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Delivering clinic- and home-based programs concurrently for children with  
Developmental Coordination Disorder: A multiple case study

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**Abstract**

Typical settings of intervention for children with developmental coordination disorder (DCD) include home, school, and clinic. Within this current study, we aimed to describe how a concurrent delivery of clinic and home programs for children with DCD would work. Four children with DCD and their families participated in a 10-week trial. All four children had high attendance rates for the clinic sessions. Two of the four families enthusiastically participated in the home program, but the other two families reported difficulties with home practice. The significance of this multiple case report lies in the increased awareness of diverse family needs and capacities to support children with DCD at home. (105 words)

Keywords: *Developmental Coordination Disorder, DCD, intervention, home program*

According to DSM-5 (Diagnostic Statistical Manual of Mental Disorders, 5th version) by the American Psychiatric Association (2013), Developmental Coordination Disorder (DCD) is characterised by a significant delay in acquisition and execution of coordinated motor skills, such as ball skills, which impact activities and participation at home, school, community, and vocational settings, including leisure and play. Among the neurodevelopmental disorders, DCD has the highest prevalence of 5-6% among children aged 5-11 years. Dyspraxia is another term used synonymously with DCD by some and differently by others (See Miyahara, Leeder, Francis, & Inghelbrecht, 2008 for more detail).

Interventions for children with DCD have been carried out and studied at clinic, university labs, home, school, and the community over the past four decades (Miyahara et al., 2017). Despite the claimed value of home and school practice, there are an extremely limited number of intervention studies that leverage non-experts, such as parents and general school teachers as interventionists. In Miyahara et al.'s, (2009) Family Focussed Intervention (FFI), there was lack of adherence to home practice of planned target skills, such as ball skills to play soccer and tennis. Cadzow et al. (2017) followed up on one such case who later attended a clinic program. As a result of the clinic intervention, the child not only improved sports skills, but started participating in school- and community-based physical activities. This longitudinal single case study observed the home- and clinic-based intervention during separate periods. It is unknown if a concurrent clinic-based intervention alongside the home-based intervention could have encouraged those participants who did not sufficiently practice more in the home-based program. In this case series, we delivered a home-based intervention program alongside a clinic-based program, and examined the practicalities of simultaneous delivery, whilst monitoring the fidelity of the two programs.

## **Method**

### *Participants*

Four children were referred to the clinic for movement problems by medical professionals who had already diagnosed the children with various conditions (Table 1). Table 1 also includes the endpoint levels of motor development that were assessed with the Developmental Coordination Disorder Questionnaire (Wilson et al., 2009), the Movement Assessment Battery for Children, Second Edition Checklist (MABC-2 Checklist) and Performance Test (Henderson et al., 2007). The three assessment instruments were not administered to determine any intervention effect, but to indicate the motor development

status of the four children. Instead, children's progress in the two programs was authentically assessed by clinical observation of task-specific skills (Kluwe et al., 2012).

## **Procedure**

### *Clinic program*

Eight preservice teachers served as clinic interventionists for this study. After the initial training, a pair of student teachers were assigned to teach a child for seven 50-minute weekly clinic sessions over a 10-week period. The details of activities in the clinic sessions are explained in each case description.

### *Home program*

The Family Focused Intervention (FFI) for Children with DCD (Miyahara et al., 2009) was used for the home program. This program is also based on cognitive behavioural case formulation, drawing on eclectic theoretical models, such as, Bronfenbrenner's theory of ecological development to identify resources, and Newell's theory of constraints to adapt the task and environment. After the intake interview, initial assessment, and explanation of FFI in the first two weeks, the FFI Workbook was provided to the parents during Week 3, to guide parents to plan and conduct interventions at home. Using the FFI Workbook, families could systematically and comprehensively prepare and execute a home program, based on the cognitive behavioural case formulation approach. They were asked to write at least one log entry per week.

## **Results**

### *Case description 1: George*

George is a ten-year old boy diagnosed with dyspraxia and suspected of having DCD, according to his general practitioner. George exhibits low muscle tone, poor balance and motor incoordination which limit his participation in activities with his peers.

