Clinical Intervention for Children With Developmental Coordination Disorder: A Multiple Case Study

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The teaching process and outcome in a skill theme program and a movement concepts program were described and analyzed in seven children with developmental coordination disorder. It was hypothesized that the skill theme program would improve targeted skills and perceived physical competence, whereas the movement concepts program would improve self-esteem and creativity. The seven children were taught individually by the same student teachers twice a week for a period of five weeks in one of the teaching methods. After a vacation, the teachers changed their teaching strategies and taught the same children using the alternative method. Although the hypothesis was generally supported, the children’s response to and progress in the programs varied. Possible factors influencing the variation were discussed.

Children with Developmental Coordination Disorder (DCD) are often recognized by teachers at kindergartens and schools (Gubbay, 1975). Physical skills required to perform academic tasks, games, and sports become increasingly demanding, and the developmental emergence of social comparison (Harter, 1988) starts to play an important role in children’s psychosocial well-being. Under such circumstances, children with DCD would fail to execute motor skills that are essential to academic achievement and activities of daily living. As teachers and parents realize their children’s failures caused by motor incoordination, the children may be referred to special intervention programs if available. Otherwise, it is the teachers that serve as preliminary interventionists for children with DCD. Teachers are thus entrusted with such an important mission to provide the children with primary care; however, they do not seem to carry it out sufficiently (Henderson, Knight, Losse, & Jongmans, 1991).

Possible reasons for teachers’ failure to provide adequate help may be ascribed to a lack of their knowledge and skills to teach children with DCD. In contrast to abundant literature on the speculated mechanisms and the assessment of DCD, the number of documents on remedial intervention for DCD is rather limited. Between the two major intervention strategies, namely the physical task-oriented approach

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and the psychological process-oriented approach (Sugden & Wright, 1998), the former is more relevant to teachers than the latter because contemporary adapted physical education is based on the functional assessment approach (Sherrill, 1998). Some authors prescribed specific activities for children with DCD (e.g., Arnheim & Sinclair, 1979; Grosse & Becherer, 1975; Kiphard, 1966) and others provided useful guidelines for intervention (cf. Cratty, 1994; Henderson & Sugden, 1992; Larkin & Hoare, 1991; Sugden & Wright, 1995). Busy teachers may try one of the “cook book recipes,” and diligent teachers would apply the recommended guidelines to their own curriculum. While the knowledge base of activity ideas is an asset for teachers, the application of theory into practice would enable teachers to manage children with DCD systematically.

While teaching children with DCD, teachers need to make a basic decision over what to teach and how to teach. Mosston (1966) proposed the *spectrum theory of teaching styles* by classifying seven teaching styles from command to discovery with an increasing shift in the role of decision making from teacher to student. The axiom of this theory is that the process of teaching and learning is based upon a chain of decisions made by teachers and learners before, during, and after teaching and learning. In the command style, teachers are in charge of choosing teaching materials and the implementation of teaching and evaluation. The opposite extreme on the spectrum of teaching styles is the discovery style in which students decide what to learn and how to evaluate their own learning outcomes. Mosston (1992) states that the selection of teaching styles should depend on the teaching and learning objectives. For example, the command style may be used for the reproduction of knowledge and motor skills, whereas the discovery style invites divergent production of ideas and movements. Sherrill (1998) recommends adapting teaching styles to individual needs and suggests prescribing the command teaching style for students with severe cognitive, behavioral, emotional, or pervasive developmental disorders. However, no specific prescription of teaching style was made for children with DCD.

Which teaching style is appropriate for children with DCD? To answer this question, we need to consider individual needs of children with DCD. Although there is a wide variation within children with DCD (Henderson & Barnett, 1998), corollary their diverse individual needs, children with DCD have two core needs in common: the acquisition of motor skills and the maintenance of self-esteem (Spitzer, Gibbon, Skodol, Williams, & First, 1994). Graham, Holt/Hale, and Parker (1993) call the traditional skills style *skill themes*, the motor creativity style *movement concepts*, and state the goal domain of each style as follows: “teaching by skill themes focuses on developing children’s competence in a variety of motor skills and movement concepts that will eventually enable the children to acquire confidence and enjoy physical activity throughout their lifetimes” (Graham et al., 1993, p. 28). Hence, teaching by skill themes seems appropriate for the psychomotor domain and by movement concepts for the affective domain.

Although available intervention studies report outcome effects of existing programs (cf. Pless & Carlsson, 2000; Miyahara, 1996), these studies fail to inform students and practitioners detailed process of teaching and learning. By reading such intervention outcome studies, readers would gain knowledge on how much an intervention program can affect the outcome variables. However, the readers still have little clue to the actual activities and how to incorporate the elements of the intervention program into their daily practice with individual cases.
There is a parallel discussion in the controlled psychotherapy outcome studies. Persons (1991) points out a discrepancy between the use of atheoretical standardized assessment and the need of individualized theoretical treatment, too much emphasis on symptomatic diagnosis (i.e., DSM) without investigating underlying mechanisms, and standardized treatment according to treatment protocols that allow for little individualization. Persons and Silberschatz (2003) further argue that the treatment protocols of randomized controlled trials often cover neither the treatment of comorbid conditions nor the solutions to noncompliances and difficulties in therapist-client relationship. DCD intervention outcome studies are similarly problematic with regard to the diagnosis of DCD that is symptomatic in nature, based on ambiguous criteria (Henderson & Barnett, 1998), and exclusive to those youngsters who are not diagnosed, yet in need for treatment. The DCD intervention studies also frequently employ standardized assessments that are not always tailored to identify specific movement problems, underpinning factors of the problems, and comorbid psychosocial disorders (Sugden & Chambers, 1998). Although several intervention programs have been reviewed comprehensively (e.g., Sugden & Wright, 1998), the levels of flexibility and usefulness of intervention protocols remain uncovered in intervention studies.

