**COGNITIVE STRATEGIES AND MOTOR PERFORMANCE
IN CHILDREN WITH
DEVELOPMENTAL COORDINATION DISORDER**

by

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of the requirement of the
degree of Master of Science**

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ABSTRACT

Children with Developmental Coordination Disorder (DCD) struggle with motor skills that are acquired incidentally by most children. Often children with DCD are referred to occupational therapy, but these children appear resistant to traditional occupational therapy intervention. Recent development of a new approach called verbal self-guidance, (VSG) has shown promising results. However, the salient components of this intervention remain unidentified. The purpose of this study was to carry out a detailed analysis of videotaped intervention sessions to determine if domain-specific strategies were a component of the VSG intervention. The results of this behavioural observation suggest that VSG is a seemingly complex, multidimensional intervention. In addition to the global strategy, Goal Plan Do Check, eight domain-specific strategies along with supplementing task knowledge could be identified as components of this intervention. This exploratory study reinforces the need for further analysis into the interaction between cognitive strategies and motor performance in children with DCD.

DEDICATION

**This thesis is dedicated to the seven subjects
in my longitudinal research study:
Gillian, Matthew, Scott, Genna, Hilary, Colin, & Meghan**

**The inspirational drive for this thesis emanated from my
observations of my own seven children during their "magic
years" of childhood. I have experienced and continue to
experience great joy and amazement as I watch them learn and
discover the wonders of childhood. Their discoveries have
been an affirmation of the important role occupation holds
in the lives of all children.**

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Gillian- "...Have the ambition not only to go further than any man has been before, but as far as it is possible for any man to go". (Captain James Cook)

Matthew- You have to go in a full circle to find the truth, the truth is out there!

Scott-...to boldly go where no man has gone before

Hilary- I'm sailor moon champion of justice and on behalf of the moon I will right wrongs and triumph over evil.

Genna-I love you.

Colin-To infinity and beyond!

Meghan- Mommy do you want to come to my house for dinner? And the last person, but the first in my heart, I want to thank my husband, Mark, for his support, encouragement, and occasional reality check. From you I learned the meaning of unconditional love!

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CHAPTER ONE: INTRODUCTION

For most children, skills of daily living such as cutting food, fastening zippers, handwriting, and rollerblading, are acquired incidentally. However, a subgroup of children struggle with such skills. Some of this subgroup, approximately 5 to 6% of school-aged children, have motor coordination difficulties that negatively impact school performance and/or daily living (American Psychiatric Association (APA), 1994; Cratty, 1994).

Children with motor coordination problems have been described under a variety of labels in the literature for decades (Cratty, 1994; Gubbay, 1978; Henderson, 1987; Orton, 1937; Walton, Ellis, & Court, 1962). At an International Consensus Conference on Children and Clumsiness (Polatajko & Fox, 1995), experts from around the world agreed that common nomenclature was essential and recommended that the term Developmental Coordination Disorder (DCD) should be used when referring to children with such motor difficulties (Polatajko & Fox, 1995). In keeping with this recommendation, and for the purposes of this thesis, the term Developmental Coordination Disorder (DCD) (APA, 1994) will be used.

DCD may present as deficits in occupational performance, often necessitating a referral to occupational therapy (Case-Smith, Allen, & Pratt, 1996). Traditional occupational therapy treatment approaches include sensory

integration therapy (Ayres, 1972; Fisher, Murray, & Bundy, 1991) and perceptual motor training (Case-Smith et al., 1996; Hulme & Lord, 1986). These approaches have shown little effect in remediating the motor deficits of these children (Kaplan, Polatajko, Wilson, & Faris, 1993; Kavale & Mattson, 1983; Polatajko, Macnab, et al., 1995). These approaches focus on remediating underlying deficits, anticipating improved performance in motor behaviour. These traditional approaches, based primarily on neurodevelopmental theories, have a continuing influence on pediatric occupational therapy practice (Case-Smith et al., 1996).

However, recent research in motor learning has challenged the assumptions of these theories. Contemporary motor theory emphasizes heterarchical, systems-based models, in which motor behaviour is considered to be dynamic and dependent on a number of components, including task, environment, and person variables (Shumway-Cook & Wollacott, 1995).

Treatment approaches for children with DCD based on this contemporary motor learning theory have been proposed in the broader literature (Bouffard & Wall, 1990; Henderson & Sugden, 1992). One such approach, the Problem Solving Approach proposed by Bouffard and Wall (1990), incorporates contemporary thinking from the motor learning, cognitive science, and cognitive psychology literature. This approach

focuses on cognitive and metacognitive processes and task variables in guiding motor behaviour. Henderson and Sugden (1992) proposed a similar approach, the Cognitive Motor Approach, to remediate deficits in children with motor difficulties. Although these models are similar, the extent to which cognition plays a pivotal role varies between these approaches. These two approaches, theoretical in nature, have had limited clinical study to date.

The theoretical approaches recommended by Bouffard and Wall (1990) and Henderson and Sugden (1992) parallel the investigation of a new approach in occupational therapy (Martini, 1994; Wilcox, 1994). In occupational therapy, Wilcox and Polatajko (1993), Wilcox (1994), and Martini (1994) recently began to explore the use of verbal self-guidance to remediate the occupational performance deficits of children with DCD. This approach is similar to those proposed by Bouffard and Wall (1990) and Henderson and Sugden (1992). The theoretical underpinnings of this new approach are described by Wilcox (1994) and Martini (1994) as being based on a synthesis of cognitive behaviour modification theory and contemporary motor learning theory in a client-centred framework.

This new approach, named VSG, uses Meichenbaum's (1977; 1991) Goal Plan Do Check (GPDC) executive strategy. VSG has shown promising early results. Wilcox (1994), using single case design (N=1, with 9 replications), applied VSG to

children aged 7 to 12 years. The children were taught the strategy, and then the strategy was used to learn three child-chosen motor goals. In 12, 50-minute sessions, Wilcox yielded positive outcomes. A significant improvement in communication, daily living skills, socialization, academic performance, and behavioural control was demonstrated (Wilcox, 1994).

Martini (1994) undertook a systematic replication of Wilcox's (1994) work to determine if the therapeutic effect could be replicated by another therapist. Martini's systematic replication (N=1, with 3 replications) also yielded positive results. Thus, results of both Wilcox (1994) and Martini (1994) suggested that the children with DCD used the GPDC strategy and were able to apply it to their chosen motor goals with subsequent improvement in goal performance.

Wilcox's (1994) study also evaluated the maintenance and generalization of behaviours. Wilcox stated "these results are quite exceptional. Generalization, particularly to the degree and nature reflected in VSG data, is rarely reported in the cognitive behaviour modification literature" (p.125). Wilcox suggested that the possible variables related to improvement in occupational performance include the use of the GPDC strategy, the client-centered nature of the therapy, diagnostic task analysis, and parent

involvement. However, Wilcox went on to say, that a limitation of the study was that it

leaves the investigator without an understanding of which aspects of the intervention were most salient. A detailed analysis of videotapes would reveal the nature and pattern of mediational strategies that were precursors to the discovery, by the children, of the keys to occupational performance that resulted in their mastery (p.131).