During the intake interview with his assigned student teachers, George and his father both agreed that riding a bicycle and climbing a tree were the most important skills for George to learn, so he could join his peer group. The student teachers used monkey bars in the clinic gym instead of climbing a tree, and a small-step approach to learning how to ride a bicycle.

At the initial assessment, George could hang from a monkey bar with both hands for 20 seconds. By Week 9, he could hang for 45 seconds with hands on separate monkey bars. In Week 10, he successfully swung from one rung to the next, with his trailing hand

moving to join the leading hand. When he tried to reach the trailing hand beyond the leading hand to the next rung, he lost grip and fell from the bar.

On the bicycle, George was able to sit on the saddle and push the ground with his feet to glide. George seemed to be afraid of losing balance and falling, looking down and dragging his feet on the ground, not gliding with his feet off the ground. To counter his fear of falling, the bicycle was fixed on a stationary bike stand, and George started looking straight ahead. Then George rode a bicycle with training wheels, and later without training wheels. By Week 10, George could glide on a flat surface for approximately 5 meters.

Concerning the home program, the father was not confident to teach and found it challenging to motivate George to practice at home due to lack of time and fatigue after school. Upon the parent's request in Week 9, the student teachers developed a strength training routine that George practiced in the morning: bicep curls, bent-over row, squat and modified push-ups with knees on the floor. The strength training was implemented successfully, and in follow-up email communication at Week 23 George's father reported they continued to use it.

#### *Case description 2: Brigid*

Brigid is a seven-year old girl who has been diagnosed by a paediatrician with developmental dyspraxia and movement coordination disorder. The paediatrician described that Brigid's running gait cycle was underdeveloped, as well as her ability to hop and jump. The clinic was recommended to practice repetitive patterning and increase general strength over her whole body. By consulting with Brigid and her mother, Brigid's student teachers set clinic goals to hold a handstand, perform cartwheels, swing on monkey bars for three rungs, trap and kick a football, and hop three times on one foot.

Brigid was highly motivated to learn how to perform the handstand, cartwheel, and swing on the monkey bars to catch up with other children at school. From Week 2 to 5, the student teachers supported her to perform a handstand whilst leaning against the wall. Under the parent's supervision, Brigid practiced what she learned in clinic at home. Despite this, her rudimentary gymnastics skill levels plateaued between Weeks 5-10.

With the monkey bars, Brigid could hold the same bar with both hands for a few seconds in Week 2, and improved to hold onto separate bars and then swing one hand to join the other hand by Week 4. Too shy to practice this skill in front of other pupils at school, Brigid practiced at school on evenings and weekends for three or four times per week alongside the clinic practice. Yet, Brigid could hang onto the monkey bar no more

than three seconds in Week 10.

With regard to ball skills and hopping, Brigid learned to trap and kick a football into a goal, and she could hop on one leg three times by Week 10. Like the other skills, Brigid frequently practiced these skills at home under the parent's supervision.

*Case description 3: Philip*

Philip, a nine-year-old boy, was referred by a paediatrician who diagnosed him with dyslexia and learning difficulty. He did not feel confident to play with classmates and did not participate in physical activities. The paediatrician suggested working on ball skills, such as kicking, catching, and throwing.

Consulting with Philip and his mother, a pair of student teachers set specific long-term objectives for ball skills, jumping rope, bicycle riding, tying shoelaces and handwriting. Philip worked on soccer, basketball, netball, and rugby ball skills. By Week 10, he achieved the objectives of catching, dribbling, and shooting a basketball; trapping a soccer ball and dribbling around five cones in a line; and kicking a soccer ball into a goal from ten metres away. Philip also improved his jump rope skills, from stepping forward one foot at a time in Week 2; to three consecutive steps while running in Week 3; eight consecutive steps in Week 4; and ten consecutive steps in Week 10.

