttle Run Test), 4) functional lower extremity strength (Functional Strength Measure) and 5) isometric leg strength of the knee extensors (handheld dynamometer). The Wards method was used to identify subgroups.

Results

Four clusters were identified. Cluster 1 (n=107) contained both TD (n=65) and DCD children. They demonstrated good aiming and catching skills and had good functional strength. The children in the AR group (≤ 16 th percentile MABC-2; n=23) and DCD (≤ 5 th MABC-2 n=19) in this cluster had predominantly low Total Scores based on their manual dexterity. Cluster 2 (n=77), the second largest, involved children with poor coordination, poor functional strength and poor aerobic capacity but had good isometric strength and anaerobic power. Cluster 3 (n=68) consisted of children that were poor on all outcomes (poor isometric and functional strength, poor anaerobic and aerobic capacity with low scores on the MABC-2). Cluster 4 had the lowest number of children (n=19). This group had good aerobic and anaerobic capacity as well as and functional strength. Only one child with DCD and two AR were in this cluster (again with low Total Scores based on their poor manual dexterity).

Conclusion

Our findings suggest heterogeneity in physical fitness profiles. Fitness consists of many aspects that are only mildly interrelated. These variations may have serious implications for participation and health. Not only are the outcomes in children with DCD very heterogenic, the different backgrounds that led to these profiles need to be taken into account for intervention planning. Comprehensive evaluation of functional strength, aerobic and anaerobic condition and its relation with coordination, together with history taking about physical activity exposure in this population is therefore important for intervention design.

Physiological characteristics and generalised self-efficacy of children with low movement proficiency and the impact on physical activity

★Wright K, Licari M, Thornton A, Jackson B, Dimmock J, Naylor L, Reid S, Furzer B

Introduction

Previous research has identified that children with low movement proficiency (LMP) have lower levels of physical activity (PA), lower aerobic fitness (AF), self-efficacy and increased body fat and/or low muscle strength (MS) independently. To date, the relationship between these variables and how they change with age in children with LMP is not well understood. A greater understanding of what restricts this cohorts ability to participate in PA will provide key target areas to inform future interventions.

Method

One hundred and twenty children matched for age (M age 8.54 ± 1.86 yrs) participated in the study. Movement proficiency was assessed via the Movement Assessment Battery for Children-2 (MABC-2); 60 children were classified as typically developing (TD) according to MABC-2 scores (MABC-2 ≥ 17 th percentile), with 60 classified as LMP (MABC-2 ≤ 16 th percentile). Dual Energy X-ray Absorptiometry scans were used to determine body composition. Strength was assessed using handgrip dynamometry and 5-repetition maximum (5RM), with PA assessed using Actigraph GT3x accelerometers. Peak aerobic capacity (VO_{2peak}) was determined using an incremental treadmill protocol using a COSMED portable analyser. Children also completed the Children's Self-perceptions of Adequacy in and Predilection for Physical Activity scale (CSAPPA) to establish generalised self-efficacy towards PA.

Results

Independent-samples t-tests between groups revealed that children with LMP exhibited lower PA levels (M= 151.16, SD=90.59; t (111)= 2.364, p=0.02), MS (M= 71.55, SD=20.10; t (109.4)= 5.05, p<0.001) and AF (M= 36.62, SD=8.00; t (115.7)= 2.046, p=0.04) when compared to TD group (M= 193.85, SD=100.49; M= 93.42, SD=26.80; M= 39.72, SD=8.42). However, no significant difference in body composition (lean mass; body fat percentage) was found between groups. Children with LMP reported lower levels of Adequacy (M= 19.35, SD=5.67; t (107.8) = 3.234, p=0.002) and Predilection for PA (M= 23.48, SD=7.02; t (112.8)= 4.16, p<0.001) when compared to TD children (M= 22.29, SD=4.12; M= 28.35, SD=5.68). Analysis on age interaction effects is ongoing and will be presented at the conference.

Conclusion

Children with LMP were significantly different compared to TD children in both their physiological function and measures of generalised self-efficacy, which may have impacts on their capacity and willingness to participate in PA. In contrast to previous research, our study showed no differences in body composition variables. Results of this study demonstrate that children with LMP may benefit from interventions that directly target, MS, AF and self-efficacy with the aim of enhancing PA participation.

Longitudinal examination of physical activity levels in children with and without motor coordination difficulties during early childhood

★King-Dowling S, Wellman S, Le T, Rodriguez C, Missiuna C, Timmons B, Cairney J

Introduction

Children with Developmental Coordination Disorder (DCD) are less active than their typically developing peers. As these children grow, active pursuits become more demanding and complex, and it is theorized that the activity gap between children with and without DCD widens over time. However, as previous research has primarily focused on older children and adolescents with DCD, a point at which the activity deficit is already present, it remains unclear when this divergence in physical activity occurs. The purpose of this study was to investigate the daily moderate-to-vigorous physical activity (MVPA) levels in children with and without motor coordination difficulties over time, starting at preschool age (4-5 years), to examine if the activity gap is already present or if it begins to emerge during this early childhood period.

Method

Participants 4 to 5 years of age were recruited and asked to complete 3 annual assessments as part of the Coordination and Activity Tracking in CHildren (CATCH) study. At baseline children completed the Movement Assessment Battery for Children-2, with children scoring ≤ 16 th percentile considered to be at risk for DCD (DCDr). Physical activity was measured each year over 7-days using Actigraph accelerometers and was analyzed in 3-second epochs using established cutpoints to determine average daily minutes of MVPA. Only children who wore the accelerometer ≥ 10 hours on ≥ 3 days were included in the analyses. Mixed effects modeling was used to determine if DCDr predicts MVPA over time, controlling for sex. A time-by-group interaction was also tested to determine if the rate of change in MVPA differs by DCDr status.

Results

Fifty-nine children (37 DCDr, 43 boys) to date have completed 3 annual assessments for the CATCH study. A significant effect for group (estimate=-10.94, $p=.02$) and sex (estimate= 15.8, $p<.01$) was found, indicating that children in the DCDr group were less active than their typically developing peers and girls were less active than boys over the study period. There was no significant time effect or time-by-group interaction indicating that gap in MVPA between groups was consistent across time.

Conclusions

A deficit in MVPA is present in preschool-aged children with motor coordination difficulties and this persists through early childhood. This finding highlights the importance of early interventions to help minimize the risk of inactivity and associated health risks in children with DCD.

Longitudinal assessment of aerobic and anaerobic fitness in young children at risk for DCD: Preliminary results from the CATCH study.

Chirico D, King-Dowling S, James M, Le T, Rodriguez C, Missiuna C, Timmons B, Cairney J

Introduction

Children and adolescents with developmental coordination disorder (DCD) exhibit lower levels of health-related fitness compared to typically developing (TD) peers that persists over time. However, previous longitudinal studies tracked children beginning from mid- to late childhood when baseline differences already exist. Research is limited on the longitudinal tracking of aerobic and anaerobic fitness in preschool aged children at risk for DCD (DCDr). The purpose of this study was to determine the longitudinal tracking of short-term muscle power (STMP) and aerobic fitness in 4 and 5 year old children with DCDr compared to typically developing (TD) controls.

Method

Participants 4- to 5-years old were recruited for the Coordination and Activity Tracking in Children (CATCH) study. To date, a total of 68 participants have completed three years of assessments. Motor skills were assessed using the Movement Assessment Battery for Children-2 (MABC-2) at baseline, and children were grouped as DCDr (≤ 16 th percentile on MABC-2) or TD (> 16 th percentile on MABC-2). Aerobic fitness ($n=68$; DCDr=44) was assessed by time to exhaustion on maximal treadmill test using Bruce protocol and 2-min heart rate recovery (HRR) following the treadmill test. STMP ($n=64$; DCDr=41) was assessed using peak power (PP; W/kg) and mean power (MP; W/kg) during a 30-second Wingate protocol on a pediatric cycle ergometer.

Results

A repeated-measures ANOVA was used to evaluate group (DCDr vs. TD) and time effects, as well as their interaction, while controlling for sex. A significant main effect for group was evident for time to exhaustion ($F=9.74$, $p=0.003$), PP ($F=6.23$, $p=0.015$) and MP ($F=11.01$, $p=0.002$), whereby children with DCDr exhibited lower levels at all time points. There was no group effect for HRR. A significant main effect for time was also found for time to exhaustion ($F=43.03$, $p<0.001$), HRR ($F=5.07$, $p=0.008$), PP ($F=24.02$, $p<0.001$), and MP ($F=19.82$, $p<0.001$), while no interaction effects were evident.

Conclusion

Children at risk for DCD exhibited lower aerobic fitness and STMP than controls, which remained constant over time. Although the DCDr group demonstrated similar increases in aerobic and anaerobic fitness over time as TD controls, they are at a deficit as early as four years of age. This study highlights the importance of early detection and intervention in children with DCD, and suggest that reductions in anaerobic and aerobic fitness are early markers of reduced health-related fitness that may precede overweight and obesity.

Parental influences on physical activity behaviour in very young children at risk for DCD

Kwan M, King-Dowling S, Ceccacci A, Rodriguez C, Missiuna C, Timmons B, Cairney J

Introduction

In addition to academic and self-care difficulties, there is compelling research showing children with Developmental Coordination Disorder (DCD) engage in less physical activity (PA) than their typically-developing (TD) peers (Rivlis et al., 2011). Very little research, however, have investigated theory-based determinants related to PA in young children with motoric difficulties. The purpose of the current study is to present updated findings comparing objectively assessed PA behaviours of children at risk for DCD (DCDr) and TD children, and the relationships between PA and salient parental influences.

Method

Children recruited as a part of the baseline cohort of the Coordination and Activity Tracking in Children (CATCH) study were included (N=480; 46% DCDr; 57% boys). Motor skills were assessed using the Movement Assessment Battery for Children version 2, and children scoring ≤ 16 th percentile were categorized as DCDr. Parents completed a questionnaire measuring their perceived importance of PA, enjoyment of PA, parental support for PA, and perceptions of their child's competence. Additionally, each child wore an RT3 Triaxial Actical Accelerometer for seven consecutive days.

Results

Univariate analysis of variance found no significant differences in time spent in moderate-to-vigorous PA between DCDr ($M=71.46 \pm 19.89$) and TD children ($M= 72.87 \pm 20.42$). Similarly, no differences were found in light PA or sedentary behaviours. Correlation analyses did not find significant relationships between children's PA and parental influences, but there was significant relationships between parental perceptions of their child's motor competence and the child's PA behaviors ($r = .13$ $p < .01$).

Conclusions

Our findings suggest that there are no differences in PA behaviours between DCDr children and their TD peers during the early childhood period. While parental PA cognitions do not appear to be related to PA in very young children, there was a weak but significant relationship between parent perceptions of their child's motor competence and the child's PA. Overall, results suggest that these young children tend to be fairly active with 62% meeting the PA recommendations of 60 minutes of energetic activity per day. Future research will continue examine how patterns of PA and its psychosocial determinants change over time, critical for identifying specific periods and targets for intervention efforts.

What does a mean standard score mean? Profiles of children in “at risk” and “impaired” range of MABC-2

Ferguson G, Bonney E, Smits-Engelsman B

Introduction

The purpose of this study was to investigate whether subtypes of children with developmental coordination disorder (DCD) could be identified based on their performances on the items of Movement ABC-2. Given the discussions about cut off values of DCD, we were specifically interested in the profile of children in the at risk range (between the 5th and 16th percentile). According to structure of the test we expected subtypes of children based on the poor manual dexterity, aiming and catching, and balance.

Method and Results

Participants included were 6-and 11-year-old children who participated in our research in the last 5 years either as intervention children or as controls (n=504). Pretest values on the MABC-2 of 158 children with developmental coordination disorder (DCD), who were enrolled in one of our intervention studies, 118 children at risk, and 228 without DCD were used for the analysis. Variables included for cluster analysis (k-means) were the standard scores on the individual items. Based on this analysis four clusters emerged. Of the TD children 171 (75%) were good on all 8 items (Cluster 1 Overall Good). Of the DCD group (intervention children) 84 were generally poor on all items (Cluster 2 Overall Poor 53%) and 44 (28%) were very poor on manual dexterity (Cluster 3 Poor Dexterity) while the minority 30 (19%) had predominately aiming and catching problems (Cluster 4 AC group). Importantly in the “at risk” group only 2 clusters (Cluster 3 and 4) emerged. A cluster relatively poor on all items did not come up as the “at risk” cluster. This group was either poor at the two dynamic balance items or at manual dexterity.

Conclusions

The results confirm the heterogeneity of children with DCD. Importantly identification of subtypes (or weaknesses in one area) in the “at risk group” are important. Deficiencies are more specific in the at risk children than in children below the 5th. Children in the “at risk range” of the MABC-2 are not “generally slightly worse than TD” or “generally slightly better than DCD”. Children in the “at risk range” not only have movement difficulties but also some movement strengths. Profile exploration can help researchers and therapist to plan more effectively for the different subtypes of children.

Functional fitness can be improved and sustained over time in adolescents with DCD

Mcintyre F, Chivers P, Hands B

Introduction

Adolescents with movement difficulties have lower physical fitness measures than their typically developing peers. Most exercise interventions designed for this group are short term with minimal improvements reported and little known about follow-up changes or sustainability. This study reports longitudinal findings of an exercise intervention with participation up to six years.

Methods

Participants attend a University exercise clinic twice per week for 90 minutes over a 13 week semester, twice a year. Each participant is paired with a trainer who designs and delivers an individually focussed program involving cardio work, resistance training, and motor skill techniques. Program eligibility includes age 13-18 years and a motor disability based on the Neuromuscular Developmental Index (NDI) derived from the McCarron Assessment of Neuromuscular Development and/or a history of movement difficulties as per the DSM-V guidelines. Participants attend the program for as many semesters as necessary or until they turn 18 years of age.

Seven physical fitness measures (multistage fitness test; curl-ups; grip strength, chest and leg strength; standing broad jump and vertical jump) are taken at baseline, then pre and post each semester program. Linear Mixed Modelling (LMM) was used to analyse the change in each fitness measure over time controlling for age, BMI, gender, NDI, number of sessions attended during the 13 week program, and test occasion. Non-significant variables were removed one at a time until only significant model predictors remained in the LMM.

Results

Data for 78 adolescents (males=51; Mage = 14.04 yrs (1.50)) with a mean NDI of 69.96 (20.84) are reported. Exercise adherence varied, with participants attending on average 21 of 26 sessions each semester. The number of semesters attended ranged between 1 and 12.

LMM results showed that six of the seven fitness scores (except 1RM Chest) improved over time. The influence of session adherence, BMI, NDI, age and gender varied between fitness measures, however those with milder motor impairment showed greater improvement.

Conclusion

Sustained improvements in aerobic fitness and strength can be achieved by adolescents with movement difficulties. The longer the adolescent was engaged in the program, the greater the improvements. Importantly, these improvements were maintained despite breaks between programs of 9 and 13 weeks. Fitness focussed interventions need to be offered for extended periods of time with a frequency of 2 x week to achieve sustained improvements.

A comparison of Movement ABC-2 data from Italy and the UK

Zoia S, Biancotto M, Guicciardi M, Barnett A, Canale N, Henderson S, Sudgen D

Introduction

The Movement Assessment Battery for Children-2nd edition (MABC-2) Test is widely used to identify children with motor problems. Ideally, any country using the test should produce national norms, which provide data on the performance of typically developing children and thus take into account cultural diversity in motor experiences. This helps to verify the validity of the test for local use.

The aim of the present work was to verify differences in motor performance due to cultural diversity in living conditions and motor experiences, by comparing performance on Age Bands (AB) 1 (3-6 year olds) and 2 (7-10 year olds) of the MABC-2 in Italian children with data from the UK standardization sample.

Method

Data from an Italian sample of 718 children (338 in AB1; 380 in AB2) were compared to data from 765 children from the UK standardization sample (432 in AB1; 333 in AB2). Children were individually tested on the 8 items of the MABC-2, testing the three competence areas: Manual Dexterity (MD), Aiming and Catching (AC) and Balance (B). Linear regression models were used to predict MABC-2 scores on the basis of age and group identity (UK or Italy), therefore three models were considered: (1) only age as independent variable; (2) age + group identity; (3) age + group identity + interactions between these two independent variables.

Results

The linear model with the best fit according to the BIC criterion (≥ 6) is the second one: age + group identity. Few differences were found by comparing the Italian and UK population, however the obtained results remark the necessity to use reference norms that are valid for the group of tested children.

Differences were not identified for a unique subcomponent of MABC-2 test, but within each competence area (Manual dexterity, Aiming & Catching and Balance.)

Conclusion

These data objectify cultural diversity in motor experiences. The significant age + group identity linear model indicates that along the ages the eventually few differences between UK and Italian sample remain stable.

What the MABC-2 Test assesses: Factorial analysis on three age versions of the test

Psotta R, Brom O

Introduction

Results of the the Movement Assessment Battery for Children – 2nd edition (MABC-2) Test serve as the diagnostic criterion A for DCD according to the DSM-5TM (APA, 2013). However, a question arises as to which motor abilities are really captured by the motor tasks involved in three age versions of the MABC-2 test – AB1 (3-6 years), AB2 (7-10-years) and AB3 (11-16 years). Therefore the study examined the factorial validity of the MABC-2 Test across all age groups of children.

Method

Confirmatory factor analysis (SPSS AMOS 22.0) was carried out on data obtained from testing by the MABC-2 Test in three samples of children aged 3-6 (n = 392), 7-10 (n = 483) and aged 11-16 (n = 674). Post hoc modifications of the basic hypothesized models of the Test were performed to find the fitting models and thus to examine the two alternative (“non-specific motor factor” and “specific motor factors”) hypotheses on the Test.

Results

The covariance matrix of each of the three age versions of the MABC-2 Test fitted well with the 3-specific correlated factor model including latent factors such as manual dexterity, aiming & catching, and balance, with meeting of the fitting criteria such as of the chi-square χ^2 test ($p > 0.05$), relative χ^2 (CMIN/df < 3.0), root mean square error of approximation (RMSEA < 0.07), goodness of fit index (GFI > 0.95), adjusted goodness of fit index (AGFI > 0.95), and the Tucker-Lewis index (TLI > 0.95). The test item, Jumping on mats, showed non-significant factor loading on the latent factor of balance in the AB1 (0.07; $p > 0.05$). In the AB2 and AB3, the dynamic balance items, Hopping on mats with both better and other leg (Bal3b, Bal3o), did not significantly differ from a zero loading ($p > 0.05$), with the exception of Bal 3o item in AB3 however manifesting very low factor loading on the latent factor of balance (0.15; $p > 0.05$).

Conclusion

The study supported the 3-specific factor structure of the MABC-2 Test across all the age versions of the test. The test presents for professionals in psychological, clinical, and educational practice a valid diagnostic tool to assess both overall motor proficiency and the specific motor abilities such as manual dexterity, aiming & catching, and balance abilities not only in subjects in middle and older childhood but already in preschool children.

Suboptimal bone status for adolescents with movement difficulties – it's gender specific

Chivers P, Rantalainen T, McIntyre F, Hands B, Weeks B, Beck B, Hart N, Siafarakis A

Introduction

Australian adolescents with movement difficulties (suspected Developmental Coordination Disorder (sDCD)) have fracture rates (26.9%) higher than their comparison population (4.6%) and have poor bone health compared to European normative data. It is unclear whether the sub-optimal bone status is related to the condition or caused by lack of loading due to low physical activity levels. This study examines whether these differences remain when compared with healthy Australian age-matched adolescents with a similar environmental opportunity for physical activity.

Method

Australian adolescents aged 12-18 years with sDCD (N=39) and an Australian comparison sample (N=147) undertook radial and tibial peripheral Quantitative Computed Tomography (pQCT) bone scans. Motor difficulties were assessed using the McCarron Assessment of Neuromuscular Development. Stress Strain Index (SSI (mm³)), Total Bone Area (TBA (mm²)), Functional muscle bone unit (FMBU: (SSI/bone length) and Robustness (SSI/bone length³) were computed. Specific group differences were examined using Mann-Whitney U Test. sDCD participants were younger (M=14.4 years SD=1.3) than the comparison group (M=15.3 years SD=1.8) ($p=.007$), gender was equally represented for the radius (54.1% male) and tibia (53.2% male), although sample size differed for each bone site due to motion artefact (sDCD Radius n=26, Tibia n=39, comparison group Radius n=96, Tibia n=147). A general linear model for each bone measure was used to determine differences between groups controlling for gender, age and bone length (proxy for growth and hormone related differences), whilst investigating possible interactions between groups with gender and age.

Results

sDCD participants had lower scores for Tibial SSI, TBA and Robustness, and no gender group interaction was observed. A significant gender-x-group interaction was found for Tibial FMBU ($p=.021$) with sDCD males having lower Tibial FMBU scores (M=36.7 SD=8.0) than comparative group (M=41.7 SD=6.5) ($p=.004$). In contrast sDCD females Tibial FMBU scores were slightly higher (M=40.4 SD=13.6) than the comparative group (M=38.1 SD=6.3) ($p=.542$). No significant group differences were observed for Radial bone measures.

Conclusion

Comparisons of sDCD bone measures with Australian comparative data are similar to European results however gender differences were found in the present study. Australian adolescent boys with suspected DCD have weaker bones compared to Australian comparative data, whereas there were no differences between groups for the girls. These differences may be due to lower levels in habitual weight-bearing physical activity level which may be more distinct in adolescent boys with suspected DCD compared to girls.

FRIDAY AFTERNOON STREAM D

Do students with handwriting dysgraphia also have "keyboarding dysgraphia"?

Weintraub N, Rosenberg T, Bar-Ilan Traub R

Introduction

Students with DCD often encounter handwriting difficulties (i.e., dysgraphia) due to their motor or cognitive deficits. Word-processing via keyboarding is a common alternative writing mode for these students, and is frequently recommended as a test-taking accommodation. However, since keyboarding, as handwriting, requires motor and cognitive skills, it is possible that students with dysgraphia will also encounter keyboarding difficulties (henceforth, "keyboarding dysgraphia"), as measured by keyboarding speed and accuracy. Studies relating to keyboarding performance among higher-education students with dysgraphia are scarce. The purpose of this study was to examine if students with dysgraphia are more prone to having "keyboarding dysgraphia" compared to their normally achieving (NA) peers. This study focused on keyboarding speed; "keyboarding dysgraphia" was defined as typing at a speed that is lower ($Z < [-1.5]$) than expected.

Method

The study included 2 groups of higher-education students: (a) with dysgraphia ($n=28$, $M_{age}=24.9$ years, $SD=3.3$) of whom 20(71.4%) were males, and (b) NA students ($n=44$, $M_{age}=22.9$ years, $SD=1.9$) of whom 13(29.5%) were males. The students with dysgraphia had been diagnosed with a learning disability in childhood and demonstrated handwriting difficulties based on a standardized test ($Z < [-2]$). Their scores on motor (Purdue), grapho-motor (ROCF) and/or executive functions (BRIEF) measures were $Z < [-1]$. Preliminary analysis showed that the students with dysgraphia scored significantly ($p < .01$) lower on handwriting, motor and executive functions measures compared to the NA group. Both groups spent approximately 2.5 hours/day typing on the computer, and there was no gender effect on keyboarding speed. The students were individually tested on the measures mentioned above, as well as on a standardized keyboarding copying test.

Results

Significant group differences were found ($t = -1.711$, $p < .05$) in keyboarding speed; students with dysgraphia scored lower. There was also a significant medium correlation between handwriting and keyboarding speed among the students with dysgraphia ($r = .55$, $p < .01$) but not among the NA group. Finally, 8(28.6%) of the students with dysgraphia were found to have "keyboarding dysgraphia" compared to only 2(4.5%) in the NA students.

Conclusions

It appears that students with dysgraphia may be more prone to having "keyboarding dysgraphia" as compared to their NA peers. These results suggest that for students with slow handwriting, keyboarding may not always be a sufficient alternative writing mode, and thus, additional or other accommodations may need to be considered. However, these results are preliminary and focused only on speed. Additional studies on this topic are warranted, including examination of keyboarding accuracy.

Motor performance among students with dysgraphia

Tal-Saban M, Weintraub N

Introduction

Dysgraphia is a form of learning disability that affects students' handwriting performance, and in turn, their written expression. These difficulties can manifest as illegible or slow handwriting, as well as pain and fatigue. Difficulties in handwriting are especially prevalent among students with motor problems such as Developmental Coordination Disorders. Several studies have reported that the fine-motor and grapho-motor skills of elementary-school students with dysgraphia are lower compared to their peers. However, similar studies among higher-education students are scarce. The aim of this study was to compare the objective and subjective motor performance of higher-education students with and without dysgraphia.