The goal of Wilcox (1994) and Martini (1994) was to teach the GPDC strategy. The current thesis is an initial attempt to understand the dynamics of the VSG intervention. It is speculated, by this investigator, that domain-specific strategies may be active ingredients in this treatment approach and may have contributed to maintenance and generalization of VSG. This assumption is theoretically based in the cognitive strategy literature (Pressley, Forrest-Pressley, Elliot-Faust & Miller, 1985; Pressley et al., 1987; Sugrue, 1995) which suggests that executive strategies, such as GPDC, only lead to improved performance when the child has a repertoire of domain-specific strategies (Pressley, Borkowski, & Schneider, 1987; Sugrue, 1995; Tarver, 1986). Indeed, Pressley et al. (1987) suggest that Meichenbaum's Goal Plan Do Check strategy, the strategy used by both Wilcox (1994) and Martini (1994), "illustrated

an interweaving of higher-order planning, goal-specific strategies and monitoring" (p.5).

The assumption that domain-specific strategies are a salient feature of VSG intervention is based empirically on observations made during a preliminary scanning of the videotapes of the intervention sessions of Wilcox (1994) and Martini (1994). Preliminary review of these videotapes indicated that the children not only learned the GPDC strategy, as reported by Wilcox and Martini, but also appeared to learn other domain-specific strategies. The purpose of this study was to conduct a detailed examination of the videotapes to uncover the strategies that were used in the process of VSG.

This thesis focused on cognitive strategies in an attempt to identify one salient feature of this approach: those cognitive strategies that appeared to enhance motor performance. The findings of this exploratory study reinforce the need for further analysis into the interface between cognitive strategy use and improvement in motor performance in children with DCD.

CHAPTER TWO: LITERATURE REVIEW

Developmental Coordination Disorder

Children's motor competence has been found to influence their self-concept and social adjustment (Henderson, May, & Umney, 1989; Schoemaker & Kalverboer, 1994). Indeed, experiences of early childhood are laden with activities that require competence in motor skills. Tying shoe laces, fastening zippers, and pouring milk on cereal requires varying degrees of motor competence. Additionally, motor competence extends beyond self-care activities into the realm of extracurricular sports and leisure. Involvement in such activities plays a crucial role in the development of the child's self-concept and provides an opportunity for social interaction (Bouffard et al., 1996).

It is estimated, however, that 5-6% of school-aged children exhibit motor coordination difficulties (APA, 1994). This translates into approximately 129,000 school-aged children in Canada.

The significance of this motor disability is acknowledged in The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), where such children are classified as exhibiting Developmental Coordination Disorder (DCD) (American Psychiatric Association, 1994). The International Classification of Diseases 10 (World Health

Organization, 1992) acknowledges the condition under the rubric of specific developmental disorder of motor function.

Mounting empirical evidence suggests that DCD is a life-long disability (Cantell, Smyth, & Ahonen, 1994) that may interfere with academic, social, and vocational development (Bouffard et al., 1996; Schoemaker & Kalverboer, 1994). The diagnosis of DCD is given when a child exhibits motor coordination difficulties that significantly hinder activities of daily living and/or school performance and are not the result of another physical disability (APA, 1994).

Although DCD has had a relatively short history, first appearing in DSM-III-R (APA, 1987), the disability has a long past. Prior to DSM-III-R, these children were often labeled under a variety of terms. Such labels included: clumsy (Cratty, 1994; Gordon & McKinlay, 1980; Gubbay, 1975; Henderson & Hall, 1982; Newham & McKenzie, 1993; O'Brien, Cermak & Murray, 1988; Smyth, 1996), dyspraxic (Ayres, 1972; Cermak, 1985; Denckla, 1984; Goodgold-Edwards & Cermak, 1990), apraxic (Bairstow & Laszlo, 1989; Gubbay, 1978; Iloeje, 1987; Walton, et al., 1962), and physically awkward (Wall, Reid, & Paton, 1990). Symptoms and severity of DCD vary from child to child (Henderson, 1987; Willoughby & Polatajko, 1995). Researchers have begun to investigate and hypothesize subtypes, but as yet, this research remains inconclusive (Ayres, 1972; Cratty, 1994; Goodgold-Edwards & Cermak 1990; Hoare & Larkin, 1991; Larkin & Hoare, 1992;

Laszlo & Bairstow, 1985). The heterogeneity of this population makes study difficult (Hall, 1988; Henderson, 1987; Henderson & Hall, 1982; Larkin & Hoare, 1992; Lazarus, 1990).

An International Consensus Conference (Polatajko & Fox, 1995) addressed key issues surrounding DCD. Experts from around the world, gathered to debate and dialogue about DCD. A definite outcome of this conference was the sentiment that a consensus of terms was imperative. Researchers and clinicians agreed that the term Developmental Coordination Disorder would be used when referring to these children.

Etiology

There is consensus that the basis of this disorder consists of motor coordination problems that negatively impact daily performance. However, the etiology of the disorder remains elusive (Cratty 1994). It was once believed that clumsiness was due to maturational lag (Gubbay, 1978) or would resolve itself by adolescence (Gubbay, 1978).

Differing theoretical perspectives, including neurophysiological, cognitive, developmental, and ecological, have postulated explanations of the cause of DCD.

Laszlo and Bairstow (1971; Bairstow & Laszlo, 1989) believe that the etiology of DCD is dysfunction in the kinesthetic system, whereas others hypothesize visual

perceptual dysfunction (Henderson & Hall, 1982; Hulme Biggerstaff, Moran, & McKinley, 1982). Smyth (1991) speculates that a central translation problem and motor programming dysfunction combine to cause DCD (Peik, Coleman, & Carman, 1995). Ayres (1972, theorizing from a neurodevelopmental perspective, hypothesized sensory integrative dysfunction as the cause.

It is clear that theoretical diversity exists among researchers in the field; however, there is a unifying concern in ascertaining the underlying cause(s) of the disability. Continued research and debate in the literature may provide further evidence of the causes underlying DCD. For the present, the causes remain unclear (Willoughby & Polatajko, 1995).

Related Problems

What is clear is that the motor problems experienced by children with DCD may lead to significant social, emotional, and/or academic problems (Henderson & Hall, 1982; Henderson, et al., 1989; Losse, et al., 1991; Schoemaker & Kalveboer, 1994; Smyth, 1992). Additionally, articulation problems have been associated with DCD (APA, 1994; Cermak, 1985; Smyth, 1992). Kaplan, Wilson, Dewey, and Crawford (1995) identified an overlap of DCD with Attention Deficit Disorder (ADD) and Learning Disabilities (LD). These researchers suggested a predisposing gene for these conditions. However, as Kaplan

et al. (1995) noted, this theoretical assumption is hypothetical and requires further exploration.

Motor Difficulties

It is apparent that children with DCD experience significant motor difficulties and are at risk for sport injuries (Ehrlich, Hulstyn, & d'Amato, 1992). They spend less time engaged in physical activity and, consequently, are often marginalized on the playground (Schomaker & Kalverboer, 1994). They also lack fitness and strength (Bouffard, et al., 1996; O'Beirne, Larkin, & Cable, 1994) and tend to use activity avoidance as a coping strategy.

Children with DCD are reported to have slower and more variable movement patterns (Kalveboer, 1993; Rosblad & VonHofsten, 1994), sacrifice speed for accuracy (Missiuna, 1994), and may have poor visual rehearsal strategies that may interfere with visual memory (Dwyer & McKenzie, 1994; Newnham & McKenzie, 1993).

In a fascinating study, Marchiori, Wall, and Bedingfield (1987) investigated the movement patterns of physically awkward boys during performance of slap shots in hockey. Subjects participated in a six week training period that was supervised by parents. Results of this study suggest that physically awkward children, even after 1,200 slap shots, still displayed extremely variable performance. Marchiori et al. proposed that children with DCD have

difficulty with procedural knowledge. Children with DCD continue to use the same motor strategies that have been proven to be ineffective.