Bicycle riding was practiced in four clinic sessions and at home on a rural farm. Initially, Philip was afraid of taking his feet off the ground and did not want to pedal due to a fear of falling. In Week 3, he could glide down a gentle slope at the clinic for 4 meters independently. In Week 4, Philip could pedal the bicycle further than eight meters. In Week 7, he practiced gliding down a slope at home. In Week 10, at the clinic he could pedal independently in a line for 10 meters and manoeuvre the bicycle around cones. The parent reported that she had often found it difficult to motivate her son to practice cycle skills. One day, she decided to walk fast and let Philip follow her on the bicycle to feed horses on the farm. This tactic worked, not for the sake of learning itself, but because of the real-life context.

Philip was reluctant to practice fine motor skills. To learn how to tie shoelaces, he started with making a "bridge" and the first loop in Week 2; wrapped the loop with the lace in Week 3; and had difficulties in remembering where the lace should go without guidance in Week 4 and 5. The student teachers changed the task from shoelaces to tying a long rope around the waist, which he achieved in Week 9 and 10. However, this skill was not transferred to tying shoelaces. At home, for handwriting practice Philip wrote three stories

on topics of his choice.

Philip enjoyed and responded to the clinic program extremely well by interacting with student teachers positively and practicing the planned activities thoroughly. Although Philip was not so keen to participate in the home program, he practiced handwriting and bicycle skills when encouraged by the parent. Overall, the home program effectively supplemented the clinic program.

*Case description 4: John*

John is a nine-year old boy who was referred by a pediatrician with a diagnosis of dyslexia and learning difficulty. John is described as lacking confidence to play with classmates and not participating in physical activities. The paediatrician recommended John to work on ball skills, such as kicking, catching, and throwing.

John's student teachers set clinic learning objectives to intercept, dribble, and shoot a basketball, a hockey puck, and a soccer ball. The student teachers and John decided on extra goals as well, such as jump rope for ten consecutive jumps; ride a bicycle for ten metres; and tie a double bow. By Week 10, he achieved all clinic objectives except tying a double bow. He could make a loop and wrap the loop with the lace. But he forgot where the lace should go without the student teachers' guidance.

John's parent reported that no FFI was practiced at home. She only wrote in the FFI Workbook while waiting for John at the clinic. She wrote "some frustration and yet, trying to keep it fun and light hearted" in the Workbook log. She also reported that she once left a hockey stick in the hallway at home, and that John had spontaneously played hockey with his sister inside the house.

*Fidelity and feasibility of the clinic and home programs*

To check the fidelity of simultaneously delivering the two programs, the endpoint parental survey was administered. All four parents reported their satisfaction at 80 %. Their positive comments on the clinic program also indicated fidelity of the clinic intervention. Three children fully participated in all seven clinic sessions, and one child was absent from one session due to illness. Table 2 shows the response to the FFI varied among the four families. All parents completed most of the workbook sections. The frequency of parents' workbook log entries ranged from 0 to 8 over 7 weeks. Only Brigid's family achieved the minimum standard of once a week for acceptable fidelity. Parents reported that children were less motivated to practice at home on weeks when the clinic programme was not held due to school holidays.

## **Discussion**

Concurrent implementation of clinic and home intervention programs worked for two of the four children with DCD. Participation in the clinic program was consistently high, but participation in the home program varied, depending on the environment, the relationships with family members, available time, and the family priority and commitment.

All four children responded well to the clinic program with respect to attendance and engagement in activities, but their participation in the home program varied, depending on the aforementioned factors. Although the children's target movement skills improved to various degrees, their endpoint standard assessment results were not well beyond the diagnostic cut-off of the 15th percentile on the DCDQ, the MABC-2 Checklist or Test. These findings on the standardised assessment are fairly consistent with the evidence from a careful systematic review and meta-analysis (Miyahara et al, 2017) that revealed little improvement on the standard assessment. The best lesson gleaned from the present work is a confirmation not to focus on the improvement of the standardised assessment scores as an effect of a home program, but on the implementation of the home program to support struggling families.