Method

The study consisted of 140 higher education students from various academic settings. Seventy nine students had dysgraphia ($M_{age}=24.53$ [$SD=2.6$]; 83.5% males) and 61 students without dysgraphia (hence forth, typical students - $M_{age}=24.75$ [$SD=2.6$]; 65% males). The students with dysgraphia had been diagnosed with a learning disability in childhood and demonstrated handwriting difficulties based on a standardized test (Handwriting Performance of Post-Secondary Students [HaPPS]; $Z<[-2]$). The typical students had no reported developmental disabilities and their score on the HaPPS was $Z>2$. The students were individually administered fine-motor (Purdue), grapho-motor (ROCF) and orthographic-motor integration tasks (OMI; writing the alphabet from memory), as well as a modified version of the Adolescents and Adults Coordination Questionnaire (M-AAC-Q; self report), which evaluates motor-based daily functions.

Results

First we examined gender differences with respect to the different tests for a possible confounding effect. No significant differences were found ($p>.05$). Next, one-way ANOVAs revealed that students with dysgraphia scored significantly lower ($p<.05$) than the typical students on all motor performance tests : Purdue ($F[1,97]=10.85$; eta squared = .10), ROCF ($F[1,73]=8.19$; eta squared = .10), and OMI ($F[1,63]=19.96$; eta squared = .24), and reported more motor-based daily function difficulties: M-AAC-Q ($F[1,49]=11.4$; eta squared = .19).

Conclusions

This is one of the few studies examining the motor performance of higher-education students with dysgraphia. Similar to findings among elementary-school, higher-education students with dysgraphia exhibited more difficulties in fine-motor, grapho-motor, and orthographic-motor integration skills as well as on motor-based daily functions compared to the typical students. These results suggest a co-occurrence of dysgraphia and DCD among these students, as reported in previous studies. They also emphasize the importance of identifying and treating the motor performance of students with dysgraphia. Nevertheless, this study primarily focused on fine-motor skills and thus further exploration of gross-motor skills among students with dysgraphia are suggested.

An Examination of the Long Writing Pauses in Children with Developmental Coordination Disorder using Eye and Pen Movements

Prunty M

Introduction

Difficulties with handwriting are reported as one of the main reasons for the referral of children with Developmental Coordination Disorder (DCD) to healthcare professionals. Previous research has found that children with DCD produce less text than their typically developing (TD) peers as a result of long pauses during writing. However the nature of these long pauses (>10 seconds) are poorly understood. It is not known for example whether the long pauses occur due to cognitive processes such as planning and revision, or physical reasons such as fatigue. The aim of this exploratory study was to characterise the long pauses observed in the handwriting of English children with DCD using eye and pen movements.

Methods

Twenty 8-15 year-old children with a diagnosis of DCD participated in the study. Participants completed the 10 min free-writing task from the Detailed Assessment of Speed of Handwriting (DASH) on a LCD digitising writing tablet. Eye gaze behaviour was captured during the writing task using eye-tracking technology. The location of eye movements during the long writing pauses were coded to describe cognitive processes during long pauses such as reviewing the text, planning content or distraction from the task.

Results

A description of the handwriting and eye movement measures will be reported. The analysis adds to the literature by being the first to describe eye movements during writing in children with DCD. Discussion will centre on both the theoretical and practical implications of these findings.

Graphomotor adaptation in children with Developmental Coordination Disorder and/or Dyslexia

Danna J, Velay J, Jover M

Introduction

Handwriting has been showed to be altered in children with dyslexia (DD; e.g. Lam, et al., 2011), in children with developmental coordination disorder (DCD; e.g. Rosenblum, et al., 2013) and in children with comorbid DD and DCD (Huau et al., 2015). The symptom overlap between DD and DCD could be explained by a common deficit in procedural learning (Nicolson and Fawcett, 2011). Most of the studies exploring this hypothesis relied on serial reaction time tasks and produced inconsistent results. The present study aimed at comparing the performance of DD and DCD children in a motor adaptation task, as Doyon et al. (2009) demonstrated that motor learning could be divided in sequence learning and motor adaptation.

Method

Twenty children with DD, 20 children with DCD, 20 children with DD and DCD, and 20 control children (TD) wrote on graphic tablet the trigrams 'eue', 'eeu' and 'uee' in cursive handwriting. Eight repetitions in two conditions – from the left to the right (classic condition) and from the right to the left (adaptation condition) were tested. Handwriting abilities were also assessed using the BHK test (Hamstra-Bletz, DeBie & den Brinker, 1987).

Results

Data collection is still ongoing. Preliminary analyses in 20 DD and 20 TD children showed lower z-scores in the BHK test in DD children and an interaction effect between group and condition in the trigram task. The DD and TD children did not differ in the classic condition. In the adaptation condition children with DD reproduced the trigrams with a longer movement time, a lower velocity, and a poorer fluency than TD children. The performance of children with DCD and with comorbid DCD and DD will soon be analysed.

Conclusion

First results replicate the finding of poorer handwriting skills in children with DD. They indicate that motor adaptation was not maintained in children with DD. Comparison of these results with those of the DCD and of the comorbid DCD and DD groups will contribute to a better understanding of the status of motor difficulties in neurodevelopmental disorders.

Dyspraxia in the Workshop, qualitative research exploring the impact of Dyspraxia on skilled applied artists (A work in progress)

★Öhlund E

Introduction

Little is known about how DCD (also known as Dyspraxia in the UK) influences artists and craft practitioners. This research explores the impact DCD has on applied artists, specifically those working with metal, and their craft practices. Silversmithing involves complex skills and the organization of combinations of processes, tools and physical approaches so therefore it is particularly interesting to study DCD in this particular pathway within applied arts.

Method

The research is a qualitative study, carried out in the form of in depth case studies. It comprises of an autoethnographic case study along side six case studies with adult DCD participants. Three participants are Silversmithing /Jewellery MA students at the Royal College of Art London and the other three participants are professional practicing Silversmiths/Jewellers. Ages range from 25-65 across both sexes and world nationalities. Case studies are conducted with attention to detail and a holistic approach to the individual's life history together with exploring how DCD traits have had an impact on their craftwork practices.

Results

Early findings suggest that motor difficulties such as the regulation and sustaining of grip pressure, tool accuracy, body awareness and posture control may lead to atypical workshop practices. Additional difficulties with executive function can result in over compensatory or avoidance coping mechanisms that can be counter-productive to the overall success of the creative process. However some individual self-developed coping strategies have facilitated great professional success by using the way that they think to their advantage. Investigating these strategies may offer vital information on alternative approaches for concurring the difficulties that effect adults with DCD, and utilising potential aptitude.

Conclusion

This research, which is a work in progress, will contribute to knowledge of DCD and provide insight into its bearing on the applied arts. It can also be applied to DCD in adulthood in general, helping to identify which DCD traits are continuing to effect functionality into adult life. I hope that the research will provide more data to contribute to advancements in supporting children and adults with DCD, especially but not solely in art and design. I am approaching this research from the perspective of a professional silversmith with DCD.

SATURDAY MORNING STREAM A

The Effectiveness of a Motor and Pre-literacy Community-based Program in Preschool Aged Children

★Bedard C, Bremer E, Campbell W, Cairney J

Introduction

The attainment of fundamental movement skills (FMS) such as throwing and catching and running is critical to a child's overall development. FMS are the foundational building blocks that allow children to learn more complex movements that facilitate independent participation in activities of daily living, athletic pursuits, and recreational physical activities. Furthermore, movement skill proficiency is closely related to many health variables including physical activity levels, physical fitness, and healthy body composition. Increasing evidence from neuroscience and early childhood education research demonstrates enhanced movement gains in young children as a result of their participation in interventions involving movement skill learning blended with pre-literacy skill development. The effectiveness of such interventions in a community-based setting with active involvement of care-givers is unknown and therefore, this research sought to investigate the effectiveness of a motor and pre-literacy skill program for a community sample of 3-4 year old children and their care-givers.

Methods

A quasi-experimental study design was used to evaluate the program in 19 families (experimental group, n=8; control group, n=11). The program was run for one hour/week for 10 consecutive weeks and consisted of motor skill instruction, free-play, and an interactive reading circle, with active involvement of care-givers each week. Motor and pre-literacy skills were assessed in all children pre- and post-intervention using the Peabody Developmental Motor Scales-2 and the Preschool Word and Print Awareness tool.

Results

The average age of the children was 44 months and 47% were males. Two one-way ANCOVAs were conducted to detect a difference between experimental and wait-list control group on gross motor skills (stationary, locomotor, and object manipulation) and print awareness controlling for baseline scores. There was a significant effect of group on gross motor raw scores overall ($F(1, 16)=4.67, p<.05$) and print awareness ($F(1, 16)=11.9, p<.05$), after controlling for baseline scores.

Conclusion

This novel study demonstrated positive developmental gains in preschool children with typical development after participation in a motor skill and pre-literacy program. Future research will involve implementing and evaluating the effectiveness of the program as a tertiary prevention intervention for children with specific movement limitations such as children with Developmental Coordination Disorder or Down Syndrome. The community-setting and care-giver involvement components of the program, are unique intervention elements will likely be instrumental in these population, as typical intervention research in these populations are clinic-based and often neglect the role of care-givers.

Exergames as an additional tool for training children with DCD, a feasibility report

★Bonney E, Ramekers E, Smits-Engelsman B

Introduction

Several studies have shown that the use of exergames can lead to improved balance and agility. Although effect sizes are moderate, children enjoy the games, which can improve engagement in the intervention. Therefore including exergames as an adjunct to mainstream intervention is worth considering. It may also be a useful alternative to more sedentary games or in settings where outside play is impossible.

However, implementing exergames in clinical practice is not easy if one only reads the scientific intervention papers. Since we have done studies with different groups and over a larger age range (between 6-15 years, with CP, DCD and overweight/Obesity) we would like to share how we organized the training, how we adapted the games that were played to the goals, how we monitored the enjoyment levels, perceived exertion and participants' heart rate as a means to monitor the program over the sessions.

Method

Two master's degree students evaluated and selected numerous games and organized them per training option. Then using each of these games, a protocol was developed with possible adaptations to gradually increase the load on coordination/agility, strength and conditioning without hampering the playability. This protocol was used and evaluated in 3 ways: did the children like the training, what was their perceived exertion, what was their maximum heart rate before, during and after each training. We also evaluated changes in participants' coordination, agility and anaerobic endurance.

Results

We seek to show (with photos and video clips) how we implemented the use of active computer games for the development of motor competence. We will report pitfalls, how high the intensity of the training levels was based on HF and how high the children perceived the level of training. Although not the goal of this talk we will also report differences between pre and post intervention measures after 14 sessions on coordination and agility in a small group children (n=20), with poor motor coordination (<16th MABC).

Conclusion

There is a need to accumulate knowledge on how to maximize the use of exergames in intervention: 1) As homework, 2) a source of non-sedentary play, and / or 3) as an additional intervention tool for sedentary persons and in situations with reduced opportunities for participation in physical activity.

The effect of an active electronic games intervention on running biomechanics in children at risk of Developmental Coordination Disorder

Campbell A, Smith A, Jensen L, Straker L

Introduction

Developmental coordination disorder (DCD) affects 5% of children worldwide with a further 10% considered at risk of DCD (Barnhart et al., 2003; Wilson et al., 2013). DCD is characterised by reduced age appropriate motor skills that has a range of behavioural and psychological implications. Children with DCD have been shown to run with different biomechanics than children without DCD (Diamond et al., 2014; Chia et al., 2013). An active electronic game intervention may offer an effective avenue for children with DCD to rehearse their motor skills, which may transfer to more efficient running mechanics. This crossover randomised and controlled trial (RCT) aimed to determine whether the intervention altered the running kinematics and kinetics of children at risk of DCD.

Method

Twenty one children (mean age 11.0 \pm 1.0years) determined to be at risk of DCD [scored \leq 16th percentile MABC2 and \leq 15th percentile DCDQ] participated. Three-dimensional motion analysis (Vicon; Oxford, UK) and AMTI force plates (Watertown, USA) were used to collect lower limb kinetics and kinematics during a series of 10meter running trials, performed following a 16 week active games condition and 16 week no games condition. One stride from 4-6 successful trials were analysed. Linear mixed models were used to compare gait parameters following each condition.

Results

The participants ran at the same speed, with the same stride length, stance duration and lower limb kinetics after both the active games and no games conditions. After the active games condition, the participants ran with less hip adduction and greater hip external rotation during both late swing [hip adduction mean difference (MD):4.6°, 95% confidence interval(CI):3.0 to 6.3, $p<0.001$: hip external rotation MD:3.8°, 95%CI:1.7 to 5.9, $p<0.001$], and stance [hip adduction MD:4.1°, 95%CI:1.8 to 6.4, $p<0.001$; hip external rotation MD:3.2°, 95%CI:0.8 to 5.5, $p=0.009$] phases, in comparison to after the no games condition. They also used less ankle eversion (MD:3.4°, 95%CI:1.6 to 5.3, $p<0.001$) in late swing, and greater knee external rotation (MD: 2.6, 95%CI:1.1 to 4.0, $p=0.001$) during stance after the active games intervention.

Conclusions

An active games randomised and controlled intervention successfully altered the running kinematics of children with DCD such that they ran with their lower limb more neutrally aligned in the frontal plane (i.e. less ankle eversion and hip adduction). This was achieved through greater external rotation at the hip and knee. This more neutral alignment might be a more efficient running technique, despite no detected changes to kinetics.

Children with development coordination disorder have normal rate of learning when trained with either a variable and repetitive practice protocol.

Smits-Engelsman B, Bonney E, Jelsma D, Ferguson G

Introduction

Children with DCD have difficulty in learning motor skills, yet under particular conditions they learn at the same rate as typically developing children (TDC). The latter was demonstrated using repetitive learning. Since there are indications that variable learning is superior to repetitive training the question arises whether variable practice leads to better learning and transfer than repetitive training. We examined if the rate of learning was different in these two training protocols. Moreover we tested if transfer effect was different between protocols. Finally the question was asked if children with DCD would benefit more from one of the protocols.

Method

111 children aged 6-10 ($M=8.0$, $SD=1.0$) with no active computer gaming experience were randomly divided in two groups. The first group (Variable, $n=55$) followed a training program with a variable protocol ("Variable", 10 different games) while the second group ("Same", $n=56$) followed a repetitive practice protocol (playing the test game in every session). Half the participants in each group met the criteria for DCD. All subjects experienced 5 weeks of training two times per week, for 20 min. Both protocols aimed at learning dynamic balance and agility skills. Changes in outcome in a test game and in motor test scores were examined pre- and post-training. In addition their rate of learning was calculated over the 5 weeks of intervention.

Results

ANOVA repeated measures indicated that, children submitted to the "Same" protocol outscored the ones in the "Variable" protocol on the test game (Protocol x Training). Importantly, there was no interaction effect between protocol and participant groups (TD and DCD). The rate of learning was comparable between TD and DCD. There was a significant transfer effect to balance tasks (both virtual and real life tasks) but transfer was not better for one of the protocols.

Conclusions

By playing active computer games motor performance, especially balance, gets better, both in TD children and in children with poor motor coordination. Our results confirm that there is transfer of training from video games to untrained tasks. The results do not support the generally held belief that DCD children are less able to learn.

Sensorimotor Training to Affect Balance, Engagement, and Learning for Children with Developmental Coordination Disorder

McCoy S, Hsu L, Price R, Arias L, Jirikowic T, Kartin D

Introduction

Sensorimotor Training to Affect Balance, Engagement and Learning (STABEL) is a novel virtual reality (VR) system designed to improve the ability to use specific sensory information during balance. STABEL combines VR goggles and compliant standing surfaces to control the visual display and support surface during a game involving standing balance. We examined the effects of STABEL on functional balance and motor abilities in children with Developmental Coordination Disorder (DCD).

Method

Four children with DCD, verified by the Diagnostic and Statistical Manual of Mental Disorders- fifth edition, 5 to 12 years old, participated this study. All parents reported obvious concerns with children's motor functions related to daily activities ("Red Zone" in Movement Assessment Battery for Children (MABC) checklist). Three children demonstrated significant limitations in motor and balance control (≤ 5 th percentile in MABC-2nd edition (MABC-2) total motor and balance composites). One child demonstrated some difficulties in motor functions (≤ 25 th percentile in MABC-2 total motor composite). All children were tested pre- and post- STABEL with the MABC-2, (gross and fine motor), and the Pediatric Clinical Test of Sensory Interaction for Balance-2 (P-CTSIB-2), for standing balance under altered sensory conditions. They received 5 sessions (mean total of 286 minutes [sd: 36.7]) of STABEL at home over 1-1.5 months. Within each STABEL session, children moved their bodies, perturbing their balance, to control a virtual character to catch targets and to avoid obstacles while the visual background and stability of the surface were manipulated. Visual (speed of flying targets and obstacles) and support surface (firm versus more compliant foam) conditions during the game were varied within each session.

Results

All children showed increased scores in the total motor and balance scale scores of the MABC-2 and the P-CTSIB total sensory score after STABEL. For the MABC-2 balance composite, three children showed score differences (pre/post STABEL) larger than the minimal detectable change (Minimal Detectable Change [MDC]=1.26), and all four children's score differences met the minimal clinically important difference (Minimal Clinically Important Difference [MCID] = 0.52). On the MABC-2 total motor score, two children had score differences (pre/post STABEL) larger than the MDC (1.21), and also met the MCID (2.36).

Conclusions

The STABEL was acceptable and fun for children with DCD. Preliminary results indicated that children improved their balance and motor skills after STABEL. STABEL may affect sensory integration during standing balance; however further research within larger sample sizes of children with DCD is warranted.

SATURDAY AFTERNOON STREAM C

DCD and Knowledge Translation in Alberta, Canada: A Grassroots Initiative

Schell S, Roth K, Duchow H, Massey D

Introduction

Research alone does not impact health outcomes. Clinicians and the public must be aware of the information, be interested in it, and have an intention of using the new knowledge, leading to a change in behavior (Grol & Winsing, 2004).

Assessment of Barriers

In rural Alberta, Canada, DCD has been under-recognized and under-diagnosed. Children's Rehabilitation Services in our area created a Resource Team in 2012 whose task was to identify the facilitators and barriers to implementation of new research information and international recommendations into practice. Facilitators included a pre-existing organizational infrastructure that promotes a multi-disciplinary approach and supports knowledge dissemination. Barriers included a lack of knowledge about DCD across all rehabilitation disciplines and community service providers, poor early identification, and an overwhelming amount of literature on DCD.

Action

Based on the identified facilitators and barriers, a Knowledge Translation Plan (KTP) was created. The KTP included the development of three clinical reference papers (assessment, co-morbidities, and management), education of rehabilitation professionals across the province as well as local community educators and services providers, and the development and provision of DCD modules to provincial academic institutions. In addition, the diagnostic specialty clinic in our area was expanded to include a standard process of assessment and diagnosis of DCD.

Monitoring of Knowledge Use

To ensure sustained knowledge use, a provincial Community of Practice for professionals has been revitalized, workshops and presentations are provided to community service providers, and DCD information for families is shared through social media. Our DCD Resource Team has become a knowledge broker, connecting clinicians with each other and their communities to exchange knowledge and support implementation into practice.

Evaluation

Effectiveness of the KTP needs to be considered. Rehabilitation professionals in our area have reported increased recognition of possible DCD by educators and there has been an increase in the number of children referred to pediatric specialty clinic querying possible DCD. Formal evaluation of the effectiveness of the Community of Practice is currently being explored.

Conclusion

KTPs connect research with research users, accelerating implementation of knowledge into use. Our presentation will highlight the KTP process initiated by our DCD resource team and its effectiveness in supporting the implementation of DCD best practice by clinicians and service providers in Alberta, Canada.

DCD and Mental Health Outcomes: The Linkages made Clear and the Process Defined

Kamps P

Introduction

DCD is a credible mental health disorder (APA, 2013) that remains under-recognized by health professionals (Rigoli & Piek, 2016) and others (Wilson, Neil, Kamps & Babcock, 2012). It may be that because medical doctors and MHPs do not understand how the early motor delays and motor-learning difficulties associated with DCD are linked to social, academic, emotional and psychological functioning, they dismiss any relationship between these conditions. In addition to the inability of clinicians to make the needed links between DCD and secondary and tertiary outcomes thereof, researchers have been searching for the underlying connections between DCD and co-occurring mental health disorders (Blank, Smits-Engelsman, Polatajko, & Wilson, 2012; Green, Baird & Sugden, 2006).

Method

15 (+) years of action research (Braun & Clarke, 2006) as an educator, kinesiologist and psychologist has resulted in practice informing theory (Bieschke, Fouad, Collins, & Halonen, 2004). In keeping with the goals of the scientist-practitioner model (Dick, 1996), and desiring to support families with understanding about their child's complex journey, this mental health clinician has documented the process underlying early motor problems and eventual mental health concerns. There is a desire to share this information with professional colleagues for their scrutiny and insights.

Results

Based on clinical efforts with over 500 clients and using criteria documented in the DSM-5 (APA, 2013), the links between DCD and other mental health conditions will be revealed. In addition, the underlying process affecting those relationships will be identified. The introduction of this information will finally offer medical and MHPs the needed basis to consider DCD as a serious pre-determining factor for mental health concerns (Rigoli & Piek, 2016). The identified process not only offers insights about the way DCD impacts on other areas of functioning, but may also stimulate future theory development.

Conclusions

Once medical doctors and MHPs are shown how motor difficulties are connected to other mental health conditions, they and others will be in a better position to identify DCD and work to promote knowledge about this often under-identified and mis-understood population (Missiuna, Moll, King, King & Law, 2006).

Reaction to intervention model and motor skills: Transfer from knowledge to practice

Kaiser M

The development of motor skills influences socialization, self-esteem and academic performance during childhood. The socio-educative environment also influences on the development of motor skills, with Developmental Coordination Disorder (DCD) more highly prevalent in disadvantaged environments. We propose a model that focuses on prevention and intervention: the reaction to intervention model. This model includes three levels of intervention: (1) primary intervention, (2) secondary intervention, (3) tertiary intervention. First used in the education field, an adaptation can be done to address the development of motor skills and the difficulties of motor coordination. The primary intervention includes programs that promote motor skills for all the children. The secondary intervention includes intervention with small groups of children at risk to develop a DCD or with mild DCD. The tertiary intervention includes individual specific intervention for children with moderate and severe DCD.

We propose to release a systematic review of the efficacy of programs sustaining the development of motor skills, along with a systematic review of interventions that address motor coordination disorders. We classify these different programs and interventions into the different levels of the reaction to intervention model. We consider their efficacy not only on motor skills and coordination, but also on socialization, self-esteem or academic performance. Finally, we describe the consequences of these results for the development of health policy and practice.

Teaching bike-riding skills in a community setting: Perspectives of trainers and parents

Barnett A, Prunty M

Introduction

Children with DCD struggle to learn the motor skills required for participation in leisure and physical activities. This can negatively impact on their self-esteem, peer relationships and physical health. Riding a bike is a popular activity among children as well as offering a potential source of moderate-intensity activity. Furthermore, children with DCD report a desire to be more physically active and bike-riding is frequently chosen by children as a goal for therapy. Previous research suggests that task-specific intervention delivered by Allied Health Professionals, with intensive scheduling can be effective. The aim of this preliminary study was to describe the content of a community bike-riding course designed for children with movement difficulties and provide a qualitative evaluation from the perspective of trainers and parents.

Method

Nine children with movement difficulties (aged 5-15 years) took part in a community course (2 hours/ day for 5 days) designed to teach bike-riding. Bike-riding skills were rated at the start and end of the course. Semi-structured interviews were conducted with four parents and five trainers. The trainers were two community volunteers, a road safety officer, disability sport officer and a physiotherapist. In the interviews they were asked to describe aspects of teaching and learning on the course. Their views were also sought on the approaches used in the course and outcomes for the children. The interviews were transcribed and subjected to categorical-content analysis.

Results

At the start of the course none of the children could ride a bike but at the end, eight pedalled independently and one could pedal with some adult support. Parents were extremely enthusiastic about the course overall and the progress made by their children. Trainers and parents identified various positive aspects of the course including: the safe environment (sports hall), good interpersonal skills of the trainers, encouragement & praise for achievements, breaking bike-riding down into the constituent parts, and learning in a group setting.

Conclusions

The bike-riding course followed sound principles of motor learning and demonstrated that children with movement difficulties can acquire complex motor skills given an appropriate teaching environment. Specific elements of good practice identified here should be disseminated for application in future courses to allow non-specialists to deliver effective teaching in a community setting to help children with movement difficulties learn to ride a bike.