Prognosis

Given the magnitude of difficulty children with DCD experience, researchers have focused on prognosis of DCD. It was once believed that children with DCD would outgrow it (Gubbay, 1978). Recent research suggests that DCD is a permanent condition that persists into adolescence (Cantell, et al., 1994) with significant, negative, long-term effects (Cantell, et al., 1994; Hellgren, Gillberg, Bogenholm & Gillberg, 1994; Hellgren, Gillberg, Gilberg, & Enerskog, 1993; Knight, Henderson, Losse & Jongsman, 1990; Roussounis, Gaussen, & Stratten, 1987).

Interventions

Traditional Treatment Approaches

Given the significant impact that DCD has on the lives of these children, researchers accentuate the importance of early intervention (Dussart, 1995; Levine, Oberklaid & Meltzer, 1981). Often the deficits in motor coordination lead to deficits in occupational performance, necessitating

a referral to occupational therapy (Case-Smith, et al., 1996).

Neurodevelopmental treatment approaches, based on traditional hierarchical motor learning theory have significantly influenced therapy practice (Gentile, 1992). Such approaches include: sensory integration, perceptual motor training, and, to a lesser extent, process-oriented treatment. These traditional therapies have focused on remediating underlying motor deficits with the expectation of subsequent improvement in motor performance (Gentile, 1992).

Sensory Integration Intervention

One of the most common approaches used in occupational therapy is sensory integration (Ayres, 1972). Ayres postulated that sensory input is necessary for optimal function of the brain. Ayres (1989) stated that

sensory integration is a neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment. The spatial and temporal aspects of inputs from different sensory modalities are interpreted, associated and unified (p.11).

Sensory integration intervention focuses on providing the child with sensory stimulation. Ayres (1972) believed

that the proper sensory input would produce changes in the brain at the neuronal synaptic level. Ayres (1972) believed that the nervous system has plasticity and changibility and that therapy, primarily in the early childhood years, promotes underlying capabilities and minimizes abnormal function. Recent authors (Fisher, et al., 1991) have suggested changes in Ayres (1972) theory to reflect a new sensory integration. However, this elaboration on sensory integration theory is speculative and, at this time, lacks empirical support.

Polatajko, Law, Miller, Schaffer, and Macnab (1991) compared the effectiveness of perceptual motor training and sensory integration in improving motor ability in children with learning problems. Both approaches resulted in improved performance. Sensory integration was not found to be superior to perceptual-motor training. Wilson, Kaplan, Fellowes, Grunchy, and Faris (1992) investigated the efficacy of sensory integration therapy compared to spending the same length of time in academic tutoring. No significant differences were found between groups. Similarly, Densem, Nuthall, Bushnell, and Horn (1989) studied the effectiveness of sensory integration for children with motor problems. Children in that study were randomly assigned to sensory integration, a physical education program, or to a no-treatment control group. These researchers found no significant difference between groups.

Mounting evidence suggests that sensory integration provides small, if any, treatment effects (Humphries, Wright, McDougall, & Vertes, 1991; Kaplan, et al., 1993). With regard to the efficacy of sensory integration, Polatajko, Kaplan and Wilson (1992) reviewed twenty years of studies that had employed sensory integration and concluded that sensory integration is not an effective treatment for learning disabled children to change motor behaviour. Hoehn and Baumeister (1994) critically examined sensory integration therapy. They concluded "the current fund of research findings may well be sufficient to declare SI therapy not merely an unproven, but a demonstrably ineffective, primary or adjunctive remedial treatment for learning disabilities and other disorders" (p.338).

Perceptual-Motor Training

Another popular treatment approach used by occupational therapists is perceptual-motor training (Hulme & Lord, 1986). In this approach, a causal relationship is proposed between motor behavior and underlying perceptual processes. Therapy involves providing the child with a variety of tasks, including worksheets, perceptual exercises, pegboards and balance beams. Improvement in motor abilities generally is anticipated.

Kavale and Mattson (1983) completed a meta-analysis of 180 studies of perceptual motor training on children with

learning disabilities. Results suggested that perceptual motor training is not effective in remediating the motor difficulties of these children. As Cratty (1994) succinctly laments "fortunately at this time only the most naive believe in the simple causal relationship between movement capacities, exercise and motor skill and various sensory and perceptual abilities" (p.201).

Process-Oriented Treatment

A third treatment approach, used to a lesser extent by occupational therapists, is based on the premise that kinesthesia is integral to the acquisition and performance of skilled motor behaviour (Bairstow & Laszlo, 1989). Laszlo and Bairstow (1985) believe that children with DCD have kinesthetic problems. They suggest that process-oriented training improves motor performance after only eight, 15 minute training sessions. Ramps and discs form the cornerstone of this intervention. Contrary to Laszlo and Bairstow (1985) Hoare and Larkin (1991) and Lord and Hulme (1987) have found that such training does not improve motor performance of children with DCD. Polatajko, et al. (1995b) compared process-oriented treatment approach to traditional occupational therapy treatment and reported similar findings.

Eclectic Approach

A fourth approach used by occupational therapists has been described as the "eclectic" approach (Wallen & Walker 1995). It is believed by some therapists that each child presents with varying needs, and often "intervention is individualized to meet children's particular needs" (p.18). Therapists, using an eclectic approach combine several treatment approaches in order to provide intervention that is specifically designed to address the child's needs. Ziviani, Poulsen, and O'Brien (1982) combined neurodevelopmental therapy and sensory integration compared to a no-treatment control group. They noted some improvement in fine motor skills with this eclectic approach. Unfortunately, several methodological errors and limited sample size detract from the findings this study.

A number of other researchers have also documented the use of an eclectic approach to treat children with DCD (McMahon, Arrowsmith, & Gardner, 1985; Schoemaker, et al., 1994; Wallen & Walker, 1995). No combination of approaches has yet been shown to be effective with children with DCD.

In summary, interventions used by therapists are based heavily on traditional neurodevelopmental theories. None of these approaches, including sensory integration, perceptual motor training, process-oriented treatment, and the eclectic, have yet to be proven effective in remediating the deficits of children with DCD.

Contemporary Intervention

In contrast to the traditional neurodevelopmental theories, recent thinking in movement science has emphasized a problem solving approach to motor skill acquisition (Gentile, 1992). Gentile emphasizes that "to approach treatment from a movement science framework, the therapist must become an active problem solver utilizing a broad knowledge-base to generate ways of helping a particular patient who is attempting to achieve a specific functional goal" (p.32).