As in the case of our pilot study (Miyahara et al., 2009), the two families who successfully implemented the home program were highly educated and conscientious parents who were willing to spare time throughout their busy schedules to practice at home; these families were persistent and kept practicing as in the case of Case 2, Brigid, even when the skill progress was not observed. In addition to such a parental feature, the parent-child relationships in these families seemed to be more favourable than in the other families. Despite the best efforts of the clinicians and researchers, there may not be one miracle program or strategy to encourage all families to start home practice right away. If that is the case, direct service from clinic, school, or community is indispensable to support the families.

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Table 1. Case characteristics (N=4)

Case Number: Pseudonym	Case 1: George	Case 2: Brigid	Case 3: Philip	Case 4: John
Age (Years)	10	7	9	9
Medical Diagnosis	Suspected Dyspraxia	Developmental dyspraxia, movement coordination disorder	Dyslexia, learning difficulties	Dyslexia, learning difficulties
<b>Assessment</b>				
MABC2-Checklist [ raw score (%ile)]	44 (<5th %tile)	40 (<5th %tile)	20 (<5th %tile)	24 (<5th %tile)
DCDQ'07 [raw score (diagnostic category)]	43 (pDCD)	34 (pDCD)	37 (pDCD)	51 (pDCD)
MABC-2 Test [%ile (diagnostic category)]	2 (pDCD)	9 (pDCD)	16 (pDCD)	16 (pDCD)
Manual dexterity (%ile)		25	16	16
Aiming & Catching (%ile)		0.1	9	1
Balance (%ile)		9	25	91
				63

Note. MABC-2: Movement Assessment Battery for Children, Second Edition; pDCD: probable DCD; DCDQ'07: Developmental Coordination Disorder Questionnaire 2007

Table 2. Completion of Home Program Workbook sections and parental interviews on Home Program.

	Case 1: George	Case 2: Brigid	Case 3: Philip	Case 4: John
1. Remember what the family has already taught your child				
2. Identifying hard-to-achieve movement-skills				
3. Which skill should be taught first?				
4. Your child's ranked skills with reasons.				
5. What resources are available to your child				
6. Skills I have already taught the child				
7. A place to practice				
8. Equipment				
9. Skill, belief, emotion, teacher action				
10. Adjusting task and environment for success				

Note:  Completed  Uncompleted

Parent Log (frequency)	0	8	3	3
Child Log (frequency)	0	3	3	2

<b>Feasibility</b>	<b>Very low</b>	<b>High</b>	<b>Medium</b>	<b>Medium</b>
Exit interview	Found it hard to fill in the Home Program workbook. Material can be "confrontational". The strained relationship between father and son was challenging for analysing movement and motor skills.	The Home Program helped parents to think about barriers to Brigid practising homework and steps they can take to eliminate or lessen them. DVD for bike riding and the Home Program workbook were important for including child's perspectives on tasks.	The Home Program workbook helped to focus that parents on what activities to practice and also breaking down the activities.	The Home Program workbook was good to work through and identify tasks to work on, and the homework log provided a good diary of sessions that were done.

(g) legends/cutline information for photographs and other illustrations

Table 1. Descriptive details of case studies (N = 4)

Table 2. Completion of Family Focused Intervention (FFI) Workbook sections and parental interviews on FFI

(h) a brief biographical sketch

After finishing his 24 years of service for the 70 years old Movement Development Clinic in New Zealand, which has since ceased operation, Motohide Miyahara is currently a freelance independent scholar, based in New Zealand, affiliated with the Japan Center for Evidence Based Practice, and Institute of Ars Vivendi, Ritsumeikan University in Japan. Michael Culling serves as a coordinator for the Active Families program in Sports Otago. Clare Green is a Registered Occupational Therapist in Dunedin, New Zealand. She currently works as a behavioural specialist with adults who have intellectual disabilities. She was a Student Teacher and Teaching Assistant at the Movement Development Clinic during her Physical Education studies at the University of Otago, Dunedin.