Participation of Children with Developmental Coordination Disorder

Zwicker J, Ghafooripoor G, Ryan N, Shen J

Introduction

Accumulating evidence has shown that children with developmental coordination disorder (DCD) participate less frequently and in less diverse activities compared to typically-developing children; however, no studies have focused on environmental factors associated with decreased participation in children with DCD. The purpose of this study is to further describe the participation of children with DCD and to identify environmental factors that may influence participation.

Method

A cross-sectional study design will be used. Inclusion criteria include: (1) children 4-12 years; (2) diagnosis of DCD in accordance with the 5th Edition of the Diagnostic and Statistical Manual of Mental Disorder (DSM-5) criteria (APA, 2013) and European Academy of Childhood Disability guidelines (Blank et al., 2012), as assessed by a developmental pediatrician and an occupational therapist; and (3) parents must be able to read and comprehend English to be able to fill out the Participation and Environment Measure-Child and Youth (PEM-CY) (Coster et al., 2013).

We will examine the participation frequency, participation involvement, desire for change, environmental resources, environmental support, and environmental supportiveness experienced by children and families with DCD. These data will be compared to published data on typically-developing children using one-way ANOVAs (corrected for multiple comparisons) and effect sizes. If environmental variables are significantly different for children with DCD, we will explore whether maternal education or the first three digits of postal code (as a proxy for low, middle, and high SES) are associated with lower environmental supportiveness using Pearson's correlational analysis.

Result

A convenience sample of ~ 80 children who meet the inclusion criteria have been recruited through a research-integrated diagnostic DCD clinic. Parents have completed the PEM-CY and data have been entered in a database with their consent and child assent. Data analysis is underway.

Conclusions

This study will describe the participation in children with DCD in different settings - home, school, and community. The outcomes will help us discover what environmental factors influence participation in children with DCD, which in turn will aid us to focus efforts to increase participation in different settings. Our hope is that by identifying the facilitators and barriers to participation of children with DCD that we can begin to address the needs of children with DCD through changes in clinical practice and future research efforts.

Participation in children with Developmental Coordination Disorder

Hsu L, McCoy S

Introduction

Participation in home, school, and community activities is an important indicator for children's health and development. Even though some studies have indicated children with Developmental Coordination Disorder (DCD) might have concerns with participation, there is limited research in this area. The purpose of this study is to describe participation in home, school, and community activities in children with DCD by using the Participation and Environment Measure for Children and Youth (PEM-CY).

Method

Fifteen children with DCD verified by the Diagnostic and Statistical Manual of Mental Disorders-fifth edition (DSM-V) criteria, age from 5 to 12 years, participated this study.

Parents of all children with DCD completed the PEM-CY during the testing session. The PEM-CY measured levels of participation frequency and involvement, environmental support and environmental resources, in each of the following 3 settings: home, school, and community. Repeated measure ANOVAs were used to compare children with DCD's participation among the different settings. Children's scores were also compared with the normative data from test developers.

Results

Children with DCD showed significantly lower frequency ($p < 0.05$) and lower involvement ($p < 0.05$) in the school and community activities compare to home activities. They also demonstrated significantly lower environmental resources support in the school and community compare to at home ($p < 0.05$). There were no significant differences in participation between the community and the school settings. Compared to normative data, children with DCD showed no differences in frequency and involvement in the home activities. They showed lower frequency (school: DCD=3.7, norm=5.0; community: DCD=2.9, norm=4.5) and involvement (school: DCD=2.9, norm=4.3; community: DCD=2.8, norm=4.2) in the school and community activities. The environmental support (home: DCD= 78.5, norm=92.5; school: DCD=75.8, norm=91.4; community: DCD=76.7, norm=93.5) and resources (home: DCD=89.7, norm=90.4; school: DCD=78.8 norm=93.2; community: DCD=81.7, norm=92.3) were lower in all three settings.

Conclusion

Results suggest that children with DCD participated less in important school-related and community activities as compared to home activities. They also had less access to environmental resources in school and community settings compare to the home setting. Furthermore, compared to the norm, children with DCD showed generally less participation and fewer environmental supports in all settings. The PEM-CY can provide detailed information about participation in children. However, more psychometric research needs to be done for children with DCD. Based on comparisons to the norm, therapists should consider focusing on participation in all settings for this population.

Poster Presentations

Behavioural problems in preschool children with developmental coordination disorder

Adachi M, Takayanagi N, Takahashi M, Yasuda S, Yoshida S, Mikami M, Nakai A, Saito M, Nakamura K

Introduction

Children with neurodevelopmental disorders, including Developmental Coordination Disorder (DCD), are known to have an increased risk of peer victimization at school. However, little is known about whether the victimization is also experienced during the preschool years. Even though Kennedy-Behr et al.(2013) reported that 4 years old children with probable DCD (pDCD, Cairney et al.,2012) were significantly more often involved in the victimization as not only an aggressor but a victim than children without DCD, their research did not exclude the influence of other developmental problem (e.g. ASD, ADHD). Therefore, in this study, we examined the independent influence of the DCD traits on peer problems and conduct problem of preschool children.

Method

We recruited 30 clinical subjects diagnosed with only DCD, according diagnostic criteria of DSM-5, and a group of 112 Typically Developing (TD) children without motor impairment or any other neurodevelopmental disorders. All children aged 5 and were born in Japan. Peer problems and conduct problems were measured using the teacher and parents-rated Strength and Difficulties Questionnaire (SDQ-T and SDQ-P). Independent t-tests were conducted to evaluate differences between DCD and TD children.

Results

DCD children's SDQ-T total score were significantly higher compared to those of the TD children ($t(137) = -2.07, p=0.04, d= 0.43$). Among the subscale of SDQ-T, a score of SDQ-T hyperactivity was significantly higher in DCD children ($t(138) = -2.89, p<0.01, d=0.59$). In addition, a score of SDQ-T prosocial was significantly lower in DCD children ($t(138)=3.23, p<0.01, d=0.66$). However, the significant difference was found in neither score of SDQ-T peer problem ($t(139)=-1.55, p=0.12, d=0.32$) and SDQ-T conduct problem($t(139) = -1.08, p=0.28, d=.023$). On the other hand, any significant difference was not found in the score of SDQ-P between both groups.

Conclusions

In this study, no significant difference was found in conduct problems and peer problems between only DCD and TD children. However, the children with DCD were evaluated as more hyper active and less prosocial by teachers. We considered that the result of the study by Kennedy- Behr et al. (2013), which showed the children with DCD were evaluated as more aggressive, might have been the same condition. In addition, the result the difficulties of the children with DCD were found in only teachers' assessment but not in parents' might depend on different viewpoint between teachers and parents, which suggests that coordination problems causes more difficulties in a group than at home.

Psychometric properties of observational screening tools for children with Developmental Coordination Disorder

Asunta P, Viholainen H, Ahonen T, Rintala P

Introduction

Early identification of children with Developmental Coordination Disorder (DCD) is essential. In order to measure movement competence, to use a wider range of test batteries and a multilevel approach for testing in different environments is suggested. An observational, easy to use questionnaire, in the first step screening is warranted. The purpose of this study was to systematically review the literature of observational tools for children with DCD and to examine: (1) what are the most commonly studied questionnaires? (2) are there reliable, valid and feasible tools available?

Method

A systematic review of the literature was conducted to synthesize all the data on observational screening tools for school-aged children (5–12 years) with DCD from five electronic databases. The approved studies meeting our inclusion criteria were analyzed to assess the quality, the strengths and weaknesses, of the measures.

Results

Literature search of electronic databases retrieved 1486 hits. Additional search identified 35 articles and 14 different questionnaires were identified from 13 different countries. There were tools for parents, teachers, children and school nurses. All questionnaires included information on motor competence, general gross motor skills and some also on fine motor skills. None of the questionnaires were valid for population based screening, because of the sensitivity and / or specificity were too low according to criteria (APA, 1985). The most studied tool was a parent questionnaire, the Developmental Coordination Disorder Questionnaire (DCDQ).

Conclusion

There are many challenges in using initial screening tools to identify children with DCD. From the perspective of health care the screening should be as precise as possible whereas in school environment high sensitivity is sufficient. There is no accepted “gold standard” for motor skill testing, which may explain the low concurrent and predictive validity results between tests and observational tools, albeit they are measuring different aspects of motor function. A majority of the questionnaires would also require more accurate reliability studies. Notwithstanding the limitations, there are many promising questionnaires under development. Those can be recommended to provide information on functional skills and limitations across a variety of tasks and settings in daily living, at home or at school.

The assessment of motor competence in adults with DCD: relationships between different tools

Barnett A, Law C, Wilmut K

Introduction

It is well established that DCD often persists into adolescence and adulthood, continuing to have a negative impact on everyday life skills, education and employment. For children, there is consensus on the recommended assessment instruments to assess motor competence to help identify DCD and plan appropriate support for individuals. For adults, however, there are few tools available for use in the UK and each has limitations. Of the two most popular performance tests, the Movement ABC-2 (MABC-2) Test has UK norms, but these only extend to the age of 16; the 2nd Edition Bruininks-Oseretsky Test (BOT-2) has norms up to 21 years but these are from the USA and their applicability to other countries is unknown. The Adult DCD Checklist (ADC) is a self-report questionnaire developed in the UK but includes items beyond the domain of motor skill. The aim of this study was to examine the relationship between scores on these three assessment tools in a group of young adults who met the criteria for DCD in childhood and continue to report significant motor difficulties.

Method

25 individuals aged 18 to 32 took part, all having reported current motor problems and significant motor difficulties in childhood, consistent with DCD. A developmental, educational and medical history was also taken. Participants were assessed with the MABC-2 and BOT-2 Brief Tests plus the ADC. Relationships and agreement between the total test scores and their sub-components were examined.

Results

There was a significant positive correlation between MABC-2 and BOT-2 Brief percentile scores ($r=.84$, $p<.001$) and when scores were categorised as above or below the 5th percentile the Kappa coefficient was .81. There were also significant correlations between the ADC and the BOT-2 Brief (-.76) and the ADC and MABC-2 (-.72). When ADC scores were categorised as 'probable DCD' or not and compared with the test categorisations above and below the 5th percentile, the Kappa coefficient was .35 with MABC-2 and .37 with BOT-2 Brief. Relationships between similar sub-components of the tests were variable.

Conclusions

General agreement between the MABC-2 and BOT-2 scores suggest that they measure similar aspects of performance, while the ADC seems to identify different individuals. Further work is needed to develop tests and questionnaires for adults, focusing specifically on motor control and coordination, with country relevant and age-appropriate norms.

Sleep and family function in adolescents with and without Developmental Coordination Disorder

Barnett A, Sparrowhawk M, Wiggs L

Introduction

Children and adolescents with DCD often underachieve academically and have higher rates of socio-behavioural problems than their typically developing peers. Such factors are known to be associated with sleep problems in other clinical populations but the sleep of children with DCD has received little attention. The two studies which have looked at sleep found that i) parents of children with DCD reported significantly greater sleep disturbance in their child compared to healthy controls and ii) that secondary (but not primary) aged children with DCD had impaired objective sleep quality and differences in the timing of sleep compared to controls (including some differences in the variation between weekday and weekend sleep times). The aim of the current study was to examine links between the sleep of secondary school children with DCD and various aspects of child and parent functioning.

Method

Fifteen secondary school adolescents (11-16 years) with DCD, plus matched controls, participated in the study. Sleep-wake patterns were measured over one week (weekdays/ weekend) using actigraphy. Aspects of child functioning were assessed using Harter's Self-Perception Scale for Children and the parent version of the Strength & Difficulties Questionnaire (SDQ). Teachers were asked to rate key aspects of classroom behaviour and achievement. Aspects of parent functioning were assessed using the Epworth Sleepiness Scale (ESS) and the General Health Questionnaire (GHQ).

Results

The DCD group had significantly lower self-perceived social and athletic competence compared to controls. Parents in the DCD group rated their child as having significantly more socio-behavioural problems compared to parents of controls. Teacher ratings and scores on the ESS and GHQ were no different for the two groups of adolescents and their parents. Across the groups of young people, correlations between key objective sleep parameters and aspects of child and parent functioning revealed significant relationships between the SDQ total score and sleep percentage and wake episodes. Aspects of the adolescents' self-perception (social and athletic competence and global self-worth) were also related to sleep percentage, wake episodes and the time that the adolescents woke up. Parent functioning (GHQ) and adolescent sleep start time were also significantly related.

Conclusion

Whilst the direction of the links between some aspects of sleep disturbances and daytime functioning of the adolescent and parent cannot be determined, these results suggest that sleep in adolescence with DCD is an area of importance for future study.

Exploring the internal modelling deficit hypothesis in children with and without Developmental Coordination Disorder: Study Protocol

Bhoyroo R, Wigley C, Hands B

Introduction

At present, little is known about the aetiology of DCD. Researchers have hypothesised that a deficit in the internal model may contribute to the motor impairments associated with DCD. To date, research has focused on the forward model as the likely cause of DCD motor deficits using motor imagery (MI) and motor planning (MP) tasks. However, given the nature of MP tasks it is also possible that they reflect inefficiency in inverse modelling rather than the forward model. This carries important implications for DCD research: if the inverse model is incomplete or slow in actualising, then the extent to which the forward model can generate a predictive pathway would also be incomplete leading to observed failure. So far, no studies have examined whether children with DCD experience a deficit in generating internal models in the inverse model, forward model or both.

Method

Three studies, two behavioural and one neuroimaging, will be conducted. Forty male children 8-11 years old with (n = 20) and without (n = 20) DCD will be recruited.

Study 1 will test the MI ability in children with and without DCD on four MI tasks. Using the same group,

Study 2 will test their MP ability on four MP tasks carried out with and without instructions. Both studies will focus on group differences and investigate how they conform to current theories for internal action modelling.

Study 3 is an fMRI study testing ten participants randomly chosen from each group from the initial recruitment. One task from each study that best identifies the deficit in DCD will be used. The study aims to determine whether children with DCD show atypical brain activations during the forward and/or inverse modelling of motor plans compared to children without DCD. The link between MI and MP using brain activations and connectivity patterns in specific brain regions will also be explored.

Contribution

This study seeks to identify if deficits exist in the inverse model, forward model or both in children with DCD. The scarcity of neuroimaging research in DCD strongly suggests that examining the functioning of brain regions related to MI and MP abilities of this population will contribute to our understanding of its aetiology.

Role of environment in motor development: Influences of maternal psychological status on infant motor development

Biancotto M, Zoia S, Simonelli A, Piallini G

Introduction

An unavoidable reciprocal influence characterizes mother-infant's dyad and the development of motor skills is initially born on within this environment. Within this relationship, the presence of depression, somatization, hostility, paranoid ideation and interpersonal sensitivity symptoms at a subclinical level and their possible input on infant motor competences has not been yet considered. Bearing in mind that motor abilities represent not only an indicator of the infant's health-status, but also the principal field to infer his/her needs, feelings and intentions, in this study the quality of infants' movements were assessed and analyzed in relationship with the maternal attitudes. The aim of this research was to investigate if/how maternal symptomatology may lead infant's motor development during his/her first year of life by observing the characteristics of motor development in infants aged 0-11 months.

Method

Participants included 123 mothers and their infants (0-11months-old).

Mothers' symptomatology was screened with Symptom Checklist-90-Revised (SCL-90-R), while infants were tested with Peabody Developmental Motor Scale-2nd Edition (PDMS-2).

All dyads belonged to a non-clinical population, however, on the basis of SCL-90-R scores, mothers' sample was divided into two groups: normative and subclinical.

Results

Correlational and regression models analysis for PDMS-2 scores and SCL-90-R were calculated. Both positive and negative correlations were found between maternal perceived symptomatology, Somatization (SOM), Interpersonal Sensitivity (IS), Depression (DEP), Hostility (HOS) and Paranoid Ideation (PAR) and infants' motor abilities. These results were then further verified by applying regression models to predict the infant's motor outcomes on the basis of babies' age and maternal status.

The presence of positive symptoms in SCL-90-R questionnaire (subclinical group) predicted good visual-motor integration and stationary competences in the babies. In particular, depressive and hostility feelings in mothers seemed to induce an infant motor behavior characterized by a major control of the environmental space. When mothers perceived a higher level of hostility and somatization their babies showed difficulties in sharing action space, like required in the development of stationary positions and grasping objects abilities. In a completely different way, when infants can rely on a mother with low-perceived symptoms (normative group) his/her motor performances develop with more degree of freedom/independence.

Conclusion

These findings suggest, for the first time, that even in a non-clinical sample, mother's perceived-symptoms can produce important consequences not in infant motor development as a whole, but in some specific areas, contributing in shaping the infant motor ability and his/her capability to act in the world.

Structural neuroimaging in DCD with or without Dyslexia: A contribution to differential diagnosis

Biotteau M, Albaret J, Chaix Y

Introduction

About 40 to 60% of DCD subjects suffer from dyslexia. Our team project is therefore to compare neural characteristics of three populations (DD, DCD and DD+DCD), to investigate the profiles of children with co-occurrence to try to understand the reasons of such an association. The functional neuroimaging (Biotteau et al., 2016) and the cortical thickness investigation (Biotteau, submitted) have already been conducted and have shown significant differences between children with pure DCD and children with DD+DCD. The aim of the current study was now to compare the volumes of subcortical brain structures between the same three groups: children with DCD only, DD only or both DD and DCD.

Method

A group of 65 children (21♀-44♂) were recruited: 19 DD (8♀-11♂), 16 DCD (4♀-12♂) and 20 DD+DCD (6♀-14♂). Inclusion criteria were: 8 to 12 years old, with DCD or DD or DCD and DD, no known psychiatric or neurological disorder and an IQ score greater than 70. Diagnosis DD and DCD were in accordance with the DSM-IV-TR criteria with M-ABC test for motor skills and L'Alouette and ODEDYS-2 test for reading skills. Children with Specific Language Impairment and/or Attention Deficit/Hyperactivity Disorder according to the DSM-IV-TR criteria were excluded. Participants were submitted to the same evaluation, comprising an assessment of cognitive functions (WISC-IV, CBCL, CPTII), a procedural learning task and a functional and structural brain imaging (fMRI and sMRI).

All participants were subjected to T1-weighted structural magnetic resonance imaging. We used an automated procedure to analyze differences in subcortical volume between the three groups for Caudate, Putamen, Thalamus, nucleus accumbens, amygdala and hippocampus.

Results

Analyses are in progress.

Conclusion

We previously demonstrated fundamental structural and functional differences between DCD and both DD groups, especially in anterior cingulate cortex. Such results raise the question about the status of the comorbid group, which behaves like the DD group but not as the DCD group. We expect volumetric differences between children with pure DCD on the one hand and children with DD+DCD and DD alone on the other part.

Physical Fitness and Motor Competence in Adolescents with and without overweight

Bonney E, Smits-Engelsman B

Introduction

Overweight and obesity are increasingly becoming a global health issue. In 2009, the World Health Organization (WHO) estimated 10% of the school-aged children worldwide to be either overweight or obese. The prevalence of overweight (6.9 % for boys and 24.5% for girls) and obesity (2.2% for boys and 5.3% for girls) in South African adolescents is among the highest in Africa.

Overweight and obesity are the result of energy imbalance. 73.3% of South African girls aged 13- to 15-years have low physical activity (PA) level, boys are more physically active than girls. Lack of PA in children and adolescents is considered as a determinant of poor PA patterns in adulthood. Importantly in South Africa, fatness in girls is misconstrued as a sign of happiness, beauty, health and being wealthy. Children with lower levels of motor skills as in DCD are extra at risk for obesity and its secondary consequences. Moreover, studies on PA and motor competence in this age group are lacking, particularly within the African context.

Method

In this study, we questioned 258 adolescents between 13-15 year of age in the Cape Town area about their level of PA and perception of their motor skill level, and measured their BMI.

Results

63% thought of themselves as skilled, 33 % as less skilled and 5% as uncoordinated. The median number of days with 30 minutes of PA was 3. Interestingly, 98 and 96% indicated their willingness to be more active and more skilled, respectively. The mean BMI was 21kg/m² (range 12-41; 8% of the boys and 36% of the girls \geq 23kg/m²). After an interval of 2 weeks, 150 girls were tested on physical fitness and motor coordination and filled out the CSAPPA. We determined relationships between PA, motor competence (MABC-2, BOT-Running and Agility), physical fitness (strength, aerobic and anaerobic capacity) and BMI.

Conclusion

Results will be described and discussed in light of increasing inactivity patterns in youth and the impact on motor skill exploration and learning opportunities, and secondary health issues.

Comparison of health-related quality of life scores in children with Developmental Coordination Disorder (DCD)

Caçola P, Killian M

Introduction

Quality of life is a construct of general well-being. Evidence suggests that health-related quality of life of children with Developmental Coordination Disorder (DCD) is relatively low. The purpose of this study was to address quality of life of children diagnosed with DCD or Dyspraxia as perceived by their parents.

Method

Parents were recruited via the Dyspraxia/DCD Foundations around the world. An online survey with the scales PedsQL and Kidscreen was sent and posted to potential participants. Both scales are designed to measure health-related quality of life in healthy children and adolescents and those with acute and chronic health conditions. Parent scales of the PedsQL (Ages 5-7, 8-12, and 13-18) and the Kidscreen (Ages 8-18) instruments were used. 188 participants completed the PedsQL and 139 completed the Kidscreen.

Results

Scores on the Kidscreen were statistically below population average scores. Parents reported scores significantly lower than 50 on each subscale (physical, psychological, parental relationship, social support and peers, school) with 50 being a population or community sample average. These parents reported significant problems on average for their children. The PedsQL also showed significantly lower scores than a community sample of children, and even lower than a group of chronically ill children. Again, parents reported major deficits in their children's quality of life according to the PedsQL Total Score ($M = 45.75 \pm 16.01$), Psychosocial Health Summary Score ($M = 44.63 \pm 16.17$), and PedsQL Physical Health Summary Score ($M = 47.86 \pm 21.43$). To further support the results, subscales from PedsQL significantly and strongly correlated with expected subscales from the Kidscreen (e.g., Physical Functioning in the PedsQL was correlated with the Physical Wellbeing subscale of the Kidscreen at $r = .534, p < .001$).

Conclusions

We conclude that DCD significantly affects health-related quality of life, reinforcing previous evidence that showed similar results. Health-related quality of life for the children and the psychosocial impact on the family are important outcomes that have received little attention in the field. Parents' responses on open-ended questions provided insight into their experience of the impact of DCD on the health-related quality of life on the child and family. Measurement of quality of life, both in the children and the family as a whole, and its domains can give a more complete picture of day-to-day functioning of a child with DCD, and its evaluation has proven to be necessary in design and evaluation outcomes of intervention programs.

Multidimensional profiles of children referred to a motor skill intervention program

Caçola P, Cors E

Introduction

Motor difficulties may be an underlying problem for a host of physical, social and academic difficulties. The purpose of this study was to analyze the profiles of children screened for a motor skill intervention program and identify subgroups that have similar characteristics.

Method

Fifty-three children (44 males) between the ages of 4 and 16 years were tested for motor ability, cognitive ability, visual-motor integration, perceived difficulties, anxiety, and strengths and difficulties. The tests used to evaluate the subjects included the Movement Assessment Battery for Children – 2nd edition (MABC-2), Kaufman Brief Intelligence Test - 2nd edition (KBIT-2), Beery-Buktenica Developmental Test of Visual-Motor Integration - 6th edition (Beery-VMI-6) while the parents of the subjects completed the Developmental Coordination Disorder Questionnaire (DCD-Q), Screen for Child Anxiety Related Disorders (SCARED), and the Strengths & Difficulties Questionnaire (SDQ).

Results

Most children (73%) scored below or at the 5th on the MABC-2, indicating severe motor difficulties, with 65% scoring in the 5th percentile or below for balance, 46% for aiming and catching, and 60% for manual dexterity. Over 50% had low scores on the Motor Coordination category of the VMI test (less than the 5th percentile) but most children showed normal levels of Visual Perception. On the other hand, most of them had average or higher intelligence on the KBIT-2 (81%). According to parents, 75% of the children could be considered as “suspect” for DCD. About 30% of subjects were reported as having high or very high psychological difficulties, with 85% showing high emotional difficulties, 88% showing high conduct problems, 67% showing signs of hyperactivity, 73% peer problems, and 28% social issues. In addition, about 30% of parents reported high levels of anxiety in their children.