As an alternative to controlled outcome studies, Persons (1991) proposed the case formulation approach in which both assessment and treatment are intimately linked, individualized, and theory-driven. Boufard (1997) maintained that ideographic research should be conducted in order to replicate across and within individuals before nomothetic studies attempted to discover laws and principles at the group level. Instead of nomothetic comparisons of group means derived from standard assessment, Persons (1991) recommended ideographic comparisons of outcome, with the limitations of case studies in mind. Inherent problems of case studies include the comparisons of different measures which pose threat to reliability and validity. Yet, case studies can illustrate the complexities of a situation, exemplify the personal factors, and suggest readers what to do and what not to do in a similar situation (Merriam, 1992). In order to provide practitioners with useful information, the case study approach is considered to be the best for describing and analyzing the teaching process and outcome of the skill theme program and the movement concepts program on children with DCD.

Method

Participants

Seven children with DCD and seven fourth-year undergraduate students participated as learners and student teachers in the study. To disguise participants’ identity, pseudonyms were used in case descriptions, and the exact year of intervention was not mentioned. The first author served as the director of this intervention project, a clinical supervisor, and a direct observer, while the second author as a student teacher, research assistant, a direct observer of six cases, and a participant observer for her own case.

Children With DCD. Out of 47 children referred to the Movement Development Clinic for their motor coordination problems by local health professionals, seven children were identified as having DCD by a registered psychologist on the basis of DSM IV criteria (American Psychiatric Association,
1994). Other children had neuromuscular disorders, Down syndrome, or mental retardation. Some of the children with DCD did not score poorly in terms of conventional cut-off points (e.g., the 2nd, 5th, 7th or 15th percentile) on the standardized tests assessing the level of motor development. Because Criteria A for DCD has often been considered on the basis of the results from standard tests, diagnosis of DCD for the participants in this study may require further explanation.

First of all, according to DSM IV (American Psychiatric Association, 1994), Criteria A for DCD does not state that motor performance be measured by standard tests. DSM IV subscribes the criterion referenced approach in contrast to the norm referenced approach of ICD 10 (Miyahara & Möbs, 1995). Indeed, standard tests often fail to assess specific self-care skills (Henderson & Barnett, 1998) and thus may not always provide clinicians with sufficient information for Criteria A. Secondly, given that Criteria A can be satisfied only with the results from standard tests, DSM-IV Text Revision (American Psychiatric Association, 2000) recommends use of clinical judgment rather than the mechanical application of the criteria. Even if the full criteria for the diagnosis are not met, the diagnosis can be justified if the symptoms are persistent and severe. In other words, diagnosis of DCD may be made even without satisfying Criteria A. Hence, in the present study, if parents, teachers, and clinicians reported that the children performed physical activities so poorly, compared to their peers in the same age, that their activities of daily living or academic performance seemed significantly interfered, then both Criteria A and B were considered to be satisfied based on the clinical judgment of the psychologist, well experienced in the assessment and treatment of DCD in clinical settings. Information about medical conditions, nature and extent of motor problems, and psychosocial implications were obtained from health care professionals who filled in referral forms and also from significant others during intake interviews.

**Student Teachers.** Seven senior students (6 females, 1 male) in the School of Physical Education at the University of Otago served as individual tutors for the seven children with DCD as part of their advanced elective course. They had already studied motor learning and development two years before and studied how to teach children with a variety of developmental motor disorders at the same clinic in the previous year. The advantage of using relatively inexperienced teachers was that their teaching styles had not yet been established and they were open to try different teaching styles.

The student teachers were also trained as multiple case study investigators in the seminar format recommended by Yin (1994). Under the direction of the first author, they learned the purpose and protocol of case studies and theoretical and practical issues of problems in motor development (Henderson, 1986a; Henderson, 1986b) during the first three weeks in the first semester prior to a five-week teaching period. During the intervention period and thereafter, we met three times per week: twice for continuously learning the issues of motor development and once for a case conference in which we discussed case progress and any problems that arose in a group supervision format.

**Child-Student Teacher Matching.** Each child was assigned to the most suitable student teacher that taught the same child in two different styles. The suitability was determined on the basis of the individual child’s needs described
in the referral forms, the parents’ preference of student teachers’ genders, and the competence and personality of student teachers assessed by the first author’s observation in the previous year.

Protocols of Case Studies

The individual case study protocol of each student teacher consisted of (a) an intake interview to obtain developmental history and current presentation of problems; (b) an initial report on the basic components of case formulation (Sperry, Gudeman, Blackwell, & Faulkner, 1992): predisposition, symptomatic presentation, assessment results and interpretation, long-term goals, and intervention strategies; (c) daily lesson plans with short-term goals and teaching strategies; (d) teaching a child twice a week based on the daily lesson plans for a period of five weeks in each semester; (e) daily teaching evaluation against short term goals and evaluation for further needs; and (f) a final evaluation report on the results of final assessment, the course of intervention, and future recommendations. The initial assessment report, final progress report, daily lesson plans, and evaluation were marked according to set criteria.

The multiple case study protocol involved collection and review of all individual case studies, video-taping and analyzing interactions between student teachers and children, and the evaluation of intervention outcomes in the psychomotor domain and the affective domain for each individual case after each of the five-week periods of intervention. Although a five-week period might be considered rather short for obtaining substantial intervention effects, both student teachers and children were simultaneously available only for eight weeks in the first semester during which both the university and primary schools were open at the same time. Of the eight weeks, the first two weeks and the last week were used for interviews and assessment, which left a period of five weeks for intervention. In the second semester, the participants were available for six weeks, of which the first and the last sessions were used for interviews and assessment and a period of five weeks was left for intervention. Even if the intervention period was too short to gain significant intervention effects, it was considered worthwhile to describe and analyze the process and outcome of intervention in this study.

Psychometric Measures

Psychometric testing was individually administered by student teachers under the supervision of the first author for four times: pretest and posttest of the first treatment and pretest and posttest of the second treatment. The first pretest was conducted within four 60-minute sessions over a two-week period of intake interview, rapport building, and initial assessment. Two sessions in a week were allocated for the second pretest. The post-tests were incorporated into the teaching sessions toward the end of the five-week teaching period. For the initial assessment in each semester, student teachers were instructed to give first priority to the performance test in the Movement Assessment Battery for Children (MABC; Henderson & Sugden, 1992) for its status of the most frequently used tool to aid diagnosis of DCD (Henderson, 1994). The second priority was given to the Pictorial Scale of Perceived Competence (PSPC; Harter & Pike, 1984) for the evaluation of the affective domain. Once the student teachers started to teach, they tailored assessment to best suit the evaluation
of children’s progress (Persons, 1991; Sugden & Chambers, 1998). Because all psychometric tests used in this study were standardized outside New Zealand, the original test standards were applied for scoring due to the lack of normative data in New Zealand. Reliability and validity of standardized tests are available from the manual of each test.