Problem Solving Approach

Bouffard and Wall (1990) discussed a Problem Solving Approach to motor skill acquisition. In this approach Bouffard and Wall (1990) argue that five inter-related steps are necessary to guide motor skill acquisition. In the initial step, *Problem Identification*, the child identifies the nature of the problem to be solved. In the next step, *Problem Representation*, the child generates an appropriate, accurate, depiction of the motor problem. This precise representation is necessary for the child to plan and reach the final goal. Third, in *Plan Construction*, the child forms a plan to solve the movement problem. The child explores alternatives to solve the problem. Plan construction is described as a complex process that may require evaluation and revision of the plan until a suitable plan emerges. In

the fourth step, *Plan Execution*, the child carries out the plan. At this point the child may experience success if he has chosen an appropriate plan. *Evaluation of Progress*, the final step, occurs during and after the plan has been performed. The child evaluates his plan and determines whether or not it was the right plan. As Bouffard and Wall (1990) indicated, these five steps are interrelated and do not always occur in a linear fashion. For motor skill acquisition to occur, the child must choose the appropriate plan and execute it efficiently. Motor skill acquisition is often guided by an expert who helps the child through these five steps. Bouffard and Wall (1990) attributed difficulty in motor skill acquisition to three possible sources: lack of an adequate knowledge base, lack of appropriate control processes, and poor motivation. Lack of knowledge is attributed to limitations in declarative and procedural knowledge. Children may not have adequate strategies to solve the movement problem or may have inadequate ability to access such knowledge. The child may be unaware of his/her limitations and may lack the metacognitive skills to evaluate performance. Bouffard and Wall (1990) put forth an interesting, thought provoking framework, but it has had little clinical application to date and remains in the realm of untested theory.

Cognitive Motor Approach

Henderson and Sugden (1992) proposed a similar approach to that of Bouffard and Wall(1990). This model, the Cognitive Motor Approach, is based on an information processing framework and consists of a three step process of motor skill acquisition. The initial step, *Movement Planning*, requires the child to evaluate whether or not the task is attainable. In order to do this, the child must understand the task and what it demands. The child acquires this information through sensory and perceptual processes including vision and kinesthesia. The child translates this information and forms a plan. Possessing a clear expectation of what the task demands, the child enters the second step, *Movement Execution*. The child uses the plan to guide execution of the movement. This step involves several factors, including spatial considerations, force and sequencing, and organization of movement. During the final step, *Movement Evaluation*, the child monitors his/her progress. Feedback, both intrinsic and extrinsic, in the form of knowledge of results occurs. Henderson and Sugden's (1992) approach, like Bouffard and Wall (1990), has had limited clinical application. Thus, these two models have yet to be empirically tested.

Interestingly enough, these theoretical approaches from the educational literature have been recommended in occupational therapy. Goodgold-Edwards and Cermak (1990) have suggested the use of a cognitive based "rational

treatment regimen" (p.431), based on contemporary motor learning perspectives. Specifically applicable to the DCD population, Goodgold-Edwards and Cermak (1990) suggest that a cognitive understanding of the task and movement sequences required may facilitate motor learning. Goodgold-Edwards et al. highlight the use of cognition to guide behaviour.

Verbal Self-Guidance (VSG)

With repeated failure to find existing approaches effective, Wilcox and Polatajko (1993) also began to explore the use of an approach based on cognitive behaviour modification (Meichenbaum, 1977) to remediate the occupational performance deficits of children with DCD, VSG.

VSG-I

Originating from the combination of cognitive behaviour modification theory of Meichenbaum (1977) and the client-centred philosophy of occupational therapy (Canadian Association of Occupational Therapist (CAOT), 1991), Wilcox (1994) coined the term VSG to describe this new intervention. Wilcox (1994) employed single case experimental design, combined with within group design. The sample consisted of 10 children referred to occupational therapy for motor problems. All children met the DSM-IV (APA, 1994) criteria consistent with the diagnosis of DCD, were between the ages of 7-12 years, were of normal

intelligence, had normal or corrected vision and hearing, and were identified by an occupational therapist as exhibiting features of DCD. Children with neurological disorders were excluded.

The children participated in 10, 50 minute treatment sessions of VSG; all sessions were videotaped. The intervention was developed using Meichenbaum's self-instruction training concepts. The children were encouraged to become collaborators in treatment. A puppet, Mr. Goal Plan Do Check, was described to the children as the president of a detective club. The children were invited to become members and solve the mysteries of the motor goals that they had chosen to address during therapy. The children were introduced to a problem solving strategy that guided therapy sessions. This four step problem solving structure used the words Goal, Plan, Do, Check to represent the following questions:

GOAL: What is the problem?

PLAN: What is the plan?

DO: Am I doing my plan?

CHECK: How did I do?

The children applied this global, executive strategy to their chosen occupational performance goals. The specific research questions addressed by Wilcox (1994) were:

1. Can children with DCD learn the VSG strategy?
2. Can children with DCD use the strategy to attain their occupational performance goals?
3. Once attained are the occupational performance goals maintained?
4. Does the children's performance improve in other areas of occupational performance? (p.34).

Outcome measures included the Canadian Occupational Performance Measure (COPM) (Law et al., 1990), the Vineland Adaptive Behaviour Scales (Sparrow, Balla, & Cicchetti, 1984), the Behavioural Observation Scale (Wilcox, 1994), the Developmental Test of Visual Motor Integration (Beery, 1989), the Handwriting Evaluation Scale (Malloy-Miller, 1985), the Test of Motor Impairment (Stott, Moyes, & Henderson, 1984), the Child Behavior Checklist /4-18 (Achenbach, 1991), and the Eyberg Child Behaviour Inventory (Robinson, Eyberg, & Ross, 1980). Wilcox (1994) documented positive outcomes for all research questions. Results indicated generalization to other areas of occupational performance including: communication skills, daily living skills, socialization skills, manual dexterity, school competence, attention, and other dimensions of emotional and behavioural control (Wilcox, 1994).

VSG II

Stimulated by the finding of Wilcox (1994), Martini (1994) used a single case design (N=4) to determine if the results obtained by Wilcox could be replicated by another therapist. The children in this study all met the DSM-IV criteria consistent with the diagnosis of DCD, were between the ages of 7-12 years, were of normal intelligence, had normal or corrected vision and hearing, and were identified by an occupational therapist as exhibiting features of DCD. Children with neurological disorders were excluded.

The children participated in 10, 50 minute intervention sessions of VSG. As no formal VSG protocol existed, Martini (1994) described training in VSG. Writing about herself, she stated "first she read the cognitive behaviour modification literature, then she viewed the videotapes of the VSG-I study and identified the salient features. These features were then discussed with the VSG-I therapist" (p.56).

Specific research questions addressed by Martini were:

- 1) Does the child learn concepts of Goal Plan Do Check of the verbal self-guidance strategy?
- 2) When undertaking his/her selected occupational performance activities, does the child use the verbal self-guidance strategy of Goal Plan Do Check?
- 3) Does the child demonstrate improvement in the independent performance of his/her occupational performance activities(p.35).

Outcome measures included the COPM (Law et al., 1991) and behavioural observation of (a) motor performance quality using the Performance Quality Rating Scale (PQRS) (Martini, 1994), (b) time on task, (c) percentage correct use of the strategy GPDC, and (d) evidence of metacognition. Martini (1994) did not attempt to address the question of generalization of the strategy. Table 1 compares VSG-I and VSG-II.

Like Wilcox (1994), Martini (1994) achieved positive results for all research questions, thus providing further evidence to support VSG as a promising intervention for children with DCD.