Conclusions

Overall, the results indicate that these children represent a varied sample of characteristics in children diagnosed with motor difficulties. Most children had average or higher IQs, indicating that motor difficulties, and not intelligence, are at the core of their problems. These results also suggest psychological difficulties may be a consequence of the motor impairments. We recommend that testing of all domains is performed with this population, and that intervention programs focus on motor skill improvement as well as on emotional, behavioural, and social problems.

Exploring probable-DCD in a sample of children with autism spectrum disorder

Cairney J, Bremer E

Introduction

Many children with autism spectrum disorder (ASD) experience significant motor coordination problems in addition to their challenges with social skills, communication, and restrictive behaviours. In the DSM-5, children with ASD can receive a dual diagnosis of DCD (APA, 2013). The purpose of this presentation is to explore the presence of probable DCD (p-DCD) in a sample of 7-12 year old children with ASD. The relationship between the participant's motor coordination and nonverbal IQ (NVIQ) will also be explored.

Method

Data collection for this study is ongoing. Participants visited the INCH Lab for a familiarization visit approximately one week before their motor coordination and NVIQ assessment. Motor coordination was assessed with the Movement Assessment Battery for Children, 2nd Edition (MABC-2) and NVIQ was assessed with the Leiter International Performance Scale, 3rd Edition (Leiter-3). Participants later revisited the Lab on two additional occasions to complete a battery of fitness assessments as part of a larger study. Descriptive characteristics were calculated for MABC-2 and Leiter-3 test scores. Correlation analyses were used to examine the association between motor coordination and NVIQ.

Results

Eight participants (n=7 males) have completed the MABC-2 and Leiter-3. The average age of the participants is 9 years, 3 months. NVIQ scores range from 75 to 121 (MNVIQ = 105.5, SD = 13.8). Participants' mean percentile score on the MABC-2 Manual Dexterity domain was 4.1% (SD = 4.1; range = 0.5-9). The mean MABC-2 Aiming & Catching percentile score was 17.2% (SD = 21.8; range = 0.5-50) and the mean Balance percentile score was 12.8% (SD = 21.0; range = 0.1-63). The mean Total Test percentile score on the MABC-2 was 4.6% (SD = 6.0; range = 0.1-16). Results of the correlation analyses indicated that NVIQ was not significantly correlated with any of the three MABC-2 domain percentile scores or the Total Test percentile score ($r=.297$, $p=.475$).

Discussion

Preliminary results of this study indicate that all children included in the sample would be considered as having p-DCD based on their MABC-2 scores falling below the 16th percentile. As none of the participants scored in a range consistent with intellectual disability, and given the NVIQ was not related to MABC-2 scores, we conclude that participants' motor ability are not related to an intellectual disability or an inability to understand instructions for the motor tasks. Future research is needed to further explore the presence and implications of DCD in children with ASD.

The age-related validity and reliability of the Dutch version of the Little Developmental Coordination Disorder Questionnaire (Little DCDQ-NL)

Cantell M, Houwen S, Schoemaker M

Introduction

The aim of this study was to investigate the psychometric properties of the Dutch version of the Little Developmental Coordination Disorder Questionnaire (Little DCDQ-NL) in 3 to 5 year old children. It is originally developed as a proxy to measure early movement skills of 3 to 4 year old children (Rihtman, Wilson, & Parush, 2011).

Method

A convenience sample of 249 preschool aged children (82 three year olds, 89 four year olds, 78 five year olds) was recruited in the North of the Netherlands. The parents filled out the Little DCDQ-NL, and the children were tested with the Movement ABC2-NL (M-ABC2-NL; Henderson, Sugden, Barnett, & Smits-Engelsman, 2010). The internal consistency of the 15 items of the Little DCDQ-NL was determined by Cronbach's alpha. Construct validity was investigated in the total group using factor analysis. Concurrent validity was calculated separately for the three age groups by correlating the total scores of the Little DCDQ-NL and the M-ABC2-NL. Receiver Operating Characteristic (ROC) was used to examine sensitivity and specificity. The discriminant validity was determined by ANOVA to differentiate between children with age typical (TD) and at risk motor development (<16th percentile in the M-ABC2).

Results

The internal consistency of the Little DCDQ-NL was .904. The factor analysis resulted in a three factor solution explaining 63.3% of the variation; Factor I Fine motor skills, Factor II Locomotor skills and Factor III Ball skills. The Little DCDQ-NL had a moderate correlation with the M-ABC2-NL in the total group ($r = .319^*$), and of the age groups the correlation was highest in the five year olds ($p = .632^{**}$) and non-significant in the three year olds ($p = .121$). If sensitivity is kept at 80%, specificity is 24% for age three, 46% for age four and 59% for age five. The Little DCDQ-NL showed a significantly lower score ($p < .001$) in the at-risk group than the TD group.

Conclusions

Three of our findings support the psychometric qualities of the Little DCDQ-NL; i.e., it has high internal consistency, clear factor structure and it discriminates between the TD and at risk motor development groups. However, the correlation with the M-ABC2-NL, as well as the specificity, was variable and age dependent. This developmental trend suggests that in motor screening before the of age five, other variables such as child's attention, motivation, and parents' ability to observe a young child, need to be taken into account.

Validation of the Adolescent Motor Competence Questionnaire (AMCQ) in regional Victoria

Cantell M, McIntye F, Hands B, **Plumb M**, Timler A, Crawford S

Introduction

Poor motor skill development is an increasing issue for children in our local communities and recent research suggest that up to 10% of children have fundamental motor skills (FMS) below that expected for their age. In 2012, almost 20% of Ballarat children starting school were considered developmentally vulnerable in at least one of the five areas tested: physical health (FMS), social competence, emotional maturity, language skills and communication skills. Poor motor skill development is not simply that a child is bad at sport, but has a number of negative consequences across a range of areas, these include school work, self-esteem, long-term health, behaviour and peer relationships. Research shows that these difficulties continue into adolescence for 50-70% of these children, and many of these children are never diagnosed. So timely identification of motor difficulties before adulthood is crucial if we are to minimise these negative consequences.

To date there have been no valid and reliable self-report measures to identify level of motor competence and suspected motor difficulties (SMD) among 12-18 year old adolescents. However, the recent development of the Adolescent Motor Competence Questionnaire (AMCQ) has addressed this shortfall.

Developed at the University of Notre Dame, the AMCQ is a self-report questionnaire to assist on identifying adolescents with SMD. The AMCQ is aimed to accommodate the ages of 12 – 18 years. The questionnaire uses a 4-point response format of Never (1), Sometimes (2), Frequently (3), and Always (4). It includes items on functional and common motor skills and includes activities of daily living. The 26-item questionnaire was informed by the diagnostic criteria of A and B as outlined by DSM-5. The criteria of C and D (intellectual disabilities or visual impairments) could not be addressed within the development of the AMCQ. Therefore, the AMCQ is only a self-report questionnaire used to identify adolescents with SMD. To receive a diagnosis of DCD, further assessments would need to be completed.

Method

As part of the ongoing validation and cultural adaptation the current study is validating the AMCQ in regional Victoria with a minimum of 300 representative adults.

Results

The results for regional Victoria will be presented at DCD12.

Performance of Children on the Little DCDQ-US as a function of group (typical and motor concerns) and ASD status

Cermak S, Jozkowski A, Tran C, Turnbull C

Introduction

Recently, there has been an increased emphasis on the importance of early identification of motor impairments in order to provide early intervention and prevent the cycle of reduced coordination, reduced fitness, decreased physical activity and increased sedentary behavior, increased obesity, and poor self-efficacy. Further, investigators have emphasized the need for “early and often” assessments of motor functions because of their link with executive function and emotional control. Others have underscored the importance of motor skills for physical and emotional health, as well as in cognition and language. Thus, given the critical importance of motor performance and its relationship to health, early identification of motor impairment is essential. As part of an international collaboration, this study examined the ability of a parent-report screening tool, the Little Developmental Coordination Disorder Questionnaire-United States (LDCDQ-US), to identify young children at risk for motor impairments.

Method and Results

The LDCDQ is a 15-item tool with three domains (Control during movement, Fine motor, and General coordination), each with five items. Phase 1 examined the tests ability to discriminate between children with and without risk for motor impairment; Phase 2 examined whether children with motor concerns with and without ASD scored differently from each other.

In Phase 1, 245 parents of 3-4 year old children (145 typical, 100 with motor concerns) completed the LDCDQ-US questionnaire. Between-group differences on the Total score and the three domain scores were significant with parents of children with motor concerns reporting more impairment. All individual items significantly differed between groups, with the Motor concerns group scoring more poorly.

Phase 2 divided children in the Motor concerns group into those with known or suspected ASD (n=34) or without ASD (n=55). There were no between group differences on the Total Score but both motor concerns groups (with and without ASD) scored significantly more poorly than the group with typical development. There were significant differences between ASD and non-ASD participants in the Motor concerns group on the Fine Motor and the General Coordination domain scores with ASD participants scoring lower than non-ASD participants.

Conclusion

Results provide preliminary support for the validity of the LDCDQ-US as a screening tool to identify children with motor impairments.

Verbal cues improve the retention of procedural learning in Developmental Coordination Disorder

Chaix Y, Jucla M, Maziero S, Biotteau M, Albaret J, Tallet J, **Blais M**

Introduction

The aim of this study is twofold: (1) to compare the general and specific procedural learning and retention in children with neurodevelopmental disorders: Developmental Coordination Disorder (DCD), developmental dyslexia (DD), comorbid DCD+DD or Neurofibromatosis type 1 (NF1) compared to a typically developing (TD) children and (2) to explore the effect of verbal cues to improve procedural learning and its retention.

Method

68 right-handed children (8.87 ± 1.21 yo; 12 DCD, 16 DD, 11 DCD+DD, 13 NF1 and 15 TD) performed a bimanual Serial Reaction Time Task in three conditions: (1) Visuo-spatial which corresponds to responses to one of four squares horizontally aligned, (2) Visuo-spatial+Verbal corresponding to four letters (A, B, C and D) horizontally aligned, and (3) Verbal corresponding to one letter (A, B, C or D) appearing at the center of the screen. A Group \times Condition \times Bloc (B1 to B4) ANOVA was performed on the RT to test the general learning. For each condition and each group, t-tests were carried out between B4 (repeated sequence) and B5 (random sequence) to test the specific learning and between B5 (random sequence) and B6 (repeated sequence) to test the retention ($p < 0.05$).

Results

For the general learning, whatever the Group and the Bloc, RT was higher for Verbal condition compared to the other two. Whatever the group and the condition, RT decreased between B1 and B4. For the specific learning, RT increased between B4 and B5 in TD for Verbal and Visuo-spatial conditions, in DD for Visuo-spatial and Visuo-spatial+Verbal conditions, in DCD+DD and NF1 for Verbal and Visuo-spatial+Verbal conditions. Only the DCD group did not present significant increase of RT. For the retention, RT decreased between B5 and B6 for the three conditions in TD, for Verbal and Visuo-spatial+Verbal conditions in DCD, for Visuo-spatial and Visuo-spatial+Verbal in DD, for Visuo-spatial+Verbal condition in DCD+DD and NF1.

Conclusion

Results revealed that all groups presented intact general learning abilities. DCD children presented a specific learning deficit in all conditions. However, they presented a preserved retention with verbal cues. DD children benefited from visuo-spatial cues for both specific learning and retention. DCD+DD and NF1 children benefited from the verbal cues for specific learning and need both verbal and visuo-spatial cues for retention. All in all, these results indicate that each neurodevelopmental disorder are able to improve performance with practice of procedural skills but need specific cues to improve the retention of procedural learning.

Level of agreement between the MABC-2 and BOT-2 to identify learners with DCD: The NW-CHILD study

Coetzee D

Introduction

A crucial area for development in children is motor development, as it forms the basis for learning. Developmental Coordination Disorder (DCD) is a motor impairment that hampers the functional and scholastic capabilities of children. However, no golden standard has been established for evaluating learners with DCD. Two test batteries are currently used to assess children for DCD: the Movement Assessment Battery for Children Second Edition (MABC-2) and the Bruininks-Oseretsky Test of Motor Proficiency Second Edition (BOT-2).

The aim of this study was to determine the level of agreement between the MABC-2 and BOT-2 to effectively identifying learners with DCD/motor delays, between 10 and 11 years of age.

Method

This study was based on a cross-sectional cohort design forming part of a stratified and randomized longitudinal study design (NW-Child Health, Integrated with Learning and Development) covering a period of six years (2010-2016). Two hundred and eighteen participants were selected from the Zeerust district in the North West Province of South Africa. The mean age for this group was 10.05 ± 0.41 years. The MABC-2 and the BOT-2 SF were used to identify learners with DCD, by assessing their movement skills.

Results

MABC-2 and BOT-2 SF scores agreed in 185 children (84.86%). A total of 10 learners were identified with possible motor delays. 175 Learners had no motor delays. Tests resulted in differential classifications for a further 33 children (15.14%). A Kappa value of 0.333 with a confidence interval of 95% (0.17-0.5) was found.

Conclusion

The MABC-2 and BOT-2 SF showed a fair level of agreement regarding the sub-sections and total scores. This corresponds with research which indicated that there is a reasonable degree of sensitivity between the MABC-2 and BOT-2 to identify learners with motor delays. This study also found that the MABC-2 identified more children with possible DCD compared with the BOT-2. There is limited research with regard to these two assessment batteries and further investigation should be conducted with a larger and more diverse population.

Persisting motor imagery problems in adults with DCD: Evidence from a mental rotation study

Deconinck F

Introduction

It is now generally accepted that the motor problems of children with DCD persist into adulthood, yet, there is a dearth of knowledge on the nature of these problems. A pertinent question in this respect is whether the fundamental motor control issues demonstrated by children with DCD are still evident at adult age. One of these issues pertains to the inability to engage internal representations of actions, as evidenced by the inability to use motor imagery. In the current study we investigated the capacity to use motor imagery in adults with DCD.

Method

Twelve young adults, 18-25 years of age, who were diagnosed with DCD at young age and twelve adults without motor problems participated in this study. A mental rotation task was used to determine motor imagery in both samples. This task required participants to judge the laterality of a hand shown on a computer display as quickly and as accurately as possible. Pictures of right or left hands, with palm or back view, were presented randomly in increments of 60 degrees between 0 (normal view, with fingers pointing upwards) and 360 degrees.

Results

In both groups the response times were affected by the rotation of the stimulus, with larger response times for larger deviations from the normal position (0 degrees). Also, the responses appeared to be influenced by a biomechanical constraint, as internal rotations led to smaller response times than external rotations. The accuracy of the judgements approached 100% in both groups, but the individuals with DCD were significantly slower than their counterparts.

Conclusions

These findings indicate that adults with DCD do rely upon a motor imagery strategy to solve this laterality judgement task. Yet, their slower responses indicate that they are still less efficient than adults without DCD. The implication is that adults with DCD continue to show an internal modelling deficit, and, therefore, they may benefit motor imagery treatment.

The impact of the animal fun program in the execution of fundamental movement skills

De Oliveira J, Rigoli D, Kane R, McLaren S, Straker L, Dender A, Rooney R, Piek J

Introduction

The Animal Fun program, a universal early intervention program that aims to promote the motor skills and social-emotional development of young children, has shown to improve overall motor proficiency and social and behavioural outcomes. The aim of the current study was to evaluate the program's impact on children's fundamental movement skills (FMS).

Method

A total sample of 511 children (257 boys and 254 girls), aged 4 to 6 years presented at pre-test. Children's FMS were tested across three time points, pre-test, post intervention (six months later) and follow-up (18 months after pre-test), using the Movement Assessment Battery for Children-2 Aiming and Catching, and Balance tasks. The study also tested for potential moderators including pre-test motor proficiency, age, gender, and cognitive performance.

Results

Participation in Animal Fun improved children's one leg balance at post-test and follow-up compared to control children, regardless of pre-test motor ability, age, gender, or pre-test cognitive performance. Participation in Animal Fun also improved throwing skills for those children with poorer motor proficiency compared to the controls with poorer motor performance. Interestingly, it was found that the control group's catching skills improved more than the intervention group in their first year of school. Results also suggested no significant intervention effect for walking with heels raised and jumping tasks, however, an inspection of these scores revealed minimal variance in performance across all children for these tasks as a result of a possible ceiling effect.

Conclusions

The study provides some promising results regarding the efficacy of the Animal Fun program in improving one-leg balance and throwing skills, while also suggesting potential confounding factors, including measurement issues for some MABC-2 tasks.

Using a Tower of Hanoi paradigm to investigate prefrontal cortex activity: Feasibility for developmental coordination disorder research

Getchell N, Liang L

Introduction

Despite years of research, underlying mechanisms of Developmental Coordination Disorder are still unclear. Identifying the role of the prefrontal cortex (PFC) and other brain structures in DCD has potential to advance both identification and intervention. If motor issues arise from atypical PFC activity, this suggests motor planning and executive function are central to movement dysfunction. Alternatively, issues may occur due to difficulty in execution rather than planning movement, implicating different brain structures. In our research, we use near infrared spectroscopy to compare oxygenation of the prefrontal cortex in Tower of Hanoi disc stacking tasks with varied motor and/or cognitive difficulty. In a series of two experiments, we examined typically developing adults to determine the feasibility of using this protocol to detect oxygenation differences in PFC in children with DCD.

Method

In both experiments, cerebral blood flow of the PFC was measured using fNIRs. Four biomarkers (Δ oxy-Hb, Δ deoxy-Hb, Δ oxy, Δ HbT) were measured and statistically compared. The first experiment was designed to compare cerebral blood flow in adults during conditions with similar motor planning and different executive function requirements: Tapping (low EF) and TOH (high EF). 16 adult participants performed the tasks for two minutes each on an iPad. The second experiment was designed to compare cerebral blood flow in adults in computer (high EF/low MP) and manual (high EF/high MP) versions of the TOH task. 10 adult participants performed the tasks for two minutes each.

Results

Experiment I. Significant regional differences within the PFC existed between TOH and tapping, with TOH showing significantly more bilateral activation of the dorsolateral prefrontal cortex (DLPFC; $p < .001$). In addition, two biomarkers (Δ oxy and Δ oxy-Hb) were more sensitive to blood flow changes. Experiment II. No significant differences existed on behavioral measures between conditions, indicating identical EF requirements. A Chi-square analysis of Δ oxy-Hb indicated a significant difference between the conditions ($p < .05$), with manual showing greater oxygenation than computer. Because the puzzles were matched for EF, the additional PFC activity seen in the manual puzzles may represent activation required for motor planning.

Conclusions

In both experiments, we were able to detect differences in amount and focal points of PFC activation in the different TOH conditions. We found Δ oxy and Δ oxy-Hb to be the most sensitive of the biomarkers. These findings suggest that this experimental paradigm is feasible for use in populations with DCD; such studies are ongoing in our laboratory at this time.

Breastfeeding and Motor Development: A Longitudinal Cohort Study

Grace T, Hands B, Bulsara M, Oddy W

Introduction

The relationship between duration of breastfeeding and motor development outcomes at 10, 14, and 17 years were examined. We hypothesized that offspring who were breastfed for 6 months or longer would have better outcomes.

Method

Data were obtained from the Western Australian Pregnancy (Raine) Study. There were 2868 live births recorded and children were examined for motor proficiency at 10 (M = 10.54, SD = 2.27), 14 (M = 14.02, SD = 2.33) and 17 (M = 16.99, SD = 2.97) years using the McCarron Assessment of Neuromuscular Development (MAND). Using linear mixed models, adjusted for covariates known to affect motor development, the influence of breastfeeding for <6 months and ≥ 6 months on motor development outcomes was examined.

Results

Breastfeeding for ≥ 6 months was positively associated with improved motor development outcomes at 10, 14 and 17 years of age ($p = 0.019$, $\beta 1.38$) when adjusted for child's sex, maternal age, alcohol intake, family income, hypertensive status, gestational stress and mode of delivery.

Conclusions

Early life feeding practices have an influence on motor development outcomes into late childhood and adolescence independent of sociodemographic factors.

Early Life Events and Motor Development; A Longitudinal Cohort Study

Grace T, Hands B, Bulsara M, Robinson M

Introduction

Compromised motor development affects a range of health outcomes, however few studies have reported on early life risk factors for outcomes past childhood. Antenatal, perinatal and neonatal factors affecting motor development from late childhood to adolescence were explored. As sex differences in motor development have been previously reported males and females were examined separately.

Methods

Participants (N = 2868) were from the Western Australian Pregnancy Cohort (Raine) Study. Obstetric and neonatal data were examined to determine which factors were related to motor development outcomes at 10 (n = 1622), 14 (n = 1584) and 17 (n = 1221) years. The Neuromuscular Development Index of the McCarron Assessment of Motor Development determined offspring motor proficiency. Linear Mixed Models were developed to allow for changes in motor development over time.

Results

Maternal preeclampsia, mode of delivery and income affected both male and female outcomes. Lower percentage of optimal birth weight was related to a lower male NDI. Younger maternal age, smoking during early pregnancy and stress during later pregnancy were related to lower female NDIs.

Conclusion

There were some differences in the variables that affected male and female outcomes. Events experienced during pregnancy were related to motor development into late adolescence.

Differentiating movement strategies during a VR task in children with and without DCD: what makes strategies successful?

Geuze R, Jelsma D, Smits-Engelsman B

Introduction

Observation is often used to detect abnormalities in movement and coordination by therapists. When developing and learning goal-directed movement initially several strategies are explored from which one emerges as the dominant one. Normally this will be the optimal strategy, but sometimes as in Developmental Coordination Disorder (DCD) this may not be the case. The aim of this study was to detect differences in strategies between typically developing children (TDC) and children with DCD and changes over time due to intervention. We used video recordings to quantify the movements of body segments while children were playing a Nintendo® Wii Fit balance game. Cluster analysis was used to find postural control strategies. Two independent sets of observations differing in level of detail of the observation (Set1 detailed level of each gate vs. Set2 global level of total runs of 19 gates) have been analyzed to answer the question which level of detail is most informative to detect (in) efficient strategies.

Method

15 TDC and 14 children with DCD played ten runs of the Ski Slalom game (T0) and both groups repeated these ten runs after six weeks (T1). The DCD group received Wii Fit intervention in-between. Video recordings were scored by two groups of research assistants who were blind for group and time. They evaluated each run by giving a mark for quality of coordination (1-10).

Analysis

For Set1 maximal medio-lateral sway of head, shoulders, hips, arm sway and movement of feet in between the gates of three games per child per test moment were scored. Set2 scored maximal excursion of head-, shoulder-, hip-, arm- and foot movement and three specific observations (presence of rotation, opposite weight shift, or counter rotation of the arm) of each run. Two-step cluster analysis was used to find clusters of movement strategies. The mean number of successfully passed gates and mean mark identified the efficiency of each cluster.

Preliminary Results

Cluster analysis shows 3- and 4-cluster solutions for Set1 and Set2, respectively. These clusters differ in passed gates and mark, and can successfully be interpreted as strategies. Set2 clusters reveal distinct strategies, which can be recognized by therapists. The TDC use the optimal strategy more often. At T1 both TD and DCD groups shift to the use the optimal strategy more frequently. However, five children with DCD continued using the poor strategy 4 or more times out of 10 after intervention.

Leisure and play of children with Developmental Coordination Disorder

Gurtner B, Thommen E, Ray-Kaesler S, Bertrand A

Introduction

Leisure and play constitutes a major aspect of children's health and wellbeing. There is some evidence that children with Developmental Coordination Disorder (DCD) have different play behaviours than their typically developing peers that put them at risk of social isolation (Cairney, 2006; Missiuna et al., 2007). In accordance with the literature, results from a group of Swiss school-aged children with DCD (n=10) indicated a higher frequency of engagement in individual, organized sports and free play than in team-sports and social play (Ray-Kaesler et al., 2016a). This needs to be further explored with a larger sample and a comparison group of typical children.

The aims of this study are 1) to describe the leisure and play activities of Swiss children with DCD in comparison with a control group of peers with typical development, and 2) to identify the leisure and play performance issues of the group of children with DCD.

Method

Data collection is still ongoing. Parent-child (5 to 15 years) pairs are being recruited in Switzerland, including a group of clinically-referred children for motor coordination difficulties, as reflected by the DCDQ-FE (Ray-Kaesler et al., 2016b) and MABC-2 scores, alongside with a group of typically developing age and gender-matched controls. Parents are completing a research questionnaire about the child and family leisure and play participation. Furthermore, each parent and child with DCD are being interviewed with the Canadian Occupational Performance Measure (COPM) to capture their perception on the leisure and play issues the child is facing.