**Psychomotor Domain.** Three standardized tests were available to gauge the level of the children’s motor development. First, the MABC performance test (Henderson & Sugden, 1992) was chosen to measure the product of fine and gross motor performance in terms of time, distance, or accuracy. The test consists of eight subtests in three sections: manual dexterity, ball skills, and balance skills. Performance on each subtest is assigned an impairment score (IS) ranging from 0 to 5, the larger the score, the more severe the motor impairment. Second, the Test of Gross Motor Development (TGMD; Ulrich, 1985) was selected to evaluate the movement patterns of children. The test measures 12 gross motor skills for locomotion and object control. Performance is scored as either pass or fail on the basis of preset categories of movement forms. The results of this test were reported in terms of each criterion and percentile in both locomotor and object control sections. Third, the Developmental Test of Visual-Motor Integration (VMI; Berry, 1989) was used to examine children’s fine motor skill for copying different geometric shapes. The results of the all motor tests were also reported in percentile within the age group of the standardized samples.

**Affective Domain.** The PSPC (Harter & Pike, 1984) measures the domain specific self-esteem of cognitive competence, peer acceptance, physical competence, and maternal acceptance. Children rate from 1 (low competence) to 4 (high competence) on each item. The means of each section were reported in each case. Although the age of some children with DCD is beyond the prescribed range of the scale, the PSPC was used because the New Zealand children often showed difficulty in reading and understanding the verbal scale for the older children (Harter, 1982).

Children’s creativity was assessed by the Thinking Creatively in Action and Movement (TCAN; Torrence, 1981). This test measures the three aspects of creativity: fluency, originality, and imagination by examining how many different ways children can transfer a distance independently, move like another object, and mentally transform an object. The raw scores were reported in the case studies.

**Procedure**

**Research Design.** A multiple-case design (Bromley, 1986; Yin, 1994) was used to gain an insight into the process of how a wide selection of variables change after two different styles of teaching. With a small number of participants, multiple-case studies allow time-consuming and labor- and resource-intensive investigations. To gain insights into carry over and order effects, the order of presenting teaching styles was counterbalanced. Of the seven children with DCD, three children were randomly selected and assigned to the skill theme program and four children to the movement concepts program. Because student teachers were not blind to expected outcomes, their teaching process and outcome could be biased by the Rosenthal effect (Rosenthal & Jacobsen, 1968), which should be taken into account for the interpretation of the results.
Intervention

While student teachers were teaching by skill themes, they aimed to improve children’s motor skills by the traditional skills style of teaching. Whereas in teaching by movement concepts, teaching objectives were set to enhance the joy of and confidence in movement by facilitating explorative and creative environment. Teaching materials of the skill theme program included throwing, catching, batting, hopscotch, and riding bicycles. The movement concepts program involved activities such as movement exploration, creative dance, play-dough making, cutting, and drawing. Thus, motor skills were taught at times in the creative style of teaching in the movement concepts program. It is difficult to teach either by skill themes or by movement concepts per se (Graham, Holt/Hale, & Parker, 1993), and each teaching style should not be considered absolutely distinct, but relatively different in orientation and approach. The guidelines for intervention was thus flexible, and no specific intervention protocol was provided, which allowed student teachers to individualize the programs to suit individual needs.

To determine the degree that the student teachers followed the assigned teaching styles, the second author videotaped teacher-child interaction during one teaching session in each semester and analyzed the record with the Cheffers’ Adaptation of the Flanders’ Interaction Analysis System (CAFIAS; Cheffers & Mancini, 1989), which consisted of counting and categorizing verbal and nonverbal behaviors of the student teacher-child dyads. The categories included student teachers questioning, acceptance, and praise and children’s narrow dependence, more interpretation, and initiation, which were expressed in ratio. It was expected that student teachers would engage more in silence, questioning, acceptance, and praise, and children would exhibit less narrow dependence and more interpretation and initiation while teaching by movement concepts than by skill themes. In the case of noncompliances to each teaching style, such incidents were described and discussed in individual case study.

Data Collection and Analysis

After two semesters of teaching were completed, intake interviews, all lesson plans, evaluations, individual case reports, direct observation by the authors, and case conference notes were submitted to both within-case and across-case analyses conducted by the two authors using a pattern-matching strategy (Yin, 1994). The pattern-matching strategy compared the actual teaching outcomes with the theoretically predicted ones; it was examined whether the skill theme program improved targeted skills and the movement concepts program enhanced self-esteem and creativity. To determine a match between a teaching style and an outcome, two forms of replication logic, namely a literal replication and a theoretical replication (Yin, 1994) were applied. In the present study, a literal replication indicated that the expected teaching outcomes be obtained from each teaching style. For example, if a student teacher teaches how to dribble a basketball by skill themes, and a child’s dribbling skill improves, it is a positive literal replication. If the improvement does not occur, it is a negative literal replication. A theoretical replication referred to the lack of outcomes from a certain teaching style for theoretically predictable reasons. While a student teacher is teaching dribbling skill, the teacher does not...
expect that the child’s creativity would improve. If this happens, then it is a positive theoretical replication. If the child’s creativity improves unexpectedly, then it is a negative theoretical replication. Applying these two forms of replication logic to all available data from individual cases, the two authors wrote individual case studies and determined whether the match between teaching styles and outcomes were positive or negative.

Results and Discussion

Individual Case Studies

Glenn. When Glenn was six years old, he was taught in the Movement Development Clinic for one semester. During that period, he improved his running, balancing, and ball skills and gained confidence in those areas. As a seven-year-old boy, he returned to the clinic because his incompetence in ball skills became increasingly prominent, which seemed to affect his psychosocial life; Glenn did not participate in physical activities at school because of his lack of confidence. Instead, he tended to play by himself or sit and read. Although Glenn’s teacher and mother perceived him to be a “bright kid,” they realized his handwriting was delayed for his age and shared the concern about his general clumsiness.