VSG I and II Follow-Up Data

Results of a two year follow up study suggest that the behaviours chosen by the children were maintained over time. Two years later, 10 of the original 14 children's parents completed a telephone interview. Parents reported that the

Table 1

Comparison of VSG-I and VSG-II

	VSG-I (Wilcox, 1994)	VSG-II Systematic Replication (Martini, 1994)
Sample Size	10	4
Intake Criteria	• between the ages of 7-12 years • normal intelligence • normal or corrected hearing & vision • identified as exhibiting feature of DCD • attention to focus for 45 minutes • parent & child consent	• between the ages of 7-12 years • normal intelligence • normal or corrected hearing & vision • identified as exhibiting feature of DCD sufficient attention to focus for 45 minutes • parent & child consent
Hypotheses	1. The children will learn the VSG strategy 2. The children will use the VSG strategy to attain their occupational performance goals 3. Once attained the occupational performance goals will be maintained 4. The children's performance will improve in other areas of occupational performance	1. The children will learn the concepts: Goal Plan Do Check of the VSG strategy 2. When undertaking his/her selected occupational performance activities, the child will use the VSG strategy of Goal Plan Do Check 3. The child will demonstrate improvement in the independent performance of his/her occupational performance activities.
Measures	COPM Time on task Evidence of Metacognition Behavioural Observation Scale Berry Handwriting TOMI Child Behaviour Checklist Eyberg Child Behaviour Inventory Vineland	COPM Time on Task Evidence of Metacognition Performance Quality Rating Scale Percentage correct strategy use
Outcomes	positive outcomes for all research questions	positive outcomes for all research questions

children maintained the behaviours learned during VSG intervention. It was also reported that the children continued to be playful. However, the parents reported that their children seemed to only use the strategy when prompted (Polatajko, Mandich, & Martini, 1996).

Limitations of VSG Research

Wilcox's study (1994), although demonstrating promising results must be interpreted with caution. The possibility of a placebo effect must not be discounted, since no control group was available to compare the within group results. The limitations of a single case design and small sample size in both studies indicate that further research is needed. This author identified the commonalties between the three cognitive approaches discussed above, the Problem Solving Approach (Bouffard et al., 1990), the Cognitive Motor Approach (Henderson & Sugden, 1992), and VSG (Wilcox, 1994; Martini, 1994). Table 2 depicts this information.

Acquisition of Motor Skills

In the following section examination of the theories of motor skill acquisition are discussed to illustrate the assumption that cognition is a component of the early phases of motor learning.

Table 2

Comparison /Similarity of Contemporary Treatment Approaches

Problem Solving Approach (Bouffard & Wall, 1990)	Cognitive Motor Approach (Henderson & Sugden, 1992)	Verbal Self-Guidance (Wilcox, 1994; Martini, 1994)
Problem Identification	Movement Planning	Goal
Problem Representation		
Plan Construction		Plan
Plan Execution	Movement Execution	Do
Evaluation of Progress	Movement Evaluation	Check

Fitts and Posner's Model

Fitts and Posner's (1967) three stage model is generally accepted as one of the classic motor learning theories (Schmidt, 1991). The first stage, the *Cognitive Stage*, is characterized by large variability in learning. The child may not be aware of what needs to be improved or changed and may require specific feedback to identify errors. By the second stage, the *Associative Stage*, the foundation skill has been learned. This stage is characterized by fewer errors, which are often easily detectable by the child. In the final stage, the *Autonomous Stage*, the skill becomes automatic. The learner can perform the task without thinking about it. At this stage, the child can detect his/her own errors and make the appropriate changes. Variation in performance is minimal.

Adams' Model

In contrast to Fitts and Posner's (1967) three stage model Adams (1971) proposed a two stage model. The initial stage, the *Verbal-Motor Stage*, is similar to Fitt and Posner's (1967) cognitive and associative stages combined. At this stage, the foundation skills are laid and verbal control encourages and influences learning. The second stage, the *Motor Stage*, is similar to Fitts and Posner's autonomous stage. During the motor stage, behaviour becomes automatic.

Gentile's Model

Gentile (1972) also proposed a two stage model of motor learning. In the first stage, *getting the idea of the movement*, the child identifies the important components related to the skill. The child establishes an appropriate motor plan and practices the movement. The second stage is *fixation/diversification*. The child focuses on increasing his/her competency in achieving the goal. Movement is automatic.

As can be seen from the above, motor learning theory suggests a role for cognition in the early stages of skill acquisition (Fitts & Posner, 1967; Adams, 1971; Gentile, 1972). Schmidt (1991) conveys this idea when he suggests that "every skills, no matter how cognitive it might seem, requires at least some motor output, and every motor skill requires some preceding decision making" (p.8). However, Schmidt (1991) points out that different motor activities require varying amounts and combinations of cognition. Schmidt (1991) suggests that "one of the most important features of skilled [motor] performance is deciding what to do (and what not to do) in particular situations and making these decisions quickly and predictably" (p.8); a sort of motor IQ. Schmidt (1991) defines a cognitive skill as judgments about a movement, the "what to do", and defines motor skill as the quality of movement, the "how to do."

VanWieringen (1988) distinguishes two types of skills; phylogenetic skills, such as crawling, from ontogenetic skills, such as dancing. He suggests that the phylogenetic skills have little need for cognitive involvement, while ontogenetic skills require more cognitive involvement.

Acquisition Of Cognitive Skill

Anderson (1982) proposed a theory for the acquisition of cognitive skills that is consistent with the Fitts and Posner (1967) model and explains the events within each of Fitts and Posner's stages. Anderson (1982) suggested that the first stage of skill acquisition is the *declarative stage*. During this stage, the learner rehearses and learns the particulars of the task. The learner gains the factual knowledge about what the task requires. This stage parallels Fitts and Posner's cognitive stage (see Table 3). The next stage proposed by Anderson (1982), the *knowledge compilation stage*, which is a transitional stage between declarative and procedural stage, occurs when the learner begins to understand what the task requires and builds a representation of the skill. When the skill becomes ingrained and automatic, Anderson suggests that the skill has reached the *procedural stage*. Knowledge is refined and the skill is automatic. Anderson's theory is valuable in describing the stages of cognitive skill development in a

Table 3

Comparison of Models of Skill Acquisition

	Fitts & Posner (1967)	Adams (1971)	Gentile (1972)	Anderson (1982)
Early Stage	Cognitive Phase -cognitive /conscious attention to task -gross errors in performance -learner has limited awareness of where he/she is going wrong -performance is highly variable	Verbal Motor -trial and error stage -performance in verbally laden -learner focuses on attention to task/ learner thinks about each step of the skill	Getting the Idea of the movement -learner begins to understand the idea of what needs to be done to accomplish the movement -learner identifies relevant and non-relevant stimuli from the environment -learner develops coordination	Declarative Knowledge -an approximation of the skill is created -verbal guidance is used to rehearse the desired behaviour. -facts are accumulated
Middle Stage	Associative -basic movements are learned -learner focuses on refining movements -errors are fewer	-	-	Knowledge Compilation -with practice the skill is converted from the declarative stage to the procedural stage as knowledge is accumulated
Later Stage	Autonomous -movements are automatic -learner performs the skill without thinking about it "there is a good deal of similarity between highly practiced skills and reflexes" (p. 15)	Motor -performance becomes automatic -movements are accurate -learner detects small errors and makes adjustments	Fixation/Diversification -learner increases accuracy of movements -movements are efficient -learner builds a repertoire of motor skills that provide the basis for adaptation to the demands of open skill performance	Procedural Knowledge -knowledge achieves a procedural level -performance is improved -skill is automatic

parallel with motor skill acquisition. Table 3 compares these three models of motor skill acquisition and Anderson's theory of skill acquisition.

Cognitive Approaches to Skill Acquisition

The role of cognition in motor skill development has been acknowledged in the literature (Adams, 1971; Fitts & Posner, 1967; Gentile, 1972). Cognitive approaches to acquisition of skills have gained popularity in the psychology literature due to the work of such important writers as Meichenbaum (1977,1993).