Results

Preliminary analyses indicate that the group of children with DCD participate regularly in different sport activities, with the same intensity than their typical peers. However, they engage less often in team-sports and social play compared to controls, which they perceive specifically challenging (COPM). Finally, the children report more often issues related to leisure and play than their parents (COPM).

Conclusion

Preliminary results provide initial evidence that the school-aged children clinically-referred for motor coordination difficulties have opportunities and support to engage in leisure and play activities in the Swiss context. However, they express leisure and play concerns that might indicate low self-esteem and lead to social exclusion. It also highlights the importance to examine and consider these concerns through the child point of view when planning intervention.

Contemporary parent handling behaviours: do they constrain or enable infant motor development?

Hands B, Travlos V, Beaton H

Introduction

Infants' motor development emerges through a continuous series of dynamic interactions between their own innate genetic characteristics, environmental conditions and the experiences of daily interactions with their parents. Research has shown young infants to be highly responsive to prescribed handling and daily positioning activities provided by their care givers. Little is known how parent handling behaviours might constrain or enable motor development. This study aimed to investigate the relationships between parent handling behaviours and infant motor behaviours from birth to 10 months of age.

Methods

A prospective longitudinal study observed 52 typically developing term infant-parent dyads at infant's age one, three and ten months. Parent handling behaviours were scored from video filmed during routine care activities using the Parent Handling Score (cPHS), a valid and reliable tool developed specifically for the project. Motor development was assessed using the Alberta Infant Motor Scale (AIMS) (1 mth, 3mth,10 mth), to identify gross motor, the Peabody Developmental Motor Scale-2 (PDMS-2) (1 mth, 3mth,10 mth) to identify reflexes, fine, gross and visual motor function and the Test of Infant Motor Performance (TIMP) (1mth, 3mth) to identify postural control. Infants were grouped into suspected motor concerns (SMC) or typically developing (TD) based on the cut score for each motor assessment.

Results

There were significant positive correlations between the cPHS and the TIMP ($r=0.310$, $p=.023$) and the PDMS-2 ($r=0.373$, $p=.007$) at 3 mths. The number of infants identified with SMC differed according to the infant's age and tool. The PDMS – 2 did not identify any infants with SMC. At 1mth, the TIMP identified 1, AIMS identified 5. At 3mth the TIMP identified 2 . At 10mth the AIMS identified 7. Only 3 infants were identified by both tests at the same observation. cPHS scores for the SMC vs TD groups were significantly different for all three measures ($p<.001$) at 1 month. In all cases the parents of the SMC group received lower PHS scores. At 3 months only the cPHS scores for the TIMP SMC group were significantly lower ($p=.032$). At 10 months the scores were significantly lower for the SMC AIMS group ($P<.001$) and the SCM PDMS-2 group ($p = <.001$)

Conclusion

These results highlight the importance of parent handling on motor outcomes. Whilst motor assessments identified different infants with SMC, their parents scored lower on the cPHS. Different diagnoses of motor outcomes could be made based on the tool used.

Comparing features of motor impairment in Japanese children with Autism Spectrum Disorders, Attention Deficit/Hyperactivity Disorders to those of typical development

Higashionna T, Tokunaga A, Nakai A, Tanaka K, Nakane H, Tanaka G, Fukuda M, Iwanaga R

Introduction

It is well known that motor impairment is often presented in neurodevelopmental disorders such as autism spectrum disorder (ASD) and attention deficit/hyperactivity disorder (AD/HD). However, the characteristics of motor impairment according to disorder have not been fully investigated. The purpose of this study is to investigate the differences in motor impairment among Japanese children with ASD and AD/HD.

Method

Fifty-three children with neurodevelopmental disorders and 47 typically developing (TD) children (21 males, 26 females; mean age 8.40 ± 1.50 years) participated in this study. Neurodevelopmental disorders were categorized into 2 groups; ASD group ($n=17$, 15 males, 2 females; mean age 9.00 ± 2.03 years) and AD/HD group ($n=36$, 32 males, 4 females; mean age 9.08 ± 1.59 years) by diagnosis. All participants were evaluated for motor coordination ability by using Movement Assessment Battery for Children-Second Edition (M-ABC2). Analysis of variance (ANOVA) was used to compare the means of M-ABC2 scores.

Results

The results showed that both the ASD group ($p < 0.01$) and the AD/HD group ($p < 0.05$) had significantly lower M-ABC2 total scores than the TD group. Moreover, the ASD group had significantly lower scores in the three component scores of M-ABC2 compared to the TD group, while the AD/HD group had significantly lower scores than the TD group only for the components Manual Dexterity and Balance ($p < 0.05$). There were also significant group differences between the ASD group and the AD/HD group in the component Aiming and Catching ($p < 0.05$), with the ASD group having significantly lower scores than the AD/HD group.

Conclusion

Our findings suggest that there are differences between motor impairment features among Japanese children with ASD and AD/HD. Furthermore, the results of our study also suggest that children with ASD are more likely to present general motor coordination problems while children with AD/HD more commonly have problems with fine motor and balance ability. Therefore, it is necessary to approach treatment according to the diagnosis.

Developmental Coordination Disorder: What is (un)known? A study about awareness and knowledge among health care professionals, teachers, and parents

Houwen S, Cantell M, Schoemaker M

Introduction

Developmental Coordination Disorder (DCD) is a relatively common childhood disorder that affects daily functioning of children, yet the disorder often remains undiagnosed. The aim of the current study was to gain insight into the awareness and knowledge about DCD among health care professionals, teachers, and parents.

Method

An online survey among pediatricians (n=58), family/general physicians (n=29), youth health care physicians (n=50), special educational needs professionals/psychologists (n=175), speech-language therapists (n=137), teachers (n=468), and parents (n=196) was conducted. The first part of the online survey focused on obtaining demographic data (e.g., level of education, years of working experience). The second part of the online survey focused on knowledge about typical characteristics of DCD, secondary consequences, and co-morbid disorders. The final part consisted of questions about the needs and wishes for more information about DCD.

Results

More than half of the family/general physicians, speech-language therapists, teachers, and parents (62-79%) indicated that they had hardly any or no knowledge about DCD. Although somewhat more familiar with DCD, still a third of the pediatricians and youth health care physicians and half of the special educational needs professionals/psychologists had hardly any or no knowledge about DCD. Of participants who have awareness, 33-72% have knowledge about the typical characteristics of DCD. Only 21-54% have knowledge about secondary psychosocial consequences, 16-46% have knowledge about secondary physical health consequences, and 13-45% have knowledge about co-morbid disorders, with family/general physicians, speech-language therapists, and teachers being the least knowledgeable. Years of work experience, having taken an additional course, and (parents) having a child with DCD, increased the knowledge base of DCD. The majority of the respondents (85-99%) would like to have more knowledge about DCD, and they would prefer to gain that by attending a training session or conference with a knowledge module about DCD, or by visiting a website, or online course with general information about DCD.

Conclusions

This research shows the presence of a knowledge gap and the need for a greater awareness of DCD. Increasing knowledge and awareness may improve (early) identification of DCD. Future research should focus on how to best fulfil this specific need.

Factor Analysis of the Elementary School Version Questionnaire for Motor Skills

Iwanaga R, Tokunaga A, Higashionna T, Tanaka K, Nakane H, Tanaka G

Introduction

The purpose of this study is to develop an assessment tool for motor coordination skills development, which can be used by teachers, by exploring items and factors related to sensory processing development.

Method

We asked elementary school teachers in the Kansai and Kanto areas to complete a questionnaire called “The School Version of the Assessment Sheet for Sensory and Motor Development -pilot version-”. We then analyzed these data with data collected in our previous studies.

Results

Assessment Sheets for 767 children aged 7 to 12 were collected. Response ratios below 90% excluded 21 out of 60 items on the Assessment Sheet from factor analysis. Factor analysis of the remaining 39 items revealed 6 factors. These factors were named ‘Writing skill’, ‘Bilateral coordination’, ‘Sports skill’, ‘Ocular motor skill and oral motor skill’, ‘Posture control’, and ‘Drawing skill’

Conclusion

A questionnaire that includes these 39 items and evaluation methods based on the 6 factors will provide a useful tool to evaluate motor coordination skills in school-aged children by teachers in school settings.

Occupational therapy services in Quebec (Canada) schools for students with DCD

Jasmin E, Ariel S, Caron M, Currer-Briggs G, Gauthier A, Pelletier L

Introduction

Contrary to United States and some Canadian provinces, occupational therapy services in schools remain unknown and sporadically offered in Quebec (Canada). However, several studies have demonstrated the effectiveness of this service to achieve the intervention goals of students with difficulties, including DCD, and to improve their skills and school performance. Moreover, providing occupational therapy services in Quebec schools was requested by parents of children with DCD and teachers. Objective: This study aimed to describe the occupational therapy services in Quebec schools.

Method

This descriptive study was conducted with Occupational therapists (OTs) authorized to practice in Quebec and working at least one day a week in a school environment. Data collection comprised the completion of an online questionnaire (French or English version), designed for this study and validated by two OTs with expertise in pediatrics. As the questionnaire included multiple choice and short answers questions, descriptive and qualitative analyses are ongoing.

Results

Fifty-three OTs, meeting inclusion criteria, completed the questionnaire. The majority worked in regular French public elementary schools, where a traditional service delivery model was used. Student with autism spectrum disorder (64 %) and those with DCD (60 %) were the most met. Referral reasons mainly target fine motor difficulties (89 %), graphomotor/handwriting difficulties (83 %) and autoregulation/sensory processing difficulties (79 %). OTs used a variety of frames of reference, but mostly sensorimotor/multisensory (70 %) and compensatory (68 %) approaches.

Conclusion

This study will provide a better understanding of occupational therapy services offered in Quebec schools. Results will also allow identifying aspects of services that may be improved, based on scientific evidence, in order to promote educational success of students with difficulties, especially DCD.

Participation and needs of students with DCD at elementary school

Jasmin E

Introduction

At elementary school, approximately 6 % of students have a DCD, but no known study comprehensively examined their participation and needs in this environment. In order to provide the best services to promote their educational success, it is important to understand their needs in their school environment, especially those perceived by stakeholders. This study aimed to explore and to compare the perceptions of children, parents and teachers regarding participation and needs of students with DCD at elementary school.

Method

Data were derived from an ecosystemic needs assessment based on a multiple case study design. This design was chosen because it can be used to describe and analyze, in-depth, a particular social phenomenon in its real context (Yin, 2009). Participants included ten children with DCD, their parents (n = 12) and their teachers (n = 9). Individual semi-structured interviews were conducted with each participant. Intra-case and inter-case analyzes were performed, as suggested by Miles and Huberman (2003) and Yin (2009)

Results

According to participants, all children with DCD had school difficulties. However, children's expectations generally differed from those of their parents and teachers. More services at school, mainly occupational therapy and access to an expert on DCD, were requested by parents and teachers.

Conclusion

Considering the different perspectives, it would be recommended to develop indirect occupational therapy services at school, including training and support to teachers. This would meet the needs of more students with motor and functional difficulties, having or not a diagnosis of DCD.

The trajectory of DCD into adulthood - a longitudinal follow-up study of children diagnosed with DCD at 6.5 years

Johansen K, Hemgren E, Persson K

Introduction

Developmental coordination disorder (DCD) is a common motor disorder in children where high-risk infants are especially vulnerable. The impact of DCD has shown to have consequences beyond the motor domain, where failure in academic and work achievements, increased risk for mental illnesses and decreased quality of life are reported. Even though the body of research on the impact of DCD has grown, more longitudinal follow-up studies into adulthood are needed.

The aim of this study was to assess motor abilities in adults that received a DCD diagnosis at 6.5 years of age (Hemgren & Persson, 2008), as well as the impact on quality of life and psychosocial outcomes.

Method

All preterm and term infants (n=226) who were born in Uppsala County and received neonatal intensive care (NIC) at Uppsala University Children's Hospital in the late 80-ties were enrolled in a longitudinal follow-up study. At 6.5 years the children's neurodevelopment were assessed by a physiotherapist and referred to a pediatric neurologist when indicated. A total of 50 children received a DCD diagnosis as defined in DSM-IV-TR.

In the planned follow-up study the adults, now in their 30-ties, will undergo a general health examination. Motor skills will be tested with Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) complemented by the Adult Developmental Co-ordination Disorder/Dyspraxia Checklist (ADC). In addition, cognitive skills and quality of life will be evaluated.

Implications for practice

This study could extend the knowledge of the trajectory of DCD from childhood to adults as well as shed light on the impact of DCD in other areas such psychosocial outcomes in adulthood.

Positive effects of Atomoxetine therapy on visual perception in ADHD

Kashiwagi M, Tanabe T, Ogino M, Oba C, Nomura S, Okumura T, Nakai A, Wakamiya E, Tamai H

Introduction

Attention deficit hyperactivity disorder (ADHD) may have a negative impact on visual perception. Atomoxetine (ATX) is effective in reducing the symptoms of ADHD. However, the effects of ATX on visual perception have not been thoroughly investigated. The present study aims to characterise the effects of ATX on visual perception in a population of Japanese children with ADHD.

Method

Fourteen ADHD children (13 boys and one girl), aged 6-10 years, were assessed in our hospital. Before the administration of ATX, the participants were assessed with the Developmental Test of Visual Perception-Second Edition (DTVP-2), the Japanese version of the ADHD Rating Scale (ADHD-RS), and the Japanese version of the Developmental Coordination Disorder Questionnaire (DCDQ-J; Nakai A, et al. 2011). These tests were reassessed 3 to 9 months later. The daily regimen of ATX ranged from 1.2 to 1.7 mg/kg. The Wilcoxon signed-rank test was used to test differences between groups, and a p value less than 0.05 was considered an indication of statistical significance.

Results

In the DTVP-2, the average scores (before /after treatment) of Eye-Hand Coordination (8.1/9.4; $p=0.047$), Figure-Ground (9.4/11.2; $p=0.029$), Motor-Reduced Visual Perception (40.4/43.4; $p=0.032$), and General Visual Perception (81.0/86.6; $p=0.030$) were significantly improved. However, the scores of Position in Space (9.7/10.4; $p=0.21$), Copying (13.1/13.9; $p=0.13$), Spatial Relations (10.9/11.4; $p=0.69$), Visual Closure (11.3/11.2; $p=0.78$), Visual-Motor Speed (8.4/8.5; $p=0.94$), Form Constancy (10.1/10.6; $p=0.34$), and Visual-Motor Integration (40.6/43.2; $p=0.12$) did not show any significant improvement. The total scores of ADHD-RS (24.9/15.4; $p=0.008$) were significantly improved, while the total scores of DCDQ-J (43.1/43.6; $p=0.88$) did not show any significant change.

Conclusion

Our findings suggest that ATX treatment in children with ADHD is associated with significant improvements in visual perception.

Features of DCD in adolescents and adults: A scoping review

Kirby A, Barnett A, Weintraub N, van Waelvelde H

Introduction

Although it has long been recognised that the motor difficulties associated with DCD extend beyond childhood, the nature of the disorder in adolescents and adults remains poorly understood. In June 2016 a working group drafted an extension of the EACD guidelines for DCD to make recommendations for working with adolescents and adults. In preparation, a scoping review was performed. The purpose of this presentation is to summarize this review, describing the features of DCD in individuals aged 16 years and older.

Method

Using selected keywords, we conducted a literature search of studies published in English in PubMed, PsycNET and CINAHL. We also searched Google Scholar and used the ancestry method. The focus was on studies of individuals aged 16-65 years who experienced motor difficulties consistent with a DCD diagnosis. We excluded studies where individuals had motor problems associated with a known neurological or physical disorder.

Results

383 articles were found (366 after eliminating duplicates). 42 articles remained after screening the titles and abstracts for relevance. An additional 9 relevant sources were found through the ancestry method, giving a total of 51 manuscripts. The studies ranged from single case examinations to group studies using questionnaires, psychometric testing and experimental manipulations. Findings were organised using the WHO International Classification of Functioning, Disability and Health (ICF) framework. Reported impairments in 'body functions and structures' included perceptual-motor difficulties in balance, agility, ball skills and hand skills. Non-motor impairments were evident in the areas of executive function, attention, and anxiety, with symptoms of depression and low global self-esteem also reported. Limitations in 'activities' such as handwriting and driving were reported, as well as generally reduced levels of physical activity. There were also restrictions in levels of 'participation' with negative impacts on independent living, employment and quality of life satisfaction. No specific work on intervention was found, although some individual coping strategies were identified.

Conclusion

There is an emerging but limited literature on DCD in adolescents and adults. Findings suggest that a range of motor difficulties extend into adulthood, as well as associated physical, cognitive and psycho-social difficulties which continue to impact on everyday life performance, education and employment. There is an urgent need for further research with adults with DCD of all ages. This will help guide the practice of educational and health professionals, enable employers and families to understand the needs of adults with DCD and provide guidance to the individuals themselves.

Mental health problems and behavioral difficulties in preschool children with motor impairments

Kita Y, Hirata S, Suzuki K, Okumura Y, Yasunaga M, Inagaki M, Nakai A

Introduction

Mental health problems and behavioral difficulties are severe in children with developmental coordination disorder (DCD). However, few studies have focused on the association between mental health and motor skills in preschool children. The present study aimed to reveal their association and to examine whether the preschool children with motor impairments have greater problem in mental health and behavior

Method

Participants were 134 typically developing preschool children (mean age = 5.42 ± 0.90 yrs; boys = 59) who completed a test set of the Movement Assessment Battery for Children-Second Edition (MABC-2) for Age Band 1. We also evaluated their mental health and behavioral difficulties using the Strength and Difficulties Questionnaire (SDQ). The correlations between the two scales were calculated, and the differences in the SDQ scores between normal children and children at risk for DCD were examined.

Results

The significant correlations were found between the MABC-2 scores and two subscales of the SDQ (Hyperactivity and Peer problems) ($p < .01$), in which the increase in severity of motor impairments was associated with greater problems in mental health and behaviors. We identified 23 children at risk for DCD based on the MABC-2 procedure. They scored worse than normal children in subscales of the SDQ including Hyperactivity, Peer problems and Prosocial problems ($p < .01$).

Conclusion

These results suggest that good motor skills are associated with less mental health problems and behavioral difficulties in preschool children. Moreover, those in children with motor impairments were show to be more severe than in the normal children. These findings indicate necessity of early interventions both for motor skills and mental health during preschool years.

The effect of 1-year motor training program at home (ROOPA) on development of gross motor skills in children with DCD

Kordi H

Introduction

Today, most research results suggest that intervention based on task-oriented approach has a significant impact on the improvement of motor ability in DCD children (Smits-Engelsman et al., 2012). Home exercises typically are used as a supplement method in treatment of children with DCD (Waternberg et al.). Sometimes factors such as financial problems, lack of time, lack of access to therapists and the child's unwillingness to take part in the therapeutic process leads to the deterioration of CDC child's motor status. Therefore, designating a research project with the aim of developing a training package for DCD children who don't take part in therapeutic process has become more important. Although there have been some researches which observed the effect of exercise at home in addition to school exercise (Chambers&Sugden, 2014) and physiotherapy (Waternberg et al., 2007) on DCD children, very few researches have noted merely the effect of home exercises on their motor abilities.

Method

The research population consists of 3-6 year old children (boys and girls) with DCD who were diagnosed using DCDQ'7. The sample population were distributed randomly into experimental and control groups (30 children in each group). The Roopa training schedule was designed based on principles of task-based approach. Subjects were initially evaluated using Denver-2 developmental screening test and appropriate training programs were assigned to them according to their difficulties. After one year the children were reevaluated and the resulted data were analyzed using t-test.

Results

The performance of the experimental group in balance, locomotive and manipulation skills improved significantly ($p < 0.05$), but performance of control group didn't show any significant change ($p > 0.05$). Also, performance of experimental group was significantly better than control group in the post test ($p < 0.05$).

Conclusion

Present research showed that home exercise according to task based approach can improve motor abilities in children with DCD. This is also consistent with the findings of Waternberg et al. (2007) and Chambers and Sugden (2012). The results emphasize on the point that task-specific training is the acceptable way to learn a task, because it makes intuitive sense (Bayona et al., 2005).

Does the MABC-2 at 3 years of age predict DCD at 4.5 years of age in children born very preterm?

Kwok C, Synnes A, **Zwicker J**, Agnew J, Mackay M

Introduction

Children born very preterm (24-32 weeks gestational age) are at high risk for developmental coordination disorder (DCD). Early identification of DCD may allow for early intervention and improved outcomes. The Movement Assessment Battery for Children-2 (MABC-2) is commonly used to identify children with DCD and allows for assessment as young as 3 years of age; however, the predictive validity of this assessment is unknown in this population. The aims of this study were to determine if MABC-2 scores at 3 years can predict DCD at 4.5 years and if DCD can be reliably identified in very preterm children at 3 years.

Method

In this retrospective cohort study, 208 very preterm children without major disabilities (e.g., cerebral palsy, developmental delay) were seen at a tertiary neonatal follow-up program at ages 3 and 4.5 years. Of these, 43 (20.7%) children were excluded because the MABC-2 could not be completed due to immature or delayed motor skills ($n = 19$), poor attention or focus ($n = 4$), or uncooperative or other behavioral issues ($n = 20$). The final sample consisted of 165 children (median age 26 weeks, IQR 25-28 weeks), with 29 (17.6%) having a diagnosis of DCD at 4.5 years. Logistic regression was used to determine if the MABC-2 at 3 years was predictive of DCD at 4.5 years, adjusting for confounders of gestational age, Apgar scores at 5 min, and days of ventilation. Cross-tabulations were used to determine the relationship between MABC-2 scores at 3 years and DCD diagnosis at 4.5 years.

Results

MABC-2 scores at age 3 was a significant predictor ($OR = 0.82$, $p = 0.001$) of DCD diagnosis at 4.5 years. The MABC-2 had excellent sensitivity (90%), moderate specificity (69%), small to moderate positive predictive value (38%), and high negative predictive value (97%).

Conclusions

MABC-2 scores at the ≤ 5 th percentile is highly sensitive in identifying very preterm children at age 3 years who will develop DCD, but the high number of false positives at this age reduces the positive predictive value. The MABC-2 is able to identify who is not at risk for DCD at age 3 years, which can help to inform which children require monitoring and which children can be discharged. While the MABC-2 is a useful measure to identify risk of DCD in 3-year-old very preterm children, one in five children at this age may not be able to complete the assessment.

Environmental Stress Hypothesis in young adults with poor motor coordination

Li Y, Cairney J

Background

The Environmental Stress Hypothesis proposes multiple mediating pathways linking Developmental Coordination Disorder to internalizing problems through physical health and psychosocial factors. However, to date there has been a lack of evidence systematically investigating this model. The purpose of this study is to test a comprehensive model based on Environmental Stress Hypothesis in young adults.

Method

225 young adults at ages of 17-23 years were recruited. Participants completed an online survey of motor coordination, physical activity, general stress, global relationships, perceived social support, self-concept, and internalizing problems. Structural equation modeling was used to examine the fit of model derived from the Environmental Stress Hypothesis.

Results

The modified original model of the Environmental Stress Hypothesis showed a good model fit ($\chi^2=83.24$, $p<.01$; RMSEA=.056; NNFI=.927; CFI=.954; GFI=.947), and indicated that the relationship between poor motor coordination and internalizing problems were mediated by secondary stressors (i.e., general stress and global relationships), perceived social support, and self-concept.

Conclusions

This study highlights the long-term effects of poor motor coordination on mental health problems that may track into young adulthood, and illustrates potential underlying mechanisms of internalizing problems in adults with poor motor coordination. The results suggest that interventions should target psychosocial well-being, in addition to motor coordination, to prevent or improve mental health problems.

Involvement of Physical Therapists in Research of DCD in the United States

Liang L

Introduction

Developmental coordination disorder (DCD) is one of the common developmental disabilities characterized by impaired motor skills. Physical therapists (PTs) who have expertise in human movement are among the major health care providers for children with DCD. Evidence-based practice (EBP) is the general guideline for PTs to provide best services. However, lack of clinically relevant research is one of the barriers that prevent PTs from implementing EBP. A potential factor for deficiency of clinically relevant research is lack of involvement of PTs in research. The purpose of this study was to 1) explore the involvement of physical therapists in the research of DCD in the United States in the past decade, and 2) compare the amount of publications in DCD from the US to other countries.

Method

Literature search was performed in July 2016 on eight databases. Articles with 'developmental coordination disorder' in either title or abstract published between 2006 and 2016 were included. Affiliations of the first author for each publication were extracted. In addition, educational background of authors who were affiliated with institutes in the United States were identified.