Before teaching by skill themes, Glenn’s tutor, Paul, conducted initial assessments. Glenn’s weaknesses was demonstrated in the MABC score of 3 on the threading, 1 on the drawing, 2 on the bounce and catch, and 1 on the bean-bag throw items. During the ball skill testing, Glenn looked frustrated, saying the tasks were “boring.” He rushed through the trials without waiting to aim at target properly, even upon Paul’s request. The qualitative observation revealed that Glenn’s movement was jerky and often too forceful in both manual dexterity and ball skill tasks. The subtest of object control from the TGMD indicated that Glenn did not use effective movement forms to perform ball skills. On the basis of these testing results, two long-term goals were set to develop ball skills and build self-confidence through enjoyable and successful activities.

In the first semester, skill themes intervention focused on ball skills. Glenn’s tutor, Paul, realized that Glenn had difficulty in planning and executing movements and failed to understand that different objects follow different trajectory paths and that the amount of force applied to an object will determine its trajectory. Since Glenn disliked any activities with balls, Paul used scarves, ribbons, and small parachutes to teach how these objects move when thrown in a variety of environments both indoors and outdoors. At the beginning, when Glenn succeeded in easy throwing or catching tasks, he attributed the success to luck even though Paul told him that he was successful because he had done it right. After repetitively reminding him that it is his skill that determines his performance, Glenn started to show more concentration on his position and the trajectory of objects. When he succeeded, Glenn began to express his confidence and enjoyment in object control activities. Thus, attribution retraining seemed to succeed. Paul also found that Glenn was quite keen to play hockey. So Paul included other student teachers into hockey activities, and Glenn seemed to enjoy the “team” atmosphere. Teaching by skill themes did show a positive result, evidenced in the improvement of scores in the MABC and the TGMD; The MABC’s IS of the threading item decreased from 3 to 0, the bounce and catch item from 2 to 1.5, and the bean-bag throw item from
The object control section of the TGMD improved from the 9th percentile to 50th percentile. This progress was also reflected in the slight improvement on the perceived competence in the physical domain from the mean of 1.50 to 1.83. However, his perceived competence in the peer and maternal acceptance domains decreased, from 1.83 to 1.67 and from 1.80 to 1.60, respectively, over the semester for unknown reasons.

The goals of the movement concepts program in the second semester were set to improve self-confidence, concentration, tracking skills, and positive attitude toward movement activities. Glenn responded well to teaching by movement concepts. He particularly liked creative movement. Glenn’s tutor, Paul, commented that Glenn showed confidence and initiative when asked to create his own movements. Glenn was always eager to use equipment such as scarves and ribbons to create new shapes. He also enjoyed learning different tricks with rhythm sticks, which were used to improve his tracking skill. As for fine motor tasks, Glenn made a model of a dinosaur and drew, cut, and folded paper to make different figures. Paul thought learning by movement concepts was one area in which Glenn felt relaxed and confident because he could complete activities successfully.

The test results at the end of the second semester revealed that his improvement was limited to the affective domains. Glenn’s perceived peer acceptance and his maternal acceptance improved substantially: 1.83 to 3.00; 1.80 to 2.40, respectively. When the TCAM test was first administered to Glenn at the end of the first semester, he appeared to be embarrassed, giving up thinking of new movements easily, and scored lower than average for a seven-year-old in all three areas of creativity. At the end of the second semester, Glenn was no longer shy to express his creativity in movement and scored much higher than in the first semester in all areas of creativity (fluency: 24 to 50; originality: 20 to 70; imagination: 22 to 23). In contrast, Glenn’s ball skills did not improve after the movement concepts program. The TGMD object control score remained constant on the 2nd percentile, and the MABC’s IS for throwing the bean-bag into the box was one throughout the semester. A small improvement was seen in the one-hand bounce and catch by one-half. Glenn’s tutor reported that his attitude toward ball tests became one of frustration again; as Glenn would perceive the tasks to be too difficult, he did not seem to try the best of his ability. Thus, he failed even the ball skill criteria that he had already passed at the end of the first semester. It should be also noted that Glenn turned into an 8-year-old during the winter break, and he needed to perform even better than before to meet the higher standards of these age-norm tests.

The results of video analysis revealed an increase in the number of Glenn’s verbal contribution (3 to 17) and the ratio of self-initiated responses (.05 to .15) from the first semester to the second semester. Paul’s ratios of questioning (.23 to .40) and praise and encouragement (.48 to .52) increased from the first to the second semester. These results confirmed the command style teaching and learning occurred in the first semester and the discovery style in the second semester.

According to the theoretically predicted pattern, the skill theme program should enhance motor skills, whereas the movement concepts program enriches the affective domains. In the case of Glenn, this literal replication held true; his motor skills improved after the first semester, and he exhibited more creativity after the second semester. However, the theoretical replication went to an extreme. It was predicted that the ball skills would not develop in the movement concepts program, but the ball skills that Glenn had gained at the end of the skill theme
program deteriorated during the movement concepts program. No improvement in the untreated area suggests a need for continuous intervention.

Alex. Alex was a 6 year-old boy born prematurely at the gestational age of 28 weeks and stayed in a neonatal unit for his first 3 months. For his reading problems, Alex received special remedial training. He was unable to tie his shoelaces and was poor at ball and balance skills. Regardless of his academic and movement difficulties and frequent relocations in the past, he got on well with his peers and adults alike and played a variety of games with them both indoors and outdoors. He could swim well and double click a computer mouse. His mother was content that he was a healthy, outgoing happy child.

The initial assessment confirmed Alex’s weakness in ball and balance skills in both production and movement forms. In terms of the MABC’s IS, he obtained 4 for threading beads and for both bean-bag catching and ball rolling; 4.5 for one leg balance; 5 for jumping over cord, which placed him on the 3rd percentile in his age group. On the TGMD his locomotor performance was on the 5th percentile, and his object control skills on the 9th percentile. However, he perceived himself positively in all areas and rated above 3 on average in each of all four domains of the PSPC. The initial goals for the movement concepts program were to develop body awareness and spatial concepts for enhancing balancing skills and to learn skipping and hopping skills.