Cognitive Behaviour Modification

Meichenbaum (1977) proposed that cognition can positively influence problem solving and behaviour. Drawing on the work of Luria (1961) and Vygotsky (1962), Meichenbaum suggested that cognition, and particularly private speech, plays an important role in the regulation of behavior. He proposed a five stage self-instruction model. First, the adult models and verbalizes out loud the task requirements; next, the child performs the task and the adult verbalizes the process; third, the child performs the task him/herself and self-verbalizes out loud; then the child whispers to him/herself; and finally, the child performs the task using covert speech.

This model formed the basis of Meichenbaum and Goodman's (1971) classical study where they used self-instruction training and found improved performance in children with attention deficit disorder. Since that time, self-instruction has been used with other exceptional populations, including children with learning disabilities, people with schizophrenia, and students (Meichenbaum, 1991).

Cognitive behaviour modification has become one of the leading treatment techniques with exceptional children, and its efficacy with such children is well documented in the literature (Meichenbaum, 1977, 1993). Table 4 displays the components of cognitive behavioural training and self-instruction.

Cognitive Strategies

One of the major criticisms of Meichenbaum's research has been the lack of generalization and transfer. One means of supporting generalization has been with the use of an executive, global strategy. Meichenbaum (1991) describes the use of a global, executive strategy, Goal Plan Do Check. This executive strategy focuses on increasing metacognitive awareness and training the child to self-monitor and self-evaluate. Metacognition is defined as thinking about one's thinking (Flavell, 1979).

Table 4

Components of Cognitive Behavioural/Self-Instruction Training
Meichenbaum (1991)

Components of Cognitive Behavioural Training
Instruction
Discovery Learning
Modeling
Overt and covert practice
Behavioural rehearsal
Reinforcement
Shaping
Fading
Generalization training
Booster sessions
Parent, teacher involvement

Components of Self Instruction
Problem Identification
Focusing attention on the problem
Specific task strategies
Coping skills and error correction
Self -reinforcement, self evaluation

Several executive strategies similar to Meichenbaum's (1977) are described in the literature. One such strategy, suggested by Bransford and Stein (1995), uses the acronym IDEAL. The IDEAL, executive strategy involves:

- I Identify problem
- D Define goal
- E Explore possible strategies
- A Act
- L Look back and evaluate.

Common to executive strategies appears to be the identification of the problem, development of a plan or strategy to overcome the problem, enactment of the solution, and then self-evaluation of performance on the task.

Several taxonomies of strategies are described in the literature. Researchers suggest a second classification of strategies, domain-specific strategies (Pressley et al., 1987). Domain-specific strategies are strategies that are goal specific, and applicable to a specific task or activity. It is thought that an executive strategy, such as Goal Plan Do Check, can only lead to improvement in performance if it is complimented by a repertoire of domain-specific strategies (Surgue, 1995; Tarver, 1986). Deshler, Warner, Schumaker, and Alley (1983) maintain, "The general strategy may be called the "executive" strategy whereas the specific strategies are the tools that enable the student to solve a problem" (p.268).

Strategies are important variables that can influence performance. The definition of a cognitive strategy is quite controversial. Table 5 displays many of the common definitions of cognitive strategies. Given the variety of definitions, for the purposes of this thesis, the Pressley, Forrest-Pressley, Elliot-Faust, and Miller's (1985) definition of cognitive strategies will be employed. Cognitive strategies are "cognitive operations over and above the processes that are a natural consequence of carrying out the task, ranging from one such operation to a sequence of interdependent operations. Strategies achieve cognitive purposes and are potentially conscious and controllable" (p.34).

Sielger and Jenkins (1989) suggest that children continually develop new strategies to learn new skills. Some strategies are fleeting and serve as a short term bridge. Children discover strategies, and this often results in a sudden "aha" experience. However, one of the problems associated with strategies is generalization and transfer. Bransford and Stein (1995) suggested that children fail to apply strategies often due to the lack of content knowledge of the specific domain. To understand how strategies are used well, Pressley et al. (1987) studied good strategy use and subsequently developed the Good Strategy User Model.

Table 5

Definitions of Cognitive Strategies

Author	Definition
Gagne & Briggs (1974)	A cognitive strategy is an internally organized skill that governs the learner's behaviour.
Borkowski & Buchel (1984)	Cognitive strategies are techniques for initiating or enhancing an operation, which is reflected in observable behaviour.
Paris et al. (1983)	Strategies are skills under consideration.
Pressley, Forrest-Pressley, Elliot-Faust & Miller (1984)	A cognitive strategy is composed of cognitive operations over and above the processes that are a natural consequence of carrying out the task ranging from one such operation to a sequence of interdependent operations. Strategies achieve cognitive purposes and are potentially conscious and controllable activities.
Flavell (1985)	Cognitive strategies assist in achieving the goal of whatever cognitive enterprise the child is engaged in. Cognitive strategies are invoked to make cognitive progress, metacognitive strategies to monitor it.
Scholz (1987)	Cognitive strategies are complete decision plans which generate a decision through the use of specific knowledge element, heuristics, goals, and evaluative operations for each state and stage of problem coping within the cognitive system.
Lehner (1989)	Cognitive strategies refer to a sequence of mental steps to achieve a goal.
Paris et al. (1991)	Cognitive strategy is considered as a process that is consciously devised to achieve a particular goal, whereas skill is considered as a unconscious, more automatic process.
Amirkhiabani & Hendry (1994)	Strategies are tools which enable the individual to select and operate upon intellectual skills of modification of attention and retrieval of knowledge.

The Good Strategy User Model

The Good Strategy User Model (GSU) (Pressley, et al., 1987) suggests that effective strategy use is dependent on the interaction of a number of components including: strategies, metacognition, a knowledge base, specific strategy knowledge, and motivation. With respect to the first component, Pressley et al. (1987) distinguish three categories of strategies: goal-specific, higher-order, and monitoring. Pressley et al. indicates that "...goal specific strategies are domain-specific" (p.91). To prevent possible confusion between goal-specific strategies and the Goal component of Meichenbaum's Goal Plan Do Check strategy, goal-specific strategies will be referred to hereafter as domain-specific strategies (personal communications, M. Pressley, March, 4, 1997).

It is considered that these strategies interact to produce proficient performance. These strategies, combined with a solid knowledge base and motivation, form the foundation for successful strategy use, and together, are known as the GSU model (Pressley et al., 1987).

Development of the Present Research Question

Although Wilcox (1994) and Martini(1994) reported significant improvement in occupational performance for the children involved in the VSG studies, they did not report

the use of any domain-specific strategies that positively influenced motor performance. Given the evidence in the literature that the global strategy must be combined with domain-specific strategies to successfully improve skills in exceptional children, it is surprising that VSG resulted in such positive gains. This raises the question as to whether a repertoire of domain-specific strategies were taught. With Pressley et al.'s (1987) GSU Model as a back drop, it was postulated that another variable, domain-specific strategy use, contributed to the effectiveness of the intervention. Some support for this idea was provided by Meichenbaum (1977) himself, when he pointed out that a technique, such as Goal Plan Do Check, will not result in improvement in performance unless the prerequisite performance skills and domain strategies are in place.

Summary

DCD is a significant clinical problem. Although it was once believed that children grew out of this disability, empirical evidence is building that suggest the contrary. Long term sequelae include social, academic, and affective problems. Children with DCD present occupational therapists with many intervention challenges. Traditional occupational therapy intervention has been based on neurodevelopmental treatment approaches. Unfortunately, these approaches have limited scientific evidence to support their continued use. Henderson and Sugden (1992), Bouffard and Wall (1990), and Goodgold-Edwards and Cermak (1990) have all suggested a new avenue of intervention based on a cognitive approach. Wilcox (1994) and Martini (1994) explored the use of such an approach, VSG. Preliminary results were promising. However the salient features of this intervention remain elusive. If VSG is to be tested in more depth, the salient features must begin to be explored.