Results

A total of 597 identified publications were contributed by researchers from 37 countries. A total of 262 (44%) publications were contributed by researchers from Canada, United Kingdom, and Australia (101, 86, & 75 publications, respectively). Forty-one (6.9%) publications were from the United States. Among 41 publications, 10 (24%) were conducted by researchers with a PT background. The rest of the studies were from physicians, occupational therapists, experts in kinesiology, and other areas of expertise.

Conclusions

The number of publications in DCD was less in the United States compared to other countries. A limited amount of studies were led by researchers with a PT background. Physical therapists need to be more involved in the research to help with narrowing the gap between research and clinical application. In addition, publish the research findings to promote dissemination of knowledge. Hence, facilitate the growth of evidence database and provide better service to children with DCD.

Sensory adventure measurement (SAM) – a new tool for assessing SMD

Lieberman L, Bart O

Introduction

The most commonly used tools to investigate Sensory Modulation Disorder (SMD) are self-reported questionnaires. The aim of this presentation is to present a new clinical outcome measure for direct assessment of children's reactions to sensory stimuli. Individuals with SMD do not react to sensory stimuli with the same intensity, frequency and magnitude as others. These responses are expressed either as over- or under-responsiveness or as sensory seeking to any or all types of sensory stimuli.

Method

The Sensory Adventure Measurement (SAM) comprise 13 sensory stimuli from different sensory systems. Two scores are stemmed from the measure; power, the intensity of response to the sensory stimuli, and child's report.

Results

Inter rater reliability was established with average acceptance of 86% for level of intensity (Power). Test-retest reliability was assessed in a pilot study of 18 typically developed children who tested twice within a week. The Intraclass Correlation Coefficient results ranged from 0.70 to 0.97, exhibiting very good agreement. Internal consistency reliability for the SAM total power score is satisfactory (0.70). Criterion validity was established by computing correlation between SAM total power score and the Sensory Profile total score ($r=.536$, $p<.05$). Discriminate validity analysis will be presented at the time of the presentation.

Conclusion

A clinical direct reliable and valid outcome measure, in addition to the existing parental questionnaires, will enable clinicians and researcher to better detect SMD and thus to implement intervention adequately.

The effect of age on obesity and physical fitness among Israeli children and adolescents with and without DCD

Lifshitz N

Introduction

Obesity among children and adolescents has been increasing worldwide, which may significantly affect their health, educational attainment and quality of life. Due to their motor problems, children with DCD tend to prefer sedentary activities. While poor physical fitness has been associated with obesity, these children's health could be in greater risk. A previous study found that among Israeli children aged 6-11 years, those with DCD were less fit and more obese than typical children (Lifshitz, Raz-Silbiger, Weintraub, Steinhart, Cermak, & Katz 2014). There is no data whether these results are also applicable to adolescents (aged 12-18 years). Based on the previous study, the current study examines the effect of age on obesity and physical fitness among Israeli children and adolescents with and without DCD.

Method

There are 4 groups of participants: a. 22 children with DCD Mage =8.70(1.36); b. 47 typical children Mage=8.90(1.52); c. 72 typical adolescents Mage 15.10(2.03); and d. Adolescents with DCD (data collection is in progress).

Children (aged 6-11 years) were diagnosed with DCD if total score (TS) on the MABC-2 was ≤ 16 th% and their parents reported that the child's deficits in motor skills interfered with at least two daily life activities. Adolescents aged 12-15 were assessed using the DCDQ'07 (TS range 15-57) and adolescents aged 16-18 were diagnosed using the Adolescents and Adult Coordination Questionnaire (AAC-Q) (TS ≤ 15 th%).

Measures. Two measures were utilized: the Strength subtest of the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) and BMI calculation according to age and gender

Results

The preliminary findings of the study show significant differences between typical children and adolescents on BMI ($t=-4.13$, $p=.00$). The average BMI of adolescents was higher (children MBMI=18.37(3.7), adolescent MBMI=21.21(3.7). No significant differences were found for physical fitness (BOT-2).

Conclusion

The initial findings of this study show significant differences between typical Israeli children versus adolescents in BMI but not in physical fitness. Data collection comparing between typical adolescents and those with DCD, and between children and adolescent with DCD is ongoing and will be presented at the conference. As obesity is now a worldwide problem, our understanding of these issues would allow building appropriate prevention and treatment programs for children and youth with and without DCD.

The effect of frequency of verbal feedback in motor learning of children with and without DCD

Masuda T, Takahashi K, Nanakida A

Introduction

In contrast to children with more severe disability, children with clumsiness or DCD receives limited provision in Japanese school setting, although motor difficulties lead to problems in daily living and often have an effect on academic progress. Then, there are some nursery and/or elementary school teachers who does not notice that students' motor learning in their motor performance is interrupted for their directions by loud voice. This study aimed to examine effect of frequency of language feedback in motor learning of children with and without DCD.

Method

A task was to move the heaped 60 marbles on left side to the wood box on the 45 cm right side. Performance time and the number of marbles they could move without spilling out were recorded. This task was run as successive blocks of 4 trials, in counterbalance order, each preceded by 6 practice trials, and after three weeks we re-practiced as retention by 6 trials. Participants were given their results (time and number) as knowledge of results by mouth.

There were two groups: one was DCD group (33 children with DCD in elementary or nursery school, They were clients with a chief complaint of "clumsy" or "suspect DCD" at a center of special-needs-educational counselling and developmental support services in A University in Japan), and another was non-DCD group as controls (age and gender-matched 33 normal children). In addition, it was shared in three subgroups for the same number of people, according to frequency of the verbal feedback ('FB100%': verbal feedback of participant's result was given every trials, 'FB50%': once for twice, 'FB25%': once for 4 times).

Results

There was no performance time to differ for the two groups. But the number of moving marbles as accuracy was significant little in the DCD group. There were no differences in both 'FB50%' and 'FB25%' subgroups, but both FB100% subgroups were significantly low results. Especially, accuracy of 'DCD-FB100%' kept falling from 1st block, and results of retention task were worst and lower than one of last block.

Conclusion

Schmidt and Wisberg (2000) assume motor performance is falling when too much frequencies of the additional feedback, and in particular its characteristic is marked in DCD group. This results suggest that information for correction often become surplus for children with DCD, and that it may make them expect their daily failure or be emphasized their poor performance.

Classification of Children with Developmental Coordination Disorders Based on Clinical Subgroups

McCoy S, Jirikowic T, Deborah K, Hsu L, Ciol M

Introduction

The challenges of diagnosing Developmental Coordination Disorder (DCD) include lack of information about the pathology of DCD and the large variety of symptoms associated with DCD. The purpose of this study was to develop a set of standardized clinical measures to create a classification system for subgroups of children with DCD. The hypotheses were that there would be distinct sensorimotor subgroups in children with DCD and children in different subgroups would demonstrate different functional limitations.

Method

Twenty children with DCD verified by the Diagnostic and Statistical Manual of Mental Disorders- fifth edition (DSM-V) criteria, age from 5 to 12 years, participated this study. Children were examined across domains of fine motor, gross motor, balance, coordination, and intelligence by Movement Assessment Battery for Children 2nd Ed, Bruininks-Oseretsky Test of Motor Proficiency-2nd Ed coordination composites, Beery-Buktenica Developmental Test of Visual-Motor Integration, 6th Ed, Kaufman Brief Intelligence Test-2nd Ed, and parents were asked to complete the Sensory Processing Measure. Descriptive statistics were used to visualize the clinical presentation and sensorimotor behaviors of the children. Visual plots for each child's performance were created using percentile rank scores that were compared among all tests/measures. Children who demonstrated ≤ 5 th percentile in a test domain were identified as having significant limitation in the domain measured. Through pattern recognition (by percentile ranks), subgroups were identified.

Results

Results suggested that children could be classified into three groups according to intelligence and overall performance on individual testing domains: (1) Overall-limited (i.e. poor performance on the majority of the tests) and no cognitive concerns (Overall-NC); (2) Overall-limited and cognitive concerns (Overall-C); and (3) Partially-limited (i.e. poor performance on one or two of the tests) and no cognitive concerns (Partial-NC). Within the Partial-NC group, two subgroups were suggested: with primary balance and body coordination problems, and with primary fine motor and visual motor integration problems.

Conclusion

The set of standardized clinical measures allowed for identifying subgroups of DCD. However, more reliable and valid statistical analysis with larger samples of children is needed to confirm the subgroups. We recommend that DCD is conceptualized as an umbrella diagnosis and identification of subgroups should be helpful for directing evaluation and intervention in children with DCD.

Is self-report versus parent report similar for adolescent's motor competence?

McIntyre F, Hands B, Timler A

Introduction

Many parents may not be aware of the level of motor competence of their adolescent and the difficulties faced by those with a low level. Consequently, parent-reported assessments may differ from that of their child. This study examined to what extent parents' assessment of their adolescent's motor competence matched that reported by their adolescent.

Method

One hundred and thirty-three parent and adolescent pairs participated in this study. Parents completed the Developmental Coordination Disorder Questionnaire, 2007 (DCDQ-07). The adolescents aged between 12 and 16 years (66.2% males, $M_{age}=14.48$ yrs, $SD= .79$) completed the Adolescent Motor Competence Questionnaire (AMCQ). To examine differences between parent and adolescents perceptions, the DCDQ'07 and AMCQ cut scores were used to group the sample into High Motor Competence (HMC) and Low Motor Competence (LMC).

Results

Forty adolescents identified themselves with LMC (18 males, 20 females) and 93 identified as HMC (70 males, 23 females). Only 20 parents identified their adolescents with LMC (11 males, 9 females) and 113 with HMC (77 males, 36 females). The classification agreement between the AMCQ and the DCDQ'07 was 82% with 18 LMC (8 females, 10 males) pairs and 91 HMC (69 males, 22 females) pairs. Two adolescents were identified by the parents as LMC, who did not identify themselves (1 male, 1 female). This seemed to be driven by parental concern about poor handwriting and coordination (jumping, running and clumsiness). The 22 adolescents (14 females, 8 males) who identified themselves with LMC who were not identified by their parents reported difficulties related to participation and ball skills which were not observed by the parents.

Conclusions

The self-report AMCQ was developed with a significant level of consultation with adolescents with movement difficulties and appears to capture issues that may be overlooked by their parents. As less than 50% of the adolescents who self-reported LMC were also identified by their parents, in order to better identify and support this group, self-report rather than parent report measures should be used.

DCD and associated characteristics: what facilitates participation in physical activity?

McQuillan V, Sugden D, Chambers M, Swanwick R

Introduction

Children with Developmental Coordination Disorder (DCD) are defined primarily by their motor coordination difficulties possibly through poor learning and comparative lack of participation. This lack of participation brings greater risk of obesity and cardiovascular problems as well as fewer opportunities to learn. In addition studies show that children with DCD often have co-occurring non-motor characteristics associated with other developmental disorders and psycho-social conditions. These too result in less participation and limit opportunities for social contact. Understanding some of the barriers and facilitators to participation in physical activity (PA) from the child's perspective is an important first step in determining appropriate intervention to improve participation in PA for children with DCD.

The aim of this study was to investigate the perceptions of schoolchildren with DCD about reasons behind their ability to participate in physical activity.

Method

Schoolchildren aged 7-14 years who met DSM5 criteria for DCD were questioned about their perception of ability to participate in PA. They were monitored over time 2 academic years and repeatedly questioned about their perceptions. A purposive sample of 10 of these children both with and without associated characteristics and with differing degrees of motor severity was interviewed individually at school. Arts-based semi-structured interviews focused on participation in daily life including self-care, work and leisure, and in particular participation in PA. These areas were guided by categories from the International Classification of Functioning and previous research on DCD. This resulted in a series of photographs depicting activities for each category to act as visual prompts if required to elicit responses. Data were recorded, transcribed verbatim and thematically analysed.

Results

Strong themes emerged differentiating those that coped and participated in PA from those that did not cope as well. Severity of motor ability did not appear to influence outcome as much as the co-occurrence of associated characteristics, parental attitude and environmental opportunities. Difficulties asking for help, lack of confidence and not feeling safe were all associated with less participation. Whereas, associated with more positive outcomes were the autonomy to choose an activity, opportunities for structured and fun PA and a supportive environment.

Conclusion

Children with DCD face many barriers to participation in PA. However many, with the appropriate environmental support, have found ways to circumvent their difficulties, enjoy and thrive on their participation. There are some important messages that can translate into practice when planning sustainable intervention with children with DCD and their family to improve participation in physical activity.

The parental and teacher's recognition for developmental coordination disorder in preschool-aged children

Mikami M, Saito M, Masuda T, Tanaka M, Osato A, Sakamoto Y, Yoshida S, Takayanagi N, Adachi M, Yasuda S, Kuribayashi M, Nakamura K

Introduction

Motor problems of developmental coordination disorder (DCD) significantly interfere with activities in daily living and academic achievement in young children and adolescent. Additionally, these impaired daily living and academic functions could cause psychosocial problems such as lower self-esteem, isolation and avoidance from participation in motor activities. In this study, we investigated the recognition of the parents and teachers of nursery school for children's motor functions and relationships between psychological and behavioural problems and motor functions in children with DCD

Method

Among 282 children with DCD and their parents and teachers who participated in Developmental Health Check-up held in a city, 263 triads completed all examinations mentioned below: The Developmental Coordination Disorder Questionnaire-07 (DCDQ) by parents, Movement Assessment Battery for Children Second Edition (MABC-2) to evaluate children's motor functions and The Strength and Difficulties Questionnaire (SDQ) by parents and teachers to assess psychological and behavioural problems of children. In statistical analyses, we performed correlation analyses to examine the validity of parental and teacher's evaluation for motor functions of children with DCD. We also investigated the relationships between impaired motor functions and psychological and behavioural problems in children with DCD. Furthermore, we examined if comorbidities of other neurodevelopmental disorders including ASD, ADHD and ID/BID had an impact on the problems of children with DCD.

Results

In the result of group comparison on the MABC-2, the comorbidity group showed significant lower score on the total and the manual dexterity scores than the only DCD group. In the DCDQ, the total and all subscale scores reported by parents were significantly lower than those of teacher's report. As a result of correlation analyses between MABC-2 and DCDQ, almost scores of DCDQ were significantly correlated to total and subscale standard scores on the MABC-2. The total standard score on the MABC-2 significantly correlated to the hyperactivity, peer relationship problem and prosocial behaviour on the SDQ. These relations were significant but weaker after controlling for ASD and ADHD symptoms and FSIQ.

Conclusion

These findings suggested that parents' and teachers' recognition of clumsiness of children had validity and children's clumsiness could be evaluated objectively by DCDQ. Additionally, children with DCD and comorbid other neurodevelopmental disorders had more severe clumsiness and behavioural difficulties in the daily life. Whereas, when children had only DCD, their behavioural problems were difficult to be noticed by their parents and teachers.

Motor performance in the first year of life in children diagnosed with DCD at 6.5 years of age

Montgomery C, Johansen K, Hemgren E, Persson K

Introduction

Developmental Coordination Disorder (DCD) affects 5-6% of children in the early school years. The risk of DCD is higher in infants born prematurely, with low birth weight or other pre- or perinatal event. The onset of symptoms is present long before a diagnosis can be confirmed. In the early years, intervention is geared towards ameliorating the motor difficulties the infants display. The aim of this study was to describe the motor performance according to the Structured Observation of Motor Performance in Infants, SOMP-I, during the first year in children later diagnosed with DCD.

Method

Early motor performance was assessed with the SOMP-I according to its two domains: level of motor development and quality of motor performance at two, four, six and 10 months of (corrected) age in 226 infants that needed neonatal intensive care (NIC). At 6.5 years of age 189 of the children were re-assessed and 32 were diagnosed with definitive DCD. The diagnosis was set when the children performed below the fifth percentile according to the Test of Motor Impairment (TOMI) combined with an impact on their day-to-day activities and academic achievement. For this study, the infants diagnosed with DCD were categorized according to the SOMP-I percentile distribution. The 25th percentile was chosen as the cut-off for level and the 75th percentile for quality. In addition, the two domains, level and quality, were combined by categorizing the infants in an OR/AND condition, i.e. the infant's total score fell within the chosen cut-off in one or both domains, and in an AND condition, i.e. the infant's total scores fell within the cut-off for both level and quality.

Results

At 4, 6 and 10 months, almost 50% of the infants from the DCD group fell below the cut-offs for both level and quality. At ten months 65% showed quality deficits. For the OR/AND condition, 50% were below the cut off at 2 months and this increased over time and reached 77% at 10 months. For the AND condition, at least one third of the infants performed below the cut-off for both level and quality from 4 months and forward.

Conclusion

During the first year of life approximately half the infants later diagnosed with DCD in a high-risk population showed atypical motor performance according to SOMP-I. Early detection and timely intervention are important for these children to acquire adaptive strategies for everyday life.

Associations among motor ability, social-communication skills, and participation in daily life activities in children with Low Functioning Autism Spectrum Disorder

Moran A, Rosenberg L, Bart O

Introduction

Decreased motor ability is a common feature in autism, leading to the proposal of a motor-social link in autism. The purpose of the current study was to assess the contribution of motor abilities and social-communication skills to child participation among children with Low Functioning Autism Spectrum Disorder (LFASD).

Method

Participants were 25 children aged 6.5-12 years. The Bruininks-Oseretsky Test of Motor Proficiency, the Social Communication Skills Questionnaire, and the Child Participation Questionnaire were used. Results revealed the limited participation of children with LFASD.

Results

As hypothesized, social communication skills significantly contributed to child participation. The unique finding of this study is the indirect effect of motor abilities on the participation of children with LFASD through the mediating effect of the asocial communication symptoms.

Conclusions

This is an additional confirmation of the notion that global process deficits in ASD lead to participation limitations and not only to deficits in social communication domains.

The DCD subtype of Joint Hypermobility Syndrome: a latent class analysis of a clinical cohort

Morris S, Fary R, Di Mattia F

Introduction

The clinical presentation of Joint Hypermobility Syndrome (JHS) of childhood is complicated by the wide range of, and sometimes contradictory, symptoms. This study aims to describe the clinical presentation of a large cohort of children with JHS and explore subgrouping children with JHS based on their clinical presentation.

Method

Case notes for 318 children with JHS were reviewed. Clinical presentation was categorised into variables according to signs and symptoms, developmental history, physical examination results and functional, social and participative factors. Variables of >1% prevalence were reported. A subset of seven variables representing commonly reported symptoms of childhood JHS were selected for use as indicator variables in a latent class analysis. Resultant subgroups were profiled on other variables.

Results

Fatigue after activity was reported by 89% of the cohort; 43% reported recurrent musculoskeletal (MSK) pain and 29% reported chronic MSK pain. Two distinct subgroups of childhood JHS were revealed, an athletic-persistent subgroup (63%) and a systemic-profound subgroup (37%). The athletic-persistent subgroup was characterised by both recurrent and chronic musculoskeletal pain and peripheral hypermobility whereas the systemic-profound subgroup was characterised by more extreme hypermobility, recurrent MSK pain, motor delay and gastro-oesophageal reflux.

Conclusion

The findings of the study support the separation of childhood JHS into two subtypes. One demonstrates symptoms more consistent with Ehlers Danlos Syndrome (hypermobility type) with associated Developmental Coordination Disorder. The other group describe active children who present in middle childhood with both recurrent and chronic MSK pain commonly related to activity. This characterisation of JHS of childhood is essential to the development of appropriate intervention strategies as the two subgroups require different therapeutic interventions.

The Effects of Atomoxetine on Motor Coordination of the Children with ADHD - A Preliminary Report

Nakai A, Wakabayashi H, Abe K, Konishi Y

Introduction

Clinically, the children with attention-deficit hyperactivity disorder (AD/HD) often have motor coordination dysfunction. The previous studies showed the high prevalence of the comorbidity or co-occurrence as 30~50%, and this frequent and specific comorbidity has led to some new terms or concepts, such as DAMP (Deficits in attention, motor control and perception) syndrome (Gillberg, 1992), DCD-Plus (Gibbs, 2007), or the distinct subtype of ADHD (Fliers, 2009). It is reported that Methylphenidate (MPH) could improve the several aspects of motor functions in ADHD. While, there are a little study on the effects of atomoxetine (ATX), selective norepinephrine reuptake inhibitor, on motor functions of ADHD.

Method

Children with ADHD, aged 13 to 17 years old, were treated with ATX, started with 0.5mg/kg/day. The motor coordination was assessed, using the Japanese version of M-ABC2 (M-ABC2-J), before treatment and one month after the maintenance dose (1.2-1.8mg/kg/day). The MABC-2-J is now developing for the formal standardization. Thus, total raw scores were converted to total standard scores and percentiles, using the original UK data, as the reference.

Results

The total and "Aiming & Catching" (eye-hand coordination) of the M-ABC2-J were significantly improved by ATX treatment. The score of "Balance" also improved, but not significantly. While, the changes of the scales for "Manual Dexterity" were small.

Conclusion

Bart, et al. (2010) studied the effects of MPH in in children with DAMP syndrome and found the significant improvement on the M-ABC scales for manual dexterity, ball skills, and dynamic balance tasks. In contrast, MPH was associated with only minor not significant improvement in static balance control. Noradrenergic neurons project from the locus ceruleus to whole brain system, including cerebellum and spine, in which there is no dopaminergic innervation. These preliminary findings suggested that ATX might be effective to motor impairments in ADHD, through the different mechanism from MPH.

Testing the Motor Coordination Traffic Light Questionnaire in a Brazilian Sample

Nascimento R, Goulardins J, Moura M, Aquino F, Schliemann A, Souza C, Oliveira J

Introduction

Developmental Coordination Disorder (DCD) is the most prevalent movement disorder in childhood. Diagnostic criteria must consider if the motor skill deficit significantly and persistently interferes with activities of daily living appropriate to chronological age and impacts on academic/school productivity, pre-vocational and vocational activities, leisure and play. Therefore, teachers should play an important role in identifying DCD in children. However, administration of standardised questionnaires add additional load to busy schedules. The Motor Coordination Traffic Light Questionnaire (MC-TLQ) is a newly developed tool that might be helpful and quick for teachers to detect children with DCD. The aim of this study was to analyse the relationship between MC-TLQ teacher's ratings and movement performance at the Movement Battery Assessment for Children second edition (MABC-2) in a Brazilian sample.

Method

Twelve teachers from a public school were asked to complete the MC-TLQ and their learners, aged 6 to 10 years, were invited to be assessed by the MABC-2. A significant Shapiro-Wilk statistic indicates that the data were not normally distributed and Kendall's tau-b was used to test the nonparametric correlations.

Results

A total of 186 children were screened using the MC-TLQ: 13 (7%) identified as RED, 22 (11.8%) identified as ORANGE, and 151 (81.2%) identified as GREEN. The same children provided consent and were assessed using MABC-2: 13 (7%) RED (\leq 5th percentile), 35 (18.8%) ORANGE (\leq 16th percentile), and 138 (74.2%) GREEN ($>$ 16th percentile). The correlation between teacher's ratings on MC-TLQ and MABC-2 total percentiles were positive ($\tau=.331$, $p=.000$), which means that the better the performance reported by the teachers at the MC-TLQ, better motor performance assessed at MABC-2.

Conclusion

This suggests that teachers seem to have a good general idea of which children are performing more or less proficiently and they may not need a structured questionnaire to organize their thoughts on motor functioning of children.

Three case studies on avoidance behaviour in children with developmental coordination disorder (DCD)

Ng J, Frame L, Thompson H, Miyahara M

Introduction

Avoidance behaviour and irritability have been mentioned for reasons why DCD, a disorder of physical movement, appears in the Diagnostic and Statistical Manual of Mental Disorders because these behavioural problems are often dealt by mental health professionals. To date, a dearth of research exists on the behaviours of children with DCD. Here, we seek to address how children with DCD display avoidance behaviour.

Method

We used a multiple case study approach to describing avoidance behaviour in three children with probable DCD, while they were taught by student teachers at a teaching lab. Child 1 was a ten year old boy with probable DCD who displayed a tendency to trip and fall onto the floor during physical activities. To determine whether the boy fell in order to avoid physical activities or due to poor balance skills, a systematic observation of teaching sessions and the balance subtest of the Movement Assessment Battery for Children, Second Edition (MABC-2) was evaluated. Child 2 was an eight year old boy diagnosed with developmental dyspraxia. He had difficulties in completing handwriting tasks. To describe avoidance behaviour, his test-taking behaviours was observed and recorded, while he was undertaking the Detailed Assessment of Speed of Handwriting (DASH) Test. Case 3 was a ten year old boy who was diagnosed with dysgraphia and dyslexia. He was competent in gross motor skills, but he avoided handwriting tasks at home and school. Student teacher's observation was used to describe the changes in the boy's avoidance behaviour from handwriting.