Alex’s tutor, Lorna, thought that the movement concepts program suited him because he was enthusiastic to use his vivid imagination for creative movement and dance. Alex enjoyed moving to music, making different shapes with his body, and using scarves and musical instruments. Various locomotive movements were also incorporated in the creative movement. As a result, he climbed up from the 5th to 25th percentile in the TGMD locomotor section, and he marked 0 on the threading item and on the two balance skill items in the MABC at the end of the program.

The aims of the skill theme program were for Alex to become able to tie shoelaces and to improve ball, balance, and locomotor skills. Lorna found that Alex disliked being taught how to perform correct techniques for targeted skills. When particular instructions were given for hopping and skipping forms, Alex seemed self-conscious and performed worse than when he carried them out naturally in games or creative movement. Despite his disfavor of the command teaching style, he learned specific techniques, such as tying shoelaces. Moreover, he became able to keep his posture upright and use his arms effectively to maintain his balance and started to use matured movement patterns for ball and locomotor skills.

Due to Alex’s absence, tests on the affective domain were conducted only at the beginning and the end of the year. Over the two programs, the fluency and originality scores in the creativity test increased substantially, from 35 to 50 and 53 to 90, respectively. His perceived cognitive and physical competence improved slightly from 3.67 to 3.83. Lorna was glad to hear Alex say he was “really good at tying his shoes” on a physical competence item, but she was surprised to see the decline on Alex’s perceived peer (3.33 to 2.67) and maternal acceptance (3.83 to 3.00) because Alex often talked about his activity plans with his mother and friends.

Video analysis of two video clips from each program showed that Alex contributed to lessons with less frequent self-initiated or unpredictable responses in the movement concepts program (.22) than in the skill theme program (.40). The direction of the difference in the ratios is opposite to the expectation for each
program. However, in this case, Alex’s self-initiated response in the skill theme program was his attempt to break away from formal skill instructions. Lorna praised Alex less in the former program (.28) than in the latter program (.46) to keep him interested in his unfavorable skill theme program. Although the results from the CAFIAS were thus inconsistent to the expectations for each teaching style, Lorna was, in fact, making efforts to comply with the assigned teaching styles. This particular case reminded us of the importance of interpreting behavioral counts and categories by taking the meanings of behaviors into consideration.

Due to the lack of adequate measures in the affective domain, a comprehensive pattern matching was unattainable within the case. As far as the motor domains are concerned, Alex improved his motor skills not only from the skill theme program but also from the movement concepts program. This result indicates that the movement concepts program would be as effective as the skill theme program for the enhancement of motor skills, especially for the child such as Alex who is not fond of formal skill instructions but is interested in creative movement.

Anne. Anne’s development was delayed in speech, academic, and motor learning. At two and a half years of age, she was not speaking. She was behind in reading, writing, and math at school. Her mother noticed that Anne bumped into doors and dropped a glass for no apparent reason. Anne’s performance was inconsistent. For example, she was able to dress and tie shoelaces one day, but unable to do them on another day. Anne got too excited during physical activities and resisted changes in daily routines. She had no friends to play with except her little sister. At the age of 8, she received no medical diagnosis from a pediatrician who referred her to our clinic.

The initial assessment revealed Anne’s uneven motor performance: lower than the first percentile on the MABC, 5th percentile in the locomotor section, and 84th percentile in object control section of the TGMD. She was not able to make a proper stork balance position on the MABC. With regard to her ball skills, her performance outcomes were poor with IS of 1.5 for the bounce and catch item and 2 for the bean-bag throw item in the MABC, but her movement forms were mature. Her perceived competence was fairly high and above 3 in all areas.

In the first semester, Anne’s tutor, Angela, designed a movement concepts program to improve Anne’s balance, manual dexterity, and locomotor skills. Throughout the 5-week intervention period, Anne practiced the game of statues in which she was required to “freeze” and maintain a static balance. She also enjoyed manual tasks, such as collages, drawing, cutting, pasting, and creating a spider web. Video analysis showed that Anne contributed well to her own learning with her self-initiated responses (.27) and that Angela used acceptance and praise (.45) as well as questioning (.41). As a result, Anne improved her static balance from the state of not being to form a stork balance position to 2 on the MABC score. Her threading performance also improved from 4 to 3 on the MABC. She scored high (52) on the originality subtest in the creativity test.

The skill theme program in the second semester continuously focused on manual dexterity and static balance and also on ball skills. For static balance, Anne practiced the stork balance task from the MABC and received stickers as she achieved targeted times. This reward system motivated her, and she wanted to try over and over again. Manual dexterity was taught with puzzles similar to the peg task from the MABC. In addition, Angela created different ball games using balloons, tennis ball, and a basketball, and Anne enjoyed competing with Angela in
these games. There was an improvement on some items in the MABC; IS changed from 5 to 3.5 on the peg task, 5 to 4 on the flower trail task, 3 to 2 on the bounce and catch, 1 to 0 on the bean-bag throw, and 3 to 1 on stork balance. Anne’s object control score in the TGMD also showed progress from the 5th percentile to 16th percentile. However, the tasks that were not worked on, such as threading and dynamic balance items, deteriorated from 1 to 2 and 2 to 3 respectively.

Video analysis indicated that 60% of Anne’s responses were predictable, which validated the nature of the skill theme program. Anne’s originality score in the creativity test regressed to an average level. Due to her absence, the last test for Anne’s perceived competence was not administered. Angela felt the skill theme program was a more successful teaching strategy for Anne and questioned the validity of the results from the PSPC due to response bias because Anne seemed to answer every item too quickly.

In general, literal replications occurred after specific intervention on treading, stork balance, and throwing, although Anne’s progress was rather modest. Theoretical replication was seen in the deterioration of the areas, including threading, dynamic balance, and originality, that Angela did not focus on. Anne’s case also illustrated a need for continuous intervention not only in the motor domain, but also in the area of movement creativity. A short-term intervention program at the clinic may not be sufficient. Possibility should be sought for a home-based or school-based program, which enables continuous monitoring and timely intervention after any relapse.