CHAPTER THREE: METHODS

Overview

The purpose of this study was to carry out a careful analysis of Wilcox's(1994) and Martini's (1994) videotaped VSG sessions to determine if domain-specific strategies were used in addition to the global, executive strategy of GPDC. Specifically, the research objectives were:

- 1) To identify the cognitive strategies used during VSG intervention with children with DCD,
- 2) To classify the cognitive strategies observed during VSG intervention with children with DCD, using Pressley's GSU model (1987).

Research Design

This study employed behavioural observation to identify cognitive strategies observed during VSG intervention sessions. Behavioural observation has been referred to as the sine qua non of science (Suen & Ary, 1989) and is used by many researchers in a spectrum of disciplines including sociology, psychology, and special education (Etscheidt, 1991; Piaget, 1951). Observation lends itself to the descriptive stage of research and is useful in producing hypotheses that can be used in further research (Hedrick, Bickman, & Rog, 1993; Wilkinson, 1995). Furthermore, Hedrick

et al. suggest that behavioural observation is useful when researchers study the development of a new intervention or program. Thus, behavioural observation appeared to be an appropriate means to begin to explore the salient features of VSG intervention.

This behavioural study involved three Phases: a Preliminary Phase, Phase I: Identification of the Strategies, and Phase II: Verification of the Strategies.

Data Source

Data for this study were obtained from the videotaped intervention sessions of Wilcox (1994) and Martini (1994), described in the literature review chapter of this thesis. According to Wilkinson (1995), videotape analysis allows for a level of detail and reliability not normally possible in a laboratory or during formal observation in naturalistic settings. Videotaped observations serves to reduce observer drift. Observer drift is defined as error due to fatigue. Videotaped observation can be halted and returned to at subsequent times if the observer becomes fatigued. Observer bias can be readily checked by reviewing tapes with other observers and experts. The current study allowed a large quantity of videotaped data to be changed to a form that could be analyzed and collated.

All videotaped sessions occurred at The University of Western Ontario, in the Department of Occupational Therapy.

Wilcox's (1994) study was undertaken during the summer of 1992 and included ten children, and Martini's (1994) study included four children and occurred in the winter and spring of 1994.

All four children in Martini's (1994) study were included in the present study. Four of the participants in Wilcox's (1994) study were randomly chosen to be included in this study. Of the 8 children, 3 were girls and 5 were boys. The characteristics of the children involved in this study are described Table 6.

Present Study Sample

The total sample consisted of 7,000 minutes of videotaped intervention sessions. For the Preliminary Phase, 500 minutes of Wilcox's videotaped intervention (the complete intervention for one child) was viewed. These tapes were not included in the subsequent analyses.

For Phase I, 10, 10-minute segments were randomly chosen from each of the four children in Martini's study and from the four children randomly chosen from Wilcox's study. These eighty segments (800 minutes) of videotaped intervention were used to identify and classify strategies in Phase I. It took this investigator approximately 5 minutes to view and code 1 minute of videotape. In total it required approximately 4,000 minutes to develop the coding system.

Table 6

Characteristics of Children in the Present Study by: Age, Gender, Therapist, Goals, Medication, Learning Disability Status

Child	Gender	Age	Therapist Goals	Medication	LD
1SG	M	10-1	Twirling spaghetti, printing, hockey	Ritalin	
2RB	M	11-2	Typing, making ice cream, shooting a basketball	Dexedrine	X
3DS	M	7-2	Performing a karate Kata, running fast, cutting cucumbers		
4CT	F	7-10	Skipping rope, printing, making paper planes		X
5 AC	F	9-11	Cutting tomatoes, shuffling cards, writing	Ritalin	X
6JW	M	9-7	Baking cookies, cutting meat & bread, writing		
7 JW	F	8-6	Learning a Kata, making french toast, chopsticks	Ritalin	
8 AB	M	9-6	Running, putting stuff on paper, typing faster		

M-Male F -female LD-Learning Disability Therapist A Marini Therapist B- Wilcox

For Phase II, 35, 10-minute segments were randomly chosen from videotape not used in earlier phases. Table 7 depicts the number of minutes of actual videotape viewed in each phase.

Preliminary Phase

Prior to carrying out a careful analysis of the videotaped sessions of Wilcox (1994) and Martini (1994), a preliminary scanning was undertaken to determine if there was any evidence of domain-specific strategies. The videotaped intervention sessions of Wilcox and Martini were viewed with a professor of occupational therapy and an experienced clinician. Investigation of these videotapes indicated the use of strategies, other than Goal Plan Do Check, that seemed to influence motor behaviour. To confirm these findings, a further 10 sessions (500 minutes) of intervention were viewed. Narrative summaries of the key components of this intervention were compiled. Based on these preliminary findings, a full behavioural observation study was indicated. Using the strategy component of Pressley et al.'s (1987) GSU model, a study was designed to explore, in more detail, the strategies used during VSG intervention. The purpose of this study was to conduct a

Table 7

Present Study Sample

	Number of Subjects	Total Hours of Videotape	Preliminary Stage	Phase I	Phase II
Wilcox's (1994) Study	10	5,000 minutes	500 minutes	400 minutes	230 minutes
Martini's (1994) Study	4	2,000 minutes		400 minutes	120 minutes
Total	14	7,500 minutes	500 minutes	800 minutes	350 minutes

process analysis of the videotaped VSG intervention sessions of Wilcox (1994) and Martini (1994) , to examine domain-specific strategy use, and to further articulate the specifics of the global strategy, GPDC.

Phase I: Identification of Strategies

Phase I began in August 1996. The 10, 10-minute segments randomly sampled for each of the eight children were coded. Overt verbalizations that elicited change in motor performance were recorded. Procedures for this Phase are discussed below.

Establishing behavioural taxonomies is extremely time consuming (Sackett, 1978). Codes need to be clear, complete, unambiguous, and described in terms of observable characteristics (Wilkinson, 1995). In this study, an observational coding form was used as the data collection instrument (see Appendix A). This observational coding form provided the structure for the data collection process. The form was refined and used by the independent observer, the primary investigator, and the thesis committee. It assisted in ensuring that consistent procedures and criteria for the observations were followed. The criterion for recording a strategy was that the strategy was discussed in words; either by the therapist or the child, and that immediate implementation of the stated strategy resulted in a change

in observable motor behaviour. Change was considered to have occurred if the child performed the motor action.

Observational Coding Form

The observational coding form allowed for the systematic search for verbalizations of cognitive strategies over a 10-minute segment by recording the global task, transcribing the full dialogue of the therapist or child, recording the performance of the targeted behaviour, and recording whether the therapist or the child verbalized the strategy (see Appendix A).

In the early development of the classifications in Phase I, the thesis committee reviewed the findings from the videotapes with the primary investigator. This resulted in refinement of the classifications. Proposed categories were examined and determined to meet the criteria of being exhaustive and mutually exclusive, as recommended by Bakeman and Gottman (1986), Sackett (1978), and Wilkinson (1995). There was no attempt to calculate frequency counts or averages for strategy use, as summary statistics could lead to misinterpretations and inaccurate conclusions about strategy use and performance (Siegler 1987).