Results

Case 1 scored the 50th percentile on the balance subtest of the MABC-2, and tended to fall when he was unsuccessful in his attempts, or when he did not display enthusiasm. Therefore, his tripping and falling were interpreted as a form of avoidance behaviour. Case 2 asked questions irrelevant to the DASH tasks, played with the paper, and put his head down on table and did not raise it until the testing was stopped. Case 3's attitude towards handwriting tasks changed dramatically with an application of contingency management and Premack principle from completely refusing any handwriting tasks, to only writing on iPad, to willing to write on a booklet.

Conclusions

The present multiple case study may be the first systematic descriptions of avoidance behaviour in children with DCD. Attractive tasks of appropriate difficulty level, contingency management and Premack principle would be useful in treating avoidance behaviour.

Relationship between the Wide-range Assessment of Vision-Related Essential Skills and the Japanese Version of the Developmental Coordination Disorder Questionnaire

Ogino M, Kashiwagi M, Tenabe T, Ooba C, Nomura S, Okumura T, Nakai A, Wakamiya E, Tamai H

Introduction

To investigate the relationship between visual-perceptual and motor coordination in Japanese children, we used the Wide-range Assessment of Vision-related Essential Skills (WAVES) and the Japanese version of the Developmental Coordination Disorder Questionnaire (DCDQ-J). WAVES was developed for the assessment of visual abilities in Japanese children, and consists of three domains: visual perception, eye-hand coordination, and eye movement,

Method

Forty children (32 boys and 8 girls, aged 6-12 years) suspected of having neurodevelopmental disorders were evaluated using WAVES and DCDQ-J. Spearman's rank correlation coefficient analysis was used to identify any relationship between the Visual Perception and Eye-hand Coordination Index (VPECI), Eye-hand Coordination General Index (ECGI), Eye-hand Coordination Accuracy Index (ECAI), and Visual Perception Index (VPI) of the WAVES instrument, and Control During Movement (CDM), Fine Motor (FM), General Coordination (GC), and total scores of the DCDQ-J. A p-value of <0.05 was considered an indication of statistical significance.

Results

There were significant correlations between VPECI and CDM (Spearman's rank correlation coefficient = 0.313, $p = 0.049$), FM ($r = 0.329$, $p = 0.038$), GC ($r = 0.358$, $p = 0.023$), and total scores of the DCDQ-J ($r = 0.394$, $p = 0.012$). There were also significant correlations between ECAI and total scores of the DCDQ-J ($r = 0.345$, $p = 0.029$).

Conclusion

VPECI is an index of visual perception and eye-hand coordination. The ability to integrate visual perception and eye-hand coordination was reflected in the CDM, FM, GC, and total scores of the DCDQ-J.

Is this your hand or the hand of someone else?: An fMRI study on body awareness in autism spectrum disorder

Okamoto Y, Kitada R, Miyahara M, Kochiyama T, Arai S, Ishikawa S, Sadato N, Okazawa H, Kosaka H

Introduction

Since the advent of DSM-5 in 2013, a dual diagnosis of developmental coordination disorder (DCD) with autism spectrum disorder (ASD) has been accepted. However, the nature of coordination difficulties in individuals with ASD has not yet been fully characterized. We focused on body awareness which has been associated with the cortical region of lateral occipito-temporal cortex (LOTC). Given that poor body awareness is a common feature in individuals with ASD, the patterns of cortical activation in the LOTC may differ between young people with ASD and age- and IQ-matched controls while engaging in body awareness tasks.

Method

In the present behavioural and functional magnetic resonance imaging (fMRI) study, we examined if 18 young people with ASD differed from age- and IQ-matched 18 typically developed (TD) young people with respect to (1) the speed and accuracy in distinguishing the hand of self from the hands of others (Self vs. Other Identity) presented in upright and inverted orientations (Upright vs. Inverted Orientation) outside the MRI scanner; (2) neural response in the LOTC while passively observing the same hands inside the MRI scanner. We are currently collecting data on motor coordination (DCDQ, MABC-2) and gesture imitation which will be correlated with the behavioural and MRI data.

Results

Both ASD and TD groups identified their own hands more accurately than the others' hands in the upright orientation, and both groups identified the upright hands more accurately than the inverted hands. Thus, no group difference existed in the accuracy. There was a significant Group X Orientation interaction effect in that the upright hands were recognised faster than the inverted hands in the TD group, whereas the orientation of the hands made no difference in the response time in the ASD group. In consistent with the group difference in response time, the brain activation in the left upper limb sensitive region in the LOTC was greater under the inverted hand condition than under the upright condition in the TD group, whereas no such orientation-dependent activation was observed in the ASD group.

Conclusion

These findings demonstrate a reduced hand orientation effect in ASD at the behavioural and neuronal levels. We must await further data on the motor coordination and gesture ability to determine the relation between the reduced hand inversion effect and the motor abilities.

Explicit motor learning of a synchronization task is improved by auditory (vs visual) stimulations in Children with Developmental Coordination Disorder

Péran P, **Blais M**, Albaret J, Chaix Y, Maziero S, Jucla M, Biotteau M, Tallet J

Introduction

Procedural learning can be assessed by the ability to integrate a new sensori-motor sequence. The possible deficit in procedural learning in Developmental Coordination Disorder (DCD) is still unclear. Children with Neurofibromatosis type 1 (NF1) are known to be impaired in such a learning task and provide a model of procedural learning deficit. Hence, we aimed to (1) compare learning of a rhythmic sequence in DCD, NF1, control children and adults, and (2) test the possible effect of auditory and visual cues to improve learning.

Method

12 DCD, 13 NF1, 15 control children (8-12 yo) and 7 adults (20-30 yo) were asked to learn 2 non-isochronous rhythmic sequences (auditory and visual) by tapping with right index finger on the keyboard in synchronization with visual or auditory stimuli. Both conditions were counter-balanced. Both sequences were composed of 11 stimuli with an interval inter-stimuli varying from 375 ms to 1500 ms. Each sequence was practiced during 6 blocks of 5 trials. After each practice trial, visual feedback was given to inform participants of their performance (accuracy and stability). Analysis was performed with circular statistics that yield, for each trial, a vector which is composed by its mean angular direction, reflecting accuracy, and its length, reflecting stability. Large synchronization is reflected by low angular direction and high vector length. Group \times Modality \times Bloc ANOVAs were performed on the two variables ($p \leq 0.05$).

Results

Adults presented lower angular vector and higher length vector and they had higher decreased of angular vector and higher increased of length vector than all children with practice. Then, DCD children presented similar angular vector and length vector than NF1 but higher angular vector and lower length vector than control children. Angular vector decreased in both DCD and control children but not in NF1 children. Finally, the angular vector decreased and the length of the vector increased, even more with auditory than visual stimulations whatever the group.

Conclusion

Firstly, despite lower levels of accuracy and stability, DCD children presented intact procedural learning of a rhythmic sequence, which is not the case for NF1 children. This main result highlights the differential impact of idiopathic (DCD) vs secondary (NF1) nature of learning disabilities on procedural learning. Secondly auditory stimulations speed the progress of learning in all groups compared to visual stimulations. This last finding strengthens the importance to take into account the modality of stimulations for clinical intervention with children with DCD.

Relations between motor and cognitive skills in Italian, sporty and typically developed children, aged between 7 and 10 years old

Policastro F

Introduction

Recent studies demonstrate important correlations between motor, attention, working memory and motor memory disorders in children and adolescents with Developmental Coordination Disorder.

In the Italian context there are no investigations about these topics. The present research assesses typically developed, healthy children aged between 7 and 10 years old, who play basketball. The aim of the study is to verify the presence of possible correlations between the cognitive and motor abilities listed above in a healthy and sporty sample of 100 children. Furthermore this research would be relevant to the understanding of the physiological and pathological development of cognitive and motor skills. It considers young children to verify the influence of sport activity during this developmental phase.

Methods

The recruitment of children has taken place following the approval of the Ethic Committee of the University of Trieste (Italy) and only after having collected the parents' informed consent.

The subjects of this pilot study are 6 children (3 males, 3 females) aged between 7 and 10 years old, ($m=9,2$ years, $sd=1,2$).

After a preliminary questionnaire to investigate the subjects' neurodevelopmental story and their health, they were assessed and monitored following this protocol: BMI, Developmental Neuropsychological Assessment, NEPSY-II Attention Test (A4), Developmental Neuropsychological Assessment, NEPSY-II Motor Manual Sequences Test (SM4), Corsi Block-Tapping Test (Visuo-Spatial Working Memory - VSWM), Movement Assessment Battery for Children-2 (MABC-2) Band 2, 7-10 years.

After the complete assessment, all children resulted suitable. Data has been studied through marked scatter charts, to verify the correlations.

Results

The subjects scored over the 16th percentile in MABC-2. Scatter charts demonstrate possible positive correlations: VSWM with balance and motor manual skills; motor manual skills with attention; catching/aiming skills with attention; manual dexterity with attention for switching.

Charts demonstrate possible negative correlations: VSWM with catching/aiming skills, manual dexterity and attention for inhibition; balance with attention for inhibition and switching; manual dexterity with manual motor skills.

The results suggest which correlations could be found in the wider sample. The complete correlations will be analyzed through specific linear or non-linear regression.

Conclusions

This research would bring data about a non-explored topic in the Italian context. It would describe the development of young and sporty children, also useful for a comparison with an unhealthy population. It would lead to an understanding of the importance of sport activities and of the relations between different abilities.

Evaluation of a Cycling Group Intervention for Children with Developmental Coordination Disorder: a model for Health Care Professionals and Students

Prunty M, Barnett A

Introduction

In recent years there has been a shift towards participation-focused interventions for children with Developmental Coordination Disorder (DCD). One skill in particular which facilitates participation is that of bike riding which is cited as the number one therapy goal for children with DCD. While this shift is welcomed by children and families, health care professionals have few established models of service delivery from which to draw. We have developed a cycling intervention for children with DCD which is delivered by an Occupational Therapist (OT) with the support of OT students who are interested in developing practice related skills. The aim of this preliminary study was to describe this intervention and evaluate its effectiveness in meeting the cycling goals of children and increasing self-efficacy and satisfaction with their performance.

Method

Eight children with a diagnosis of DCD (aged 5-14 years) took part in the intervention at Brunel University London (2 hours/ day for 5 days). All children identified cycling as a therapy goal using the Canadian Occupational Performance Measure (COPM) during an initial assessment. Perceived performance and satisfaction levels were ascertained from both the child and the parent prior to and immediately following the intervention. Qualitative feedback from five children and parents were collected through a questionnaire to supplement the quantitative findings.

Results

None of the children could ride a bike during the first session but 7 pedalled independently and one with support during the final session. The difference between the pre and post-test scores for perceived performance and satisfaction were statistically and clinically significant for both the parents and the children. Evaluations from the parents and children revealed benefits such as an increase in confidence and learning to cycle. In addition, strategies for teaching and learning emerged as themes including the importance of breaking the task down into smaller components and engaging in practice.

Conclusion

This cycling intervention facilitated by an OT with the support of students may offer a cost effective and efficacious model for teaching children with DCD how to cycle. In addition, it may also provide other notable benefits in terms of translating knowledge to parents about teaching and learning strategies for skill acquisition.

Identification of Developmental Coordination Disorder in European French-speaking countries: validation of the DCDQ-FE 5-15

Ray-Kaeser S, Thommen E, Martini R, Memoli Robert N, Jover M, Gurtner B, Bertrand A

Introduction

Guidelines for identifying Developmental Coordination Disorder (DCD) recommend assessing the interference of motor performance on daily activities with a culturally adapted, reliable and valid questionnaire (Blank et al., 2012). The European-French version of the questionnaire DCDQ'07 (Wilson et al., 2009), the DCDQ-FE 5-15 version, showed moderate to excellent inter-language reliability for each factor (ICC=0.88-0.89), and fairly similar internal consistency (0.93) to the original DCDQ'07, attesting to the homogeneity of all items (Ray-Kaeser et al., 2016).

The aim of this study is to assess the construct validity of the DCDQ-FE 5-15 and determine cut-off values for the European-French population.

Method

Data collection is still ongoing. French-speaking parent-child (5 to 15 years) pairs living in Switzerland and France are being recruited, including a group of children with DCD and suspect DCD, alongside with a group of typically developing age-matched controls. Parents are completing the DCDQ-FE while children are being assessed with the MABC-2.

Results

The daily motor performance of children with DCD and suspect DCD (n=28), as reflected by the DCDQ-FE, is significantly lower compared to controls (n=28) ($Z=-5.7$, $p<0.001$). Preliminary analyses show that the DCDQ-FE scores are correlated with those of the MABC-2 ($r_s=0.68$, $p<0.001$). The DCDQ-FE 5-15 scores are also correlated with the MABC-2 component scores: manual dexterity ($r_s=0.77$, $p<0.001$), aiming and catching ($r_s=0.65$, $p<0.001$), balance ($r_s=0.68$, $p<0.001$).

Conclusion

Preliminary results provide initial evidence of the validity of the DCDQ-FE 5-15 in a European French-speaking context. This questionnaire enables the identification of children who are at risk for motor difficulties and who might benefit from a more in depth motor assessment.

Mirror Neuron System Activation in Children with Developmental Coordination Disorder: A functional MRI study

Reynolds J, Billington J, Kerrigan S, Williams J, Elliott C, Winsor A, Codd L, Bynevelt M, Licari M

Introduction

It has been hypothesised that deficits in imitation, and the internal representation of movement (motor imagery), linked to abnormal functioning of the mirror neuron system (MNS), may contribute to the motor impairments associated with developmental coordination disorder (DCD). Using functional magnetic resonance imaging (fMRI), this study aimed to examine brain activation patterns across various MNS activation states.

Method

Nineteen boys aged 8.25 – 12.75 years participated, including ten children with DCD (≤ 16 th percentile on MABC-2; no ADHD/ASD), and nine typically developing controls (≥ 20 th percentile on MABC-2). Imaging was conducted using a Philips Ingenia 3T Multi Transmit Wide Bore Scanner, with participants wearing a 12-channel head coil. During scanning, participants performed a target-directed adduction/abduction (side to side) index finger tapping task using their right hand under four separate conditions: (1) action observation; (2) motor imagery; (3) action execution; and (4) action imitation. Eight repetitions of each condition were completed in a randomized order across two functional studies. Each condition lasted for approximately 18 seconds with 12 seconds of rest between each.

Results

No differences in MNS activation were seen between the DCD and control groups at a neurological level, with both groups activating mirror neuron regions effectively across the conditions. Consistent with the results of previous research (Reynolds, Licari, Billington et al., 2015), group comparisons of neural activation for each task condition revealed minimal between-group differences. Small clusters of decreased activation during imitation were identified in the DCD group compared to controls in non-mirror regions involved in motor planning and attentional processes, including the thalamus, caudate and posterior cingulate.

Conclusion

The results of this study suggest that MNS dysfunction is not an underlying mechanism contributing to the motor deficits characteristic of DCD. Further research is required to explore motor planning and attentional processes in children with DCD at a neurological level.

Improvement in brain activation after a short handwriting intervention in children with Developmental Coordination Disorder

Ricard M, Srinivasan D, Vasikaran H, Liu H, Caçola P

Introduction

Poor handwriting is a core deficit in children with Developmental Coordination Disorder (DCD). The purpose of this study was to compare and investigate the effectiveness of a mobile app handwriting intervention in behavioural and sensorimotor cortex activity in children typically developing and children with DCD.

Method

Seven children previously diagnosed with DCD between ages 7 and 10 participated in the study, all paired with matched controls. They trained handwriting for a week using an iPad and stylus to play games designed specifically to improve handwriting outcomes. Children were asked to copy a short paragraph before and after the treatment and were measured for sensorimotor activity using the Functional Near-Infrared Spectroscopy (fNIRS) method, conducted with a 77-channel Shimadzu Labnirs system.

Results

In the pre-test, a group level t-statistical map (t-map) showed significant activation on brain template for controls in the motor cortex (Brodmann area 6) and the right DLPFC (Brodmann area 9), while children with DCD showed activation in left post central gyrus (Brodmann area 4). Both groups showed significant changes after the intervention, with controls demonstrating activation in pre-motor/ supplementary motor area (BA 6), primary motor cortex (Brodmann area 4) and in the right dorsolateral prefrontal cortex (DLPFC–BA 9), and the children with DCD showing a mild activation in the pre-motor area /supplementary motor area (BA 6) as well as the frontal eye field (Brodmann area 8) for visual attention and DLPFC (BA 9).

Conclusions

In the pre-test, there was no activation in the pre-motor area for children with DCD as they have difficulties with motor initiation and sequencing. Controls show activation in DLPFC indicating that during the performance of fine-motor tasks, the frontal region works with the motor cortex for motor planning and error reduction. However, after a short intervention aimed to improve handwriting, children with DCD showed significant increased HbO (increased cerebral blood flow) in frontal regions, strengthening the association between the attention and motor networks. We can conclude that the intervention is capable of increase brain activation in children with DCD.

Further Development and Validation of the Israeli Little Developmental Coordination Disorder Questionnaire (LDCDQ)

Rihtman T, Tal-Saban M, Parush S

Introduction

Even though Developmental Coordination Disorder (DCD) is not commonly diagnosed before age 5, motor difficulties may be apparent earlier than this. Children with suspected motor delay should be monitored with the aim of providing timely intervention. The Little Developmental Coordination Disorder Questionnaire (LDCDQ) was developed in Hebrew to provide an easy-to-use motor screening tool for pre-schoolers aged 3 and 4. The development process and initial psychometric properties were encouraging (Rihtman, Wilson & Parush, 2011), yet further assessment and development is recommended prior to widespread clinical use.

Methods

This report updates on the psychometric properties of the Israeli LDCDQ. Ethical approval was obtained from the Hebrew University of Jerusalem.

The previously reported convenience sample (146 pre-schoolers) was expanded to 306 children (185 boys) (M48.31+6.87 months); 199 TD (98 boys) (M47.36+6.81 months) and 107 (87 boys; M50.06+6.66 months) Ref children. The 15-item LDCDQ screening questionnaire generates three sub-scores (control during movement, fine motor, general coordination) and a total score, and was completed by the children's parents.

Results

Internal consistency for total and sub-scores (TD/Ref/total samples): previously reported Cronbach alpha values ranged from 0.653-0.931; updated values range from 0.712-0.926.

Construct validity (measured through TD-Ref group differences): Previously reported significant total score group differences were verified for the total sample ($t[141.45]=13.73; p<0.001; d=1.77$), 3-year-olds ($t[46.41]=9.91; p<0.001; d=2.10$) and 4-year-olds ($t[95.48]=10.16; p<0.001; d=1.66$). Sub scores were investigated using multivariate analyses of variance. Previously reported significant group differences were verified, with large effect sizes for all age groups.

As per previously reported findings, no age-related correlations or differences were found in the expanded sample for any LDCDQ score, providing support for instrument structure and content.

Conclusions

The expanding evidence from the continued validation procedures of the Israeli LDCDQ reinforces its potential clinical use with 3- and 4-year-olds. Future research aims to demonstrate criterion validity, sensitivity and specificity, and to establish cut-off scores for suspected motor concerns.

Development of the Little Developmental Coordination Disorder Questionnaire (L-DCDQ) – UK version

Rihtman T, Green D

Introduction

Developmental Coordination Disorder (DCD) is a common condition which may have long term impacts, yet the underlying mechanisms of functional motor difficulties are still unclear. There is increasing awareness of the need to identify younger children at risk of DCD, before secondary issues develop. Questionnaires have been developed to screen for movement problems in school-aged children; the DCD Questionnaire (DCDQ) is commonly used with children aged five+. The Little-DCDQ (LDCDQ) was developed in Israel based on the DCDQ, following the same format but with items adapted for children aged three and four (Rihtman, Wilson and Parush, 2011). However, instruments developed in one culture/language may not be suited for use in other cultures/languages; ensuring the psychometric properties of translated and adapted instruments is essential for accurate clinical use.

Method

The first phase of this study (Phase 1) aimed to develop a valid and reliable version of the LDCDQ for use in the UK to screen pre-school children for movement difficulties. Additionally, the study aims to assess relationships between sensory, behavioural and motor measures amongst young children (Phase 2). Finally, data from this study will be incorporated within a multi-site, cross-cultural collaborative investigation of motor development of young pre-schoolers (Phase 3). This research paper will report on the outcomes of Phase 1, and preliminary results of Phase 2.

Results

A robust process of translation-back translation was undertaken to generate an English language version of the LDCDQ. In Phase 1, 20 parents, 14 nursery teachers and 15 clinicians commented on item suitability for three-year-olds, four-year-olds and appropriateness to UK culture. Response data were collated and used to amend items and format, to ensure face validity of the questionnaire. Based on the outcomes of these procedures, the LDCDQ(UK) was finalised for use in Phases 2 and 3 of the study. Data collection for Phase 2 is currently underway.

Conclusions

Findings to date demonstrate the importance of employing robust procedures to ensure adequate validation of instruments originally developed in other cultures, and highlight the nuances required to adapt the original LDCDQ screening instrument for use in the UK.

The Little Developmental Coordination Disorder Questionnaire (LDCDQ) cross-cultural collaboration for identifying motor delay in young pre-schoolers

Rihtman T, Wilson B, Cermak S, Rodger S, Kennedy-Behr A, Snowdon L, Schoemaker M, Cantell M, Houwen S, Jover M, Albaret J, Ray-Kaesler S, Magalhães L, Cardoso A, Van Waelvelde H, Vincon S, Tseng M, Pienaar A, Coetzee D, Nakai A, Martini R, Tercon J, Green D, Imperatore (Blanche) E, Diaz J, Parush S

Introduction

Even though Developmental Coordination Disorder (DCD) is typically not diagnosed before 5 years, identification of younger preschool children at risk of DCD may mitigate secondary complications, through provision of early support. Screening tools to identify motor difficulties are needed, but instruments developed in one country may not be psychometrically sound in other cultures. This study aims to collaboratively develop the Little Developmental Coordination Disorder Questionnaire (LDCDQ) (a screening instrument for motor difficulties in young pre-schoolers) between several countries, while ensuring numerous psychometrically sound, comparable versions of the tool. This innovative project in the field of DCD will enable analysis and comparison of different patterns of motor development and/or delay in different cultures.

Methods

Based on a similar screening instrument for older children, the Little DCDQ was developed in Hebrew and psychometrically tested. After generating an English Little DCDQ (following recommended guidelines), 26 researchers from 17 sites adapted and psychometrically tested the instrument with their local cultures/languages. Thereafter, each collaborator used their local Little DCDQ to assess 40 children aged 3-4.11 (20 typically developing; 20 with suspected motor difficulties) following the same protocol, and data was compared.

Results

The process of the first phase of this collaboration will be briefly described and cross-cultural comparative results to date will be reported. Within most countries, significant differences in motor performance between referred and non-referred children were found. When comparing between countries, significant differences were more noticeable for non-referred than referred children; trends in high- and low-scoring means will be discussed.

Conclusion

This study has important implications for DCD research and practice. This is the first attempt to develop an instrument with the aim of facilitating cross-cultural comparison of DCD in young pre-schoolers, which will enable a unified language for researchers investigating typical and delayed motor development in pre-schoolers.

Prevalence and Comorbidities of DCD Using DSM-5, Comparison of Motor and Cognitive functions at Preschool Age in a Japanese Community

Saito M, Osato-Kaneda A, Tanaka M, Masuda T, Yoshida S, Sakamoto Y, Matsubara Y, Takayanagi N, Adachi M, Takahashi M, Yasuda S, Kuribayashi M, Nakai A, Miyahara M, Nakamura K

Introduction

The prevalence of Developmental Coordination Disorder (DCD) is reported around 5% (APA. 2013). However, epidemiological information depends on selection criteria (Brank R. 2012), and DCD has been reported to be associated with other neurodevelopmental disorders (Lingam R. 2010, 2016). To investigate DCD, it is necessary to conduct several screenings not only for DCD but also the other disorders in epidemiological studies. The aim of this study is to estimate the prevalence of DCD of 5 year-old children in a Japanese community using recommended definitions by European Academy for Childhood Disability (EACD) and Diagnostic and Statistical Manual of Mental Disorder, Fifth Edition (DSM-5). We also clarify the difference in the motor coordination difficulties and the cognitive functions among DCD children.