Steve. Steve was a happy sociable seven-year-old, who had no major movement problems at school and play. However, Steve’s school teacher suggested to Steve’s mother that Steve would benefit from the Movement Development Clinic. Steve’s school teacher rated his skipping and skipping rope as “very poor” and catching, writing, tying shoes, kicking, and hopping as “poor” on the referral form. Steve’s mother shared the view that Steve had difficulty in tying his shoelaces and also using utensils while eating. On Steve’s referral form, his family doctor wrote that Steve exhibited poor motor coordination with no specific neurological disorder.

The initial assessment placed Steve on the 65th percentile, above average for his age in the MABC. However, he received the MABC’s IS of 2 on the threading item, and he was placed on the 30th percentile in the VMI, which indicated his poor manual dexterity for certain tasks. His self-esteem was generally high (2.83-3.00) except for maternal acceptance (2.17). Thus, the results of the standardized test batteries confirmed the information from the referral form and from the intake interview with his mother.

The skill theme program in the first semester focused on specific skills, such as writing, drawing, tying shoelaces, and eating with utensils. Steve’s tutor, Helen, also worked on ball and locomotor skills as well. Steve improved his control of force in writing and drawing by carefully monitoring his own hand based upon Helen’s verbal feedback. Steve’s mother commented that his use of a knife and fork and shoelace tying had also improved. As for ball skills, there was no change on the TGMD, and he was placed on the 84th percentile in the object control section, but the change from 1 to 0 in the on the MABC score for the bean-bag throwing item witnessed his increased accuracy. Helen worked on Steve’s skipping, and consequently, the locomotor subtest score in the TGMD increased from the 8 percentile to the 91st percentile. However, Helen still noted that Steve sometimes tripped over equipment in the gym.
Helen perceived Steve as quiet. Video analysis indicated that Steve made little contribution with only one verbal response and no self-initiated response. As for Helen’s teaching style, she used more lecturing than questioning (.29) and praise and encouragement (.47), which ensured that the command style was used in the skill theme program.

While assessing Steve at the beginning of the second semester, Helen recognized that Steve’s speed in executing manual tasks was too slow, whereas throwing too fast. Therefore, the movement concepts program was designed to increase Steve’s awareness of effort (i.e., time, force, flow) and space between his body and objects. He was encouraged to verbalize his awareness, initiate activities, and contribute his own learning. Helen also incorporated shoelace tying into every session. When Steve seemed discouraged, Helen used disguised tasks, such as asking him to tie her apron strings. Video analysis evidenced Steve’s increased verbal contribution from 1 to 15 and self-initiated responses from 0 to .15. Helen used more acceptances and praise (.77) than she did during the first semester (.47), but the frequency of her usage of questioning remained the same: .29 in the first and .27 in the second semester. At the end of the second semester, Steve achieved 0 on all items of the MABC. With respect to his creativity, Steve demonstrated enhanced fluency from 19 to 44 and originality from 30 to 69, but his imagination declined slightly from 28 to 24. In all three areas of the TCAN, however, Steve was still above average for his age.

The result of pattern matching indicated that literal replication occurred in the psychomotor domain and two out of three areas of the TCAN. However, it was not possible to determine the occurrence of theoretical replication because Steve had already reached the top ceiling for his age standards in most areas and because of the lack of complete data sets. Steve is by no means a typical case of DCD, yet his manual incoordination significantly interfered with his activities of daily life. This case demonstrated that even a child who failed to meet any conventional norm-referenced cutoffs for DCD did suffer from poor motor coordination and that specific intervention enhanced his quality of life. Therefore, the norm-referenced approach to diagnosis of DCD should be reconsidered so that a child like Steve could receive the diagnosis and proper treatment based on clinical judgment (American Psychiatric Association, 2000).

**Karine.** This seven-year-old girl had been diagnosed with developmental dyspraxia and received speech therapy through the specialist education services and occupational therapy at the pediatric department in the local hospital. Because occupational therapy recently became unavailable in the pediatric department, a pediatrician referred Karine to our clinic. A psychologist’s report from the specialist education services stated that Karine had an immature body image, difficulty in producing letters on lines by muddling upper and lower cases. Karine related well with classmates and her older sister, but neighborhood children did not understand her speech problems. According to Karine’s mother, Karine was depressed about her disability, and just wanted to be like everyone else.

The initial assessment showed Karine’s overall low profile in the psychomotor domain: under the first percentile on the MABC with IS of all items no less than 3; 37th percentile in the locomotor; 9th percentile in the object control sections in the TGMD; a low average score of 2.50 from the peer acceptance items in the PSPC. Karine’s tutor, Suzanne, set goals to develop Karine’s body image, self-esteem, and positive attitude toward physical activities for the movement concepts...
program in the first semester. Suzanne used creative play activities, created different shapes using the body with hoops and elastic bands, and made a collage of the holidays, rhythm stick out of newspapers, and a paper mask. To improve Karine’s sequential memory problems, Suzanne incorporated jingles and rhymes with gesture sequences. At the end of semester, Suzanne could administer only the MABC and the TCAN due to the time limit. Although improvement was evident from decreased IS on individual items on the MABC, such as 3 to 0 on treading, 5 to 3 on the stork balance, 4 to 2 for the jumping in squares, and 1 to 0 on the tandem walk items, Karine was still placed below the first percentile. Karine seemed to enjoy and concentrate on the TCAN test and scored above average for seven-year-olds in fluency (50), originality (51), and imagination (25). The interaction between Suzanne and Karine of a particular session consisted of one-third contribution by Karine and two-thirds by Suzanne. After the videotaping and analysis of the session, however, Suzanne reported that Karine communicated and interacted more. Suzanne used a high amount of questioning (.59) and praise and acceptance (.41), which confirmed her compliance of the motor creativity teaching style.

The goals were set to improve balance, object control, and manual dexterity skills for the skill theme program in the second semester. Suzanne constructed a progress chart to monitor Karine’s progress in one-leg balance task, which sustained Karine’s motivation throughout the semester. Suzanne used a variety of objects, such as balloons, different sizes of balls, and balls made of different materials to improve Karine’s ball skills. Video analysis showed an increase in the total child contribution to the lesson from 34 to 44, but Suzanne’s teaching behaviors of questioning, acceptance, and praise remained relatively the same as in the first semester. Suzanne noted that Karine transformed from being quiet, shy, nervous, and uncertain to being friendly, outgoing, talkative, and confident over the two programs. Karine’s improvements on ball and balance skills were reflected on the respective scores in the MABC and TGMD: Bounce and catch score changed from 5 to 4, stork balance from 4 to 2 on the MABC, and from 37th percentile to 16th percentile in the object control section of the TGMD.