Phase II: Verification of Strategies

After development and refinement of the classification system was completed, an independent observer was employed to verify the identification of the strategies using new segments of videotape. The independent observer coded a total of 350 minutes of videotape, 120 minutes of Martini's (1994) videotapes and 230 minutes of Wilcox's (1994) videotapes. These were randomly chosen sessions that had not been reviewed in Phase I. The purpose of this phase was to ensure that the behavioural codes were mutually exclusive and exhaustive and that there were no strategies that fell into an undefined category (Bakeman & Gottman, 1986; Sackett, 1978; Suen & Ary, 1989). To achieve this, interobserver agreement was first established.

Interobserver Agreement

Interobserver agreement was completed by an independent observer. The primary investigator provided the observer with the data coding form and reviewed the coding system. Following this, the investigator and the independent observer reviewed a total of 134 occurrences of strategies that had been recorded in Phase I. Interobserver agreement

of 96% was established. An agreement score of 80% or greater is acceptable in the behavioural literature (Wilkinson, 1995). Next, the independent observer and the primary investigator viewed 3, 10-minute segments of not previously viewed videotaped intervention session to ensure the definitions were clear and the categories were mutually exclusive and exhaustive, and to establish interobserver agreement on videotaped data that had not been previously viewed by either the independent observer or the primary investigator. Percentage agreement scores for these three segments were calculated at 94%, 92%, and 96%, respectively. Using procedures recommended by Martin and Pears (1992), interobserver agreement was calculated by dividing the number of agreements recorded by the observers during intervention sessions by the total number of agreements plus disagreements and multiplying the dividend by 100%. Table 8 shows the interobserver agreement data and the amount of videotape viewed by the independent observer.

Table 8

Interobserver Agreement

Data Segment	Interobserver Agreement
134 occurrences of strategies in Phase I	96%
30 minutes of videotaped intervention sessions (3 -10 minute segments)	94% 92% 96% respectively

CHAPTER FOUR: RESULTS

Overview

This study investigated the use of cognitive strategies during VSG intervention with children with DCD. The findings of this study confirmed the use of the global, executive strategy, Goal Plan Do Check (GPDC) as reported by Wilcox (1994) and Martini (1994). However, several other components of the GSU Model were also evident. The GPDC strategy appeared to act as a framework for invoking these other components of the GSU Model. Frequently, domain-specific strategies were required to enable the child to articulate the goal, or the plan, to perform motor tasks. As well, it appeared that it was necessary to supplement task knowledge, a GSU component, in order for the children to be able to use the GPDC strategy.

In this chapter an elaboration of the executive strategy, GPDC, is presented. The elucidation of this strategy will demonstrate how GPDC led to the use of the other GSU components: domain-specific strategies and supplementing task knowledge. For each component, the observed behaviour, the circumstances that led to the use of the components, and an actual scenario showing how the use of the strategy effected motor performance will be provided.

Children are identified in the scenarios using the initials of their first and last name.

As discussed in the methods section, the findings of the independent observer confirmed those findings of the primary investigator. Therefore the findings of both the primary investigator and independent observer are combined for presentation of results. Figure 1 provides an overview of the components identified.

Figure 1
Summary of Results

Good Strategy User (GSU) Components

A. Higher Order Strategy

Goal Plan Do Check

B. Knowledge Base

Supplementing Task Knowledge

C. Strategy Use

Domain-Specific Strategies

1. Task Specification/Modification
2. Motor Mnemonic
3. Body Position
4. Feeling the Movement
5. Attention to Doing
6. Verbal Guidance
7. Verbal Self-Guidance
8. Verbal Rote Script

Higher Order Strategy

Global Strategy Use: Goal Plan Do Check

Observed Behaviour

Any verbal description of the targeted motor behaviour using any of the words of Goal Plan Do or Check.

Circumstance

The strategy Goal Plan Do Check, formed the architecture for each intervention session. This strategy occurred across all sessions and was used flexibly in both VSG-I (Wilcox, 1994) and VSG-II (Martini, 1994). The global strategy, Goal Plan Do Check, was used by both therapists, and the strategy was noted in all the segments of videotape that were viewed. It was used by the therapist, by the child when prompted by the therapist, and spontaneously by the child. In addition to being used in its entirety, various elements of the GPDC strategy were used in isolation. For example, the Plan was used in clarification and specification of the Goal, and, in using the Check component, the child evaluated whether the Plan was, in fact, effective. As a result of the Check, the child often refined, or abandoned the Plan. The Check component also served to confirm the effectiveness of the Plan.

Elaboration of Goal, Plan, Do, and Check

Goal

Determining the goal assisted in identifying the task for the sessions and providing a beginning focus for the session. Often supplementing task knowledge was embedded in the goal. During the Goal stage, the motor behaviour was defined. At times, in the portions of the tapes observed, the goal was very global, such as "our goal today is to print", and at alternate times the Goal was quite specific, such as "my goal is 3 capital Bs." The goal was used to refine the expectations for the segment of the videotape observed. For example, in one case, the child stated "my goal is to cut cheese." The therapist further refined the goal to be "the goal is to cut the cheese all the same width."

Plan

The plan was often very iterative and elaborate. Typically, the plan required refinement and revision. When the child "got stuck" in an activity, the therapist would evoke the use of a domain-specific strategy to refine the plan. The therapist would analyze where the child was getting stuck. The child explored a variety of plans before arriving at one that worked for him/her. After execution of an ineffective plan, the child was required to revise his/her plan, generating alternative solutions to the plan.

To illustrate, consider CT, while engaged in skipping, she stated "my plan is to jump". She attempted to jump but continually got caught in the rope. Her plan required revision. Guided by the therapist, "when skipping you jump, but where do you jump?", the child responded, after several attempts and revisions of the plan, "in the middle". When the therapist asked "why?", the child responded "because if you jump here you get caught", then the therapist stated "let's try it, so your plan is to jump in the middle."

Do

The next step in this higher-order strategy was Do, the execution of the plan. Often verbalization from the therapist accompanied the child's behaviour.

Check

The Check component provided monitoring of the task. Check took many forms, frequently taking the form of comparison. The children would compare within their own performance. Comparison also took the role of comparing performance with a model provided by the therapists or by a standard. At times, the results were self-evident. For example, during throwing a basketball, it was obvious whether the ball went in the hoop or not; or when jumping rope, if the rope got caught around the child's ankles, monitoring was self-evident. During other tasks, such as

cutting tomatoes, achieving the same width for all slices required a greater precision of check. The Check component assisted in developing the criteria that acceptably defined successful task completion.

Supplementing Task Knowledge and Domain-Specific Strategies

Along with supplementing task knowledge, eight domain-specific strategies were identified. These strategies were found to be exclusive and mutually exhaustive. The observed behaviour for each strategy is defined (see Table 9 for summary). The circumstances in which the strategy was used, followed by a listing of behaviours included under this category are described. Explicit scenarios, demonstrating the use of each strategy and its motor performance outcome, are presented.

Supplementing Task Knowledge

Observed Behaviour

Any verbalization of auxiliary knowledge about the task that is necessary for the task performance.

Circumstances

Supplemental task knowledge was provided to assist the child in understanding the demands of the task. It was used extensively by both therapists. It stood apart from the

domain-specific strategies, as this component was often a prerequisite to the use of the domain-specific strategies, and in particular the Goal and the Plan.

Table 9

Domain-Specific Strategies

Strategy	Observed Behaviour
Task Specification/Modification	Any discussions regarding the specifics, or modification