Method

This study was conducted as the Hirosaki Five years old developmental health check-up (HFC) study. Subjects are 2923/3804 children who became 5 years old from 2013 to 2015 in Hirosaki city. By primary screenings (DCDQ, SDQ, ASSQ, ADHD-RS, PSI-C), 607 children were selected to undergo second developmental health examinations (MABC-2, WISC-4 and several examinations). Finally, 440 children and their parents visited the developmental health check-up. Pediatricians and psychiatrists diagnosed neurodevelopmental disorder such as DCD, Autistic Spectrum Disorder (ASD), Attention-Deficit/Hyperactivity Disorder (AD/HD) and Intellectual Disability (ID) directly using DSM-5 criteria. We calculated the prevalence and comorbidities. In addition, the sub-components of MABC-2 in DCDs with/without other developmental disorders were statistically analyzed by t-test ($p>0.05$). We compared DCD only group ($n=53$) and control group ($n=53$) regarding the sub-components of WISC-4, matching each case in months of age, gender and FSIQ (>80).

Results

The prevalence of DCD was 5.41%. The comorbidities of DCD were ASD (36.7%), ADHD (34.0%) and ID (29.9%). 63 DCDs (42.9%) had no comorbidity. The mean MABC-2 'Manual Dexterity' and total standardized score of the DCD group with ID was significantly lower than without ID ($p<0.01$, $p<0.05$) respectively. The mean scores of 'Coding' of WISC-4 in DCDs were significantly lower than Control group.

Conclusion

This is the first epidemiological study of a community-based population sample in Japan. These findings suggest that more than half of DCD children have comorbidities and difficulties in coordination of motor function, particularly visual information processing ability. It is necessary to examine whether the symptoms will improve by early detection and treatment in the future.

Progression and participation in children with and without DCD and associated characteristics: A longitudinal study

Sugden D, Swanwick R, Chambers M, **McQuillan V**

Introduction

Developmental Coordination Disorder (DCD) is a chronic condition affecting motor coordination. It often co-occurs with other developmental conditions and associated characteristics (AC) with problematic non-motor behaviours. Both motor and non-motor difficulties can negatively impact daily function and participation. Previous studies have shown that some children with DCD improve their motor ability whilst others remain stable or deteriorate. However it remains difficult to predict which children will improve, or how this impacts on their participation.

The aim of this study was to profile the motor and associated characteristics of children with DCD and track their progression in motor ability over time compared to typically developing children (TDC). A second aim was to track children's self-perception of ability to participate in physical activity (PA) over time and compare it to their participation in extracurricular PA.

Method

Thirty-four children were recruited from mainstream schools, aged 7-14. All children were assessed for criteria for DCD in DSM5. Motor ability was assessed using the MABC2. Children categorized as DCD and TDC were concurrently asked about their perceptions of their ability to participate in (PA) using the CSAPPA. The children were followed over 2 academic years. Using Bronfenbrenner's bioecological model detailed information on each child, the family and school circumstances were collected through a series of questionnaires, discussion and observation. Nested cases were also interviewed.

Results

Six categories emerged: severe DCD (sDCD); sDCD plus AC (sDCD+); moderate DCD (mDCD); mDCD+; Typically developing children (TDC); TDC+. Distinct patterns of stability and change arose. TDC showed some variation in motor ability, however the sDCD children remained relatively stable and all remained ≤ 5 th MABC2 over time. The mDCD showed the greatest variability, with many improving or deteriorating and changing categories. However the motor results were not reflected in the children's perceptions of their own ability and did not necessarily relate to their participation in extracurricular PA in this study.

Conclusion

To our knowledge this is the first study to combine repeated measures of motor ability, repeated child perception of PA and tangible participation in extracurricular PA. The results reveal that for children with DCD participation in PA involves more complex factors than motor ability. Detail on IQ, severity of DCD, number and type of AC, family circumstances and child perceptions may have large implications for future practice improving participation in PA for children with DCD.

Friendship and Socialising Questionnaire (FAS-Q): Development and Preliminary Psychometric Properties

Tal-Saban M, Amanda K

Introduction

The purpose of this paper is to describe the development of the Friendship and Socialising Questionnaire (FAS-Q) for adults. This self-report questionnaire aims to identify experiences and competencies required to form friendships and close relationships among adults with DCD. Increasing numbers of studies are demonstrating that DCD continues into adulthood and impacts on participation in daily life. Despite the increased awareness of the implications of this disorder and evidence showing that children with DCD have problems in social relationships, few studies exist focusing on social and close relationships in adults with DCD. Moreover, to our knowledge, no questionnaire exists that assesses these abilities in adults with DCD.

Method

Constructing of the FAS-Q questionnaire was done by developing a pool of self-report questions that reflect adults' self-perceptions of their social and close relationships. This was accomplished through a comprehensive literature review, along with interviewing typical young adults. The interviews included questions regarding their social activities, self-perception of forming social and close relationships, and their management of social situations in their daily lives. Additional input was obtained from professionals with extensive clinical experience in the assessment and treatment of adults with DCD.

Results

The initial process resulted in a pool of 56 questions and social case studies (short descriptions of social scenarios with options of responses to choose). Content validity was further established through the validation of the FAS-Q questions (I-CVI) and scales (S-CVI) by a panel of 7 experts who rated each question according to its relevance to the underlying construct. Questions judged to be irrelevant ($<.80$) were eliminated from the questionnaire. Ecological validity was supported by the interview data regarding the social activities typically performed by adults. Qualitative evaluation of the user-friendliness of the questionnaire was comprised of examining the wording and questions clarity and the time required to complete the questionnaire. Following these processes, the FAS-Q comprises 36 questions divided into 3 sections: (a) social and close relationships in the past, (b) social and close relationships in the present, and (c) social case studies. The reliability of the 36 FAS-Q questions was determined using Cronbach α and found to be high ($\alpha = .84$; and for each section $\alpha > .75$).

Conclusion

The FAS-Q was found to be a valid, ecological and user friendly measure to assess social and close relationships in young adults with DCD. Further results of the construct validity will be presented in the conference.

Evaluation of factor structure equivalence of the Developmental Coordination Disorder Questionnaire across genders in Japanese preschool children: HFC study

Tanaka M, Saito M, Kaneda-Osato A, Masuda T, Takayanagi N, Takahashi M, Adachi M, Yasuda S, Yoshida S, Kuribayashi M, Nakai A, Miyahara M, Nakamura K, **Sakamoto, Y**

Introduction

The Developmental Coordination Disorder Questionnaire is a parent or guardian rated measure to identify developmental coordination disorder. The Japanese version of DCDQ (DCDQ-J) developed by Nakai et al. (2011) was confirmed its validity and reliability for community-based children sample aged four to fifteen. Additionally, they founded that the DCDQ-J had three interpretable factors (control during movement, fine motor, and general coordination) as same as the original DCDQ. However, it was unknown whether factor structure of the DCDQ-J was equivalent across genders or not. We need to confirm the factor structure equivalence across genders for comparing its mean score. This study aimed to evaluate factor structure of the DCDQ-J.

Method

This study was conducted as a part of Hirosaki Five-year-old Children Developmental Health Check-up Study (HFC study). We sent a set of questionnaire including the DCDQ-J to screen various developmental disorders for 3804 family with five years old children from 2013 to 2015 year via the municipal health center. 2923 family responded to this survey. We ruled out the data with missing value among DCDQ-J, physically handicapped children, diagnosed as intellectual disabilities by psychiatrists on the second detailed developmental health check-up after first screening. Moreover, we also excluded the data that refused to participate in the second health check-up although they met at least above the cut-off score on the first screening. Finally, we analyzed 2506 eligible data (boys = 1286, girls = 1220) in this study.

Results

A confirmatory factor analysis showed that three-factor model of the DCDQ-J provided unacceptable fit indices (CFI = .847, RMSEA = .118, SRMR = .071). Therefore, we added four error covariances based on the modification indices. This modified model provided an adequate fit to the data (CFI = .948, RMSEA = .070, SRMR = .051). Additionally, we tested the measurement invariance of this model across genders. A multi-group confirmatory factor analysis revealed that the configural invariant model provided an adequate fit to the data (CFI = .947, RMSEA = .050, SRMR = .053). The factor loading invariant model also showed acceptable fit indices (CFI = .947, RMSEA = .049, SRMR = .054) and change of fit indices met Chen's (2007) recommended criteria. However, the consistency of the intercept invariant model across genders was not supported.

Conclusion

Factor structure of the DCDQ-J was equivalent at the factor loading level across genders. This means that we can compare DCD traits across genders using the DCDQ-J.

Developmental coordination disorder trait in Japanese preschoolers impact on parenting stress

Takahashi M, Adachi M, Takayanagi N, Yasuda S, Osato-Kaneda A, Mikami M, Nakai A, Manabu S, Kuribayashi M, Nakamura K

Introduction

There are no known empirical studies examining the impact of DCD trait in children on parental stress related to parenting, while developmental coordination disorder (DCD) trait being pervasive in children of the general population. The aim of the present study was to elucidate the relationship between DCD trait and parenting stress in a community-based sample of preschoolers and their parents or caregivers.

Methods

The present study included 1781 participants who lived in Hirosaki City. The parents and primary caregivers of these children completed questionnaires concerning parenting stress and DCD, attention deficit/hyperactivity disorder (ADHD), and autism spectrum disorder (ASD) traits. We used the DCDQ, ADHD-RS and ASSQ to evaluate each trait of neurodevelopmental disorders. The PSI Child-domain was used to assess parental stress related to caring child. We conducted hierarchical multiple regression analyses to examine the influence of DCD trait in children on parenting stress beyond possible confounding factors including demographics and other neurodevelopmental disorder traits.

Results

The total score of the DCDQ was negatively associated with PSI-C score ($\beta = -0.256$, $p < 0.001$) after controlling for demographics, including sex of children, number of siblings, family structure and annual income, and other traits of neurodevelopmental disorders. Among all subscales, general coordination ($\beta = -0.270$, $p < 0.001$), which is a DCD trait, had the strongest impact on parenting stress. Interestingly, our results showed children's sex affected the pattern of the relationships between the DCDQ subscale and the PSI-C. The parenting stress experienced by parents and caregivers of boys was associated with general coordination, but not control during movement and fine motor/handwriting. However, parenting stress experienced by parents and caregivers of girls was related to fine motor/handwriting and general coordination but not control during movement. The results of another correlation analysis demonstrated DCD trait was significantly correlated with ADHD and ASD traits.

Conclusion

The DCD trait in preschoolers was found to have an impact on parenting stress as well as other neurodevelopmental disorder traits in the general population. Therefore, we highlighted the need to care for parents and caregivers who have children with a high level of DCD trait even in non-clinical population.

Peer Relationships and Health-Related Quality of Life in Adolescents with Developmental Coordination Disorder and Attention Deficit/Hyperactivity Disorder

Volkovinskaia A, McMorris C, Dewey D

Introduction

Developmental coordination disorder (DCD) is a neurodevelopmental disorder that is associated with difficulty coordinating movements, which interferes with the performance of daily activities. Individuals with DCD can also evidence social skills difficulties, behaviour problems and low self-esteem. About 50% of the individuals with DCD have attention deficit/hyperactivity disorder (ADHD), which is associated with problems in social skills, behaviour and peer relationships. The co-occurrence of DCD and ADHD could increase the likelihood of an individual experiencing difficulty in peer relationships and could influence quality of life.

Method

We used a mixed-method approach to explore peer relationships and quality of life in adolescents aged 11 to 18. Forty-four adolescents participated; nine of the adolescent had DCD, 10 had ADHD, 9 had co-occurring DCD and ADHD and 16 were typically developing (TD). The adolescents completed two quantitative questionnaires: the Peer Relationships Questionnaire for Children and the KIDSCREEN-52 Health-Related Quality of Life Questionnaire. Thirty-six participants completed a qualitative, semi-structured interview on past and current peer relationships.

Results

Adolescents with DCD and/or ADHD scored lower on the Physical Well-Being component of the KIDSCREEN-52, and were more likely to report participating in sedentary-only activities, compared to their TD peers. On the Pro-Social subscale of the Peer Relationships Questionnaire, adolescents with DCD and/or ADHD scored higher than TD peers; suggesting that they were interested in and wanted to be involved in social relationship. However, qualitative interviews revealed that among youth with DCD only and DCD+ADHD feelings of marginalization were evident. One 14-year-old female with DCD only said, "We're more of the ones that people would probably make more fun of, I guess. Like they don't necessarily want to be around us,..... [They] just think that we're weird." Adolescents with ADHD-only or co-occurring DCD and were more likely to describe being rejected or bullied by their peers. A male with DCD and ADHD, aged 14, stated, "[I am in] the group that's just off to the side,....sort of the rejects."

Conclusions

DCD, ADHD and co-occurring DCD+ADHD are associated with lower health-related quality of life and peer relationship difficulties. Although adolescent with these disorders want to participate in social activities with peers, they report feeling marginalized and/or rejected. Research is needed that explores the effectiveness of social skills interventions to determine if such programs can improve peer relationships and quality of life in children with DCD and/or ADHD.

Clumsy Kids in the Classroom

Wakefield S

Introduction

As part of my PhD I am investigating the impact of DCD upon classroom participation and occupational performance within an Australian classroom setting for primary school aged children.

Method

This has been conducted with 4 schools and data is still being collected and hopefully completed by the time of the conference, but at least three schools have been engaged at this stage. Data was collected through a three stage process of parental questionnaires (DCDQ) identified possible participants and then specific assessment using the MABC2 and KBIT 2 to identify students with possible DCD. Third stage was a classroom observation of their performance using the school AMPS and handwriting assessments.

Results

Full results will be presented at DCD12. Clinical observation indicated nearly all students who participated had a high correlation between the DCDQ and their MABC scores. Nearly all students reported handwriting difficulties. Classroom observation showed a high percentage of pausing and wait behaviours rather than asking for help/seeking assistance.

Evaluation of School AMPS as a tool for identifying children with developmental coordination disorder in the final year of preschool

Yasunaga M, Akio N, Kita Y, Miyaguchi H, Ishizuki C

Introduction

The School version of the Assessment of Motor and Process Skills (School AMPS) is a screening tool to evaluate children's motor skills and task performance within the school environment. School AMPS is useful in planning effective interventions for children with DCD in daily life, while the M-ABC2 and the DCDQ are commonly used for more precise assessment needed for the diagnosis of DCD. The present study aimed to examine the relationship between School AMPS and motor coordination assessed by the Japanese version of the M-ABC2 (M-ABC2-J) and the DCDQ (DCDQ-J), to determine the efficacy of School AMPS in identifying children with DCD.

Methods

We tested 59 Japanese preschool children (mean age 6.3 ± 3.4 yrs; 25 males; 34 females), using the M-ABC2. Parents rated the motor skills of their children with the DCDQ, while the professional occupational therapist used School AMPS. We analyzed correlations among these scores to examine the relationships between the scales.

Results

Four children obtained total scores below the 15th percentile for the M-ABC2-J, possibly indicating DCD. Sixteen children were at risk of DCD, with total scores of ≤ 40 on the DCDQ-J. School AMPS indicated nine children below the cut-off values for motor skills and 25 children for process skills. The 16 children who scored below the cut-off values of School AMPS were not found to be at risk of DCD by the M-ABC2-J and/or the DCDQ-J. We found significant correlations between School AMPS and the score of Fine Motor/ Handwriting of the DCDQ-J ($r > .46$, $p < .001$). No significant correlations were observed between School AMPS and the M-ABC2-J.

Conclusion

We did not have strong overall correlations between these scales. However, we did succeed in identifying children whose motor difficulties become more evident within the school environment using School AMPS. These children might be missed based solely on the M-ABC2-J and/or the DCDQ-J, which focus on individual motor skills. School AMPS provides valuable information regarding ADL and activities that could be used in interventions for clumsy children in the school environment.

Effectiveness of motor skill interventions in children with developmental coordination disorder: A systematic review and meta-analysis

Yu J, Sit C, Burnett A, Kwok W, Lau C

Introduction

The objectives of this review were to: 1) determine the magnitude of the effect of motor skill interventions for improving motor competence and other secondary outcomes in children with developmental coordination disorder (DCD) and 2) identify potential moderating variables that influence the effectiveness of such interventions.

Method

Six databases were searched (CINAHL Plus, Cochrane Library, EMBASE, Eric, PsychInfo, and PubMed) for studies that examined the effect of motor skill intervention (movement programs/activities developed for motor skill acquisition or improvement) on children with DCD. Studies had to be written in English and published 1995-2015. Studies were coded for research methodology, participant characteristics, intervention components, outcomes, and significant training effects. Data from studies employing a (quasi) randomized clinical trial design were analyzed using a random-effects model. Hedges' g was used as the effect size index and values were labelled as either small (≤ 0.2), medium (0.5) or large (≥ 0.8). Subgroup analysis or meta-regression was conducted to determine moderating characteristics with reference to participants and treatment design where indicated.

Results

A total of 47 studies were included for qualitative syntheses and 13 of these studies were considered eligible for meta-analyses. A majority of studies considered motor competence (83%) and psychological profiles (53%) as primary outcomes. The effect size for motor competence was of medium magnitude and considered significant at post-test (Hedges' $g=0.68$, 95% confidence intervals [CI]=0.24, 1.12, $p=0.003$). The effect size was non-significant at follow-up (Hedges' $g=0.27$, 95% CI=-0.09, 0.63, $p=0.14$). Similarly, a significant and medium effect size was found for psychological performance at post-test (Hedges' $g=0.51$, 95% CI=0.05, 0.98, $p=0.03$) but not at follow-up ($g=0.11$, 95% CI=-0.31, 0.52, $p=0.61$). Moderator analyses showed that the severity of DCD (definite DCD vs. probable DCD; $p=0.027$) and intervention dose (total minutes of practice; $p<0.001$) significantly moderated the effect of immediate training effects on motor competence. Interventions conducted in children with more severe DCD and a higher intervention dose were considered more effective.

Conclusions

There are significant and more immediate training effects with motor skill interventions aimed at improving motor competence and psychological performance in children with DCD. However, these effects are not retained. Additionally, the severity of DCD and intervention dose significantly explained the variety of intervention effectiveness on motor competence. Future intervention studies are needed to improve the sustainability of training effects as well as examine the impact of motor skill intervention on promoting activity and participation during leisure time.

It may look like DCD, but it is not!

Zwicker J, Shen J, Mickelson E

Introduction

The diagnosis of developmental coordination disorder (DCD) is based on four criteria outlined in the Diagnostic and Statistical Manual-5th ed. (American Psychiatric Association, 2013). One of these criteria is that the motor difficulties are not better explained by other diagnoses, such as intellectual disability, visual impairment, or neurological condition. Yet, few studies of children with DCD report how or if other medical conditions have been ruled out, with only 22/176 studies (12.5%) reporting that the children had been assessed by a physician (Smits-Engelsman et al., 2015). The purpose of this study was to determine what other diagnoses could present like DCD.

Method

A prospective cohort of children referred for suspicion of DCD were assessed by a developmental pediatrician and an occupational therapist. Clinical assessment included developmental history, neurological exam, parent and child interview, standardized motor assessment, and the Developmental Coordination Disorder Questionnaire completed by a parent or caregiver. Diagnosis of DCD was based on DSM-5 criteria (APA, 2013) and the European Academy for Childhood Disability guidelines (Blank et al., 2012).

Results

Of the 111 children assessed as of July 2016, 79 (71%) received a DCD diagnosis. The remaining 32 (29%) were suspected of having DCD but met the diagnostic criteria for other disorders. Of these 32 children, 16 (50%) were diagnosed with another neurodevelopmental disorder (e.g. fetal alcohol spectrum disorder, learning disability, attention deficit hyperactivity disorder), 8 (25%) were diagnosed with a neurological condition (e.g., cerebral palsy, hypotonia, seizure disorder, Chiari I malformation), and 8 (25%) were diagnosed with a genetic or other medical condition (e.g., microdeletion syndromes, Neurofibromatosis Type 1, Ehlers-Danlos syndrome).

Conclusions

Results of this study underscore the importance of having children suspected of DCD to be assessed by a physician to determine if there are other explanations for the child's motor difficulties. Research findings for studies of children with DCD that have not been evaluated by a physician should be interpreted with caution.

Quality of Life of Children with Developmental Coordination Disorder

Zwicker J, Morin D, Karras H, Shen J

Introduction

Recent evidence suggests that children with developmental coordination disorder (DCD) are at risk for experiencing a lower quality of life (QOL) than their typically-developing peers (Zwicker et al., 2013); however, few studies have specifically examined QOL in this population. The aims of this study are to: (1) compare the QOL of children with DCD to published data on typically-developing children; (2) compare the QOL of children with DCD with and without co-occurring disorders; and (3) compare the perspectives of QOL of children with DCD to those of their parents.

Method

This cross-sectional study design will describe the QOL of children with DCD. Inclusion criteria include: (1) children 8-12 years; (2) diagnosis of DCD in accordance with the 5th Edition of the Diagnostic and Statistical Manual of Mental Disorder (DSM-5) criteria (APA, 2013) and European Academy of Childhood Disability guidelines (Blank et al., 2012), as assessed by a developmental pediatrician and an occupational therapist; (3) presence or absence of co-occurring conditions, such as attention deficit hyperactivity disorder or learning disabilities; and (4) parent and child are able to read and comprehend English in order to complete the KidScreen-52 QOL questionnaire (KidScreen Group Europe, 2006).

The KidScreen-52 measures 10 dimensions of health-related QOL, including physical well-being, psychological well-being, mood/emotion, self-perception, autonomy, parent relations/home life, social support/peers, school environment, social acceptance, and financial sources. To determine which areas of QOL are most affected in children with DCD, we will use one-way ANOVAs (corrected for multiple comparisons) to compare scores across these 10 domains in children with DCD compared to published data on typically-developing children. We will use the same approach to compare QOL in children with and without co-occurring disorders and to explore the perspectives of children with DCD compared to their parents.

Results

A convenience sample of ~75 children who meet the inclusion criteria have been recruited through a research-integrated diagnostic DCD clinic. Parents and children have completed the KidScreen-52 and data have been entered in a database with their consent/assent. Data analysis is underway.

Conclusions

Results from this study will increase our understanding of QOL in children with DCD, which may inform changes in clinical practice and provide directions for future research.

Cross-Cultural Dutch Adaptation of the Adolescent Motor Competence Questionnaire (AMCQ) and Exploration of its Psychometric Properties

Zwiers K, **Cantell M**, Timler A, McIntyre F, Crawford S, Hands B

Introduction

The Adolescent Motor Competence Questionnaire (AMCQ; Timler, McIntyre, Crawford, Cantell, & Hands, 2016)) is a self-report tool developed at the University of Notre Dame, Australia, aiming to identify probable Developmental Coordination Disorder in adolescents between the ages of 12 to 18 years-old. The purpose of this study was to adapt the AMCQ for Dutch adolescents (AMCQ-NL) and to explore its psychometric properties.

Method

In the adaptation process, words were adjusted and items transformed, to make them more appropriate for Dutch culture, and back-translations were reviewed for equivalency. The first version of the AMCQ-NL was field-tested in three adolescents diagnosed with DCD. The psychometric properties of the AMCQ-NL were evaluated in a school sample of 147 adolescents (72 males and 75 females). The internal consistency of the 26 items of the AMCQ-NL was determined by Cronbach's alpha to measure reliability. Construct validity was investigated using factor analyses. Concurrent validity was measured by calculating correlations between the AMCQ-NL and Self Concept of Ability in PE class (SCAS-PE; Viholainen, Aro, Purtsi, Tolvanen, & Cantell, 2014). Gender differences were examined with a t-test.

Results

The Australian research team was satisfied with the equivalence of the back-translations to the original. Based on remarks of the participants in the field test, the AMCQ-NL was further improved. In the school sample, internal consistency of the final AMCQ-NL was very good ($\alpha=.803$) and test-retest reliability very high (ICC=.934). A high correlation ($r=.672$, $p < .01$) was found between the total score on the AMCQ-NL and SCAS-PE. The factor analysis revealed three factors explaining 35.2% of the variance: 1 "Participation in physical activity and sports", 2. "Clumsiness", and 3. "Activities of daily living (ADL)". The AMCQ-NL total scores differed ($p < .01$) between the boys ($M=89.14$) and the girls ($M=83.4$).

Conclusions

This exploratory study aimed to provide a NL version of the AMCQ that is age and culture appropriate. The results on the internal consistency, test-retest reliability and concurrent validity provided preliminary evidence of the AMCQ-NL's psychometric qualities and it can be concluded that it has the potential to be a reliable and valid tool for measuring motor competence in Dutch adolescents. Further evidence of the concurrent validity could be gathered by simultaneously assessing motor competence using a standardized field test. Future research should include a geographically and culturally more diverse sample. The next step will be to compare the factor structures between the Australian and the Dutch AMCQ.

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