Because of the lack of complete pre and posttests, it is difficult to determine whether literal replication occurred in the affective domain. However, the tutor reported that Karine seemed to progressively enjoy physical activities. After the skill theme program, Karine improved her bounce and catch skill, stork balance, and her movement patterns in object control. In the movement concepts program, various locomotor activities were incorporated. However, the locomotor score on the TGMD remained the same as the beginning of the year at the beginning of the second semester (37th percentile) and regressed during the second semester to the 25th percentile, while the locomotor activities were not the focus of intervention. Thus, both literal and theoretical replications were demonstrated. The negative theoretical replication observed in the decline of locomotor skills during the second semester implies a possible benefit of uninterrupted training even after the skills’ improvement.

Alison. At 6 weeks of age, Alison’s blood flow was restricted in her chest, and she was found not breathing in her cot. As a result she had hearing and speech problems. Alison had received speech therapy for her communication problems and physiotherapy for her poor coordination and balance caused by instability around both shoulder and pelvic girdles. As Alison went to school at the age of 5 years, she was no longer eligible for those therapies, so a physiotherapist referred
Alison to our clinic. According to Alison’s mother, Alison was bright and outgoing, and made friends easily. Although Alison was heavy on her feet, and often tripped and stumbled, she enjoyed sport at school. Her two brothers teased her speech problems, which did upset her.

Alison scored 3 on the drawing item, 4.5 and above on all three balance items, and 0 on the rest of the MABC performance test items, which placed her on the 5th percentile in her age group. The PSPC revealed that she perceived herself bright (3.67), fairly competent physically (2.83), but not so well accepted by peers (2.33) and her mother (1.67). While administering the TGMD, Alison’s tutor, Phillipa, recognized what Alison’s mother had meant by “heavy on the feet”; Alison’s running and sliding were not rhythmical, and she dragged her feet while galloping. Nevertheless, she was placed on the 63rd percentile for the locomotor section, and 75th percentile for the object control section. Based on this observation and the test results from the MABC and the TGMD, Phillipa focused on the areas of locomotion and balance in the movement concepts program.

Contrary to the first impression of a confident and open child, Alison seemed to struggle to think independently and move spontaneously. For example, when Phillipa asked Alison to hop like a kangaroo, Alison would ponder the thought with no response. Phillipa attempted different ways to unleash Alison’s creativity and spontaneity, such as letting other students show good role models, but with little success. Alison performed every activity Phillipa planned, but hesitantly and without enthusiasm, unless others were participating along side her. Phillipa’s frustration was confirmed by the video analysis of their interaction; Alison’s contribution was low (38), but Phillipa used a high percentage of questioning (.66) and an equal amount of praise (.50), consistent with the expectations from the movement concepts program.

At the end of the first semester, Alison could walk on her toes better and performed locomotor movements in more mature patterns, but she could stand on one leg for a shorter period than before. As for her perceived competence, her peer and maternal acceptance score improved from 2.33 to 3.50 and 1.67 to 2.33, respectively, but Phillipa questioned the validity of the test results because Alison appeared to have difficulty comprehending the questions and responded in the same manner to each item. However, Phillipa reported that Alison seemed to enjoy physical activities better and look increasingly enthusiastic toward the end of the first semester.

Teaching by skill themes enabled Phillipa to fully concentrate on balance and jumping, and progress charts were set up to monitor progress on these tasks. Video analysis showed that Phillipa’s teaching style was directive and conformed the prescribed command style. Although Phillipa observed enhancement in Alison’s performance, the posttest results did not reflect the improvement: The MABC scores for the one leg balance and jumping items remained 5. During the second semester, locomotor skills were not focused upon, and the locomotor score on the TGMD declined dramatically from the 84th to 37th percentile. The PSPC was not administered for the reason mentioned above. The TCAN scores remained approximately the same at the end of each semester: 19 and 16 for fluency, 22 and 21 for originality, and 23 and 23 for imagination.

In this case, literal replication was seen only with locomotor patterns after the movement concepts program. Alison’s perceived physical competence did not improve during the first semester, and it was not possible to determine the change
in her creativity due to the lack of test results. However, Phillipa’s report suggested some improvement in Alison’s joy of movement. A positive theoretical replication occurred to locomotor patterns when they stopped working on them in the skill theme program with a substantial decline.

This case also demonstrated the difficulty in maintaining the once improved performance and the challenge to assess the affective domain with the questionnaire. The inconsistent percentiles between the MABC and the TGMD in the first semester indicated the need to assess both performance outcome and movement patterns for adequate intervention. As for the TGMD, the overall scores were above average for her age group, but Alison still suffered from immature locomotive patterns; it is important to scrutinize each item instead of judging from the total scores.

**Julia.** When Julia was 9 months of age, a Plunket nurse noticed motor delay as Julia did not sit or hold anything in her hands. A general practitioner referred Julia to the Pediatric Department where Julia was seen until 3 years of age. At the age of 8 years, Julia was described as very clumsy by her mother because Julia tripped over around the house. According to her mother, Julia was a very slow eater, and was unable to tie her shoelaces. Academically, Julia was behind her age norm with particular difficulties in math and story writing due a lack of imagination. She was very quiet and had difficulty in making friends. The results of the initial assessment showed Julia’s generally low profiles in both the psychomotor and the affective domains: the MABC, TGMD both locomotor and object control all on the 2nd percentile, the PSPC between 1 and 3.

Julia’s tutor, Liz, set goals to improve ball skills, balance, and locomotion for the skill theme program. While administering the tests, Liz realized that Julia was tense in handling balls. So Liz introduced Jacobson’s progressive muscular relaxation exercise to enhance Julia’s awareness of tension and relaxation in her arms. When Julia handled balls, Liz reminded Julia to keep her arms “floppy.” Julia enjoyed playing with a spider ball that had black rubber strings attached because the “legs” made it easier and fun for her to catch. At the end of the program, Julia scored 0 in the ball skill subtest on the MABC and raised the objective control subtest score on the TGMD from the 2nd to 9th percentile. For the improvement of balance skills, a specific instruction was given to stabilize the head, and higher beams were introduced progressively to increase Julia’s confidence. As a result, the static balance score regressed from 1 to 2, but the tandem walk score improved from 4 to 0 on the MABC at the end of the first semester. Although not specifically practiced, Julia was asked to use different locomotor skills between bases of a softball game. At the end of the first semester, Liz was pleasantly surprised to find a sharp increase on the locomotor subtest score on the TGMD from the 2nd to 91st percentile.

According to Liz, Julia appeared to have increased her self-confidence and lost her inhibitions as rapport was established. This observation was supported by the general increase of perceived competence scores from a range between 1 and 3 to a range between 2 and 4. Video analysis of a session indicated that Liz did use the command style by making two-thirds of the contribution to the session with a high frequency of instruction, praise, and encouragement.

For the movement concepts program, Liz aimed to improve Julia’s manual dexterity and self-confidence. Liz realized that Julia held a pen with all four fingers and a thumb, so she taught the tripod grip with a thick pen encircled by a sponge pad. While cutting a sheet of paper with a pair of scissors, Julia held the paper
unsteadily at a wrong part, for example, at the bottom of the paper while cutting at the top. Liz explained the concept of space and time and let Julia figure out what worked best after trial and error. To stimulate Julia’s imagination and lateral thinking, Liz prepared movement problems to act out and solve. Julia was good at solving problems, such as how to move in a small circle with only one hand and one foot. To the imagination tasks, however, Julia did not move and just repeated, “I don’t know” to the instructions such as to walk around as if she was in golden syrup, or move like a monkey. Even after Liz gave hints by asking whether a monkey moved fast or slow, Julia only repeated “I don’t know,” which frustrated Liz. Video analysis of a session showed that Julia contributed verbally to the session with self-initiated responses more (.18) than she did in the first semester (0), consistent to the expectation from the movement concepts program.

Before the final assessment at the end of the year, Julia’s age changed to 9 years, so subsequently, the MABC tasks changed. As a result, Julia scored 5 on all manual dexterity items regardless of her extensive fine motor training. The perceived competence remained the same, but fluency and originality scores increased substantially from 23 to 60 and from 28 to 78, respectively, from the end of the first semester, whereas the increase of the imagination score was rather small, 15 to 19.

Literal replication was seen in Julia’s ball and dynamic balance skills, but not in static balance after the skill theme program. Manual skill and imagination exercised in the movement concepts program did not effect any improvement on the respective test results. Locomotor patterns deteriorated after the winter break (91st to 25th percentile) and remained stable throughout the second semester, which lent support to theoretical replication.

**General Discussion**

The present case study used a design similar to that of a randomized controlled study in the assignment of two intervention programs. However, the goals of the study were contained in the description and analysis of the teaching process and outcome of the skill theme program and the movement concepts program administered to seven children with DCD. It was not the purpose of this study to determine which teaching style is better for DCD, but the aim of the case study was to provide interventionists with clues for course of action to be taken by demonstrating states of affairs (Bromley, 1986). Because individual case discussion has been already made at the end of each case, this section will interpret general findings, discuss possible factors involved in the absence of intervention effects, and recommend future research directions.

In accordance with Graham et al. (1993), it was hypothesized that the skill theme program would foster motor skill development, whereas the movement concepts programs would allow children to expand their movement vocabulary and creativity. Pattern-matching procedures (Yin, 1994) were used to analyze both literal and theoretical replications. Literal replication occurred in that children improved the skills that were taught, and they appeared to enjoy themselves while engaging in movement exploration. However, the Rosenthal effect (Rosenthal & Jacobsen, 1968) might have contributed to literal replications because the students teachers and the authors were not blind to the expectations. Theoretical replication was observed in the deteriorated performance of Glenn’s ball skills, Anne’s
originality, and Karine’s, Julia’s, and Alison’s locomotive skills while their tutors were not focusing on each task. There were exceptions that did not match literal and theoretical replications. For instance, Liz worked on Julia’s manual dexterity and imagery exercise in the movement concepts program to no effect. Pattern-matching analysis in case studies lacks precision and leaves restricted conclusions to investigators’ interpretive discretion (Yin, 1994). Accordingly, we concluded that the overall pattern of results matched both literal and theoretical replications with some exceptions. Possible explanations for the exceptions include, but not limited to, insufficient intervention frequencies and periods, underdeveloping teaching skills of student teachers, unidentified organic cause of motor disorder, children’s incompatible personality traits with the movement concepts program, unsuitable test items, and inadequate discriminatory power in test items.

In addition to the description and analysis of how children with DCD responded to the two teaching styles, this case study raised a question concerning the norm-referenced approach to diagnosing DCD in favor of using clinical judgment. Indeed, Glenn and Steve could not be diagnosed with DCD on the basis of norm-referenced approach, but the identification of their significant coordination problems allowed them to receive beneficial intervention. This is not to depreciate the norm-referenced approach; the approach is still useful for screening and management purposes. In employing standardized assessment, it is important to cover both performance outcome and movement pattern, lest a child such as Alison with discrepant test results between the MABC and the TGMD be overlooked. Taken together, motor assessment needs to be comprehensive, and clinical judgment deserves more recognition and emphasis in diagnosing DCD.

Although most children with DCD often made literal replication by progressing in the domain that they worked on, they also showed theoretical replication in that the intervention effect flagged on the specific area when the particular intervention was discontinued. In the first author’s experience, some children with DCD improve after intervention but come back to the clinic, sometimes repeatedly, for their recurrence as in the case of Glenn. This suggests that interventionists continuously monitor children with DCD after initial improvement and if necessary, resume task-specific intervention in a suitable teaching style. Future research should identify effective strategies for relapse prevention by determining the appropriate frequency and length of intervention, maintenance training, and monitoring. This is a multiple case study of only seven cases. Obviously, more case studies are called for so that practitioners can learn to describe, formulate, and conduct effective intervention to heterogeneous children with DCD.

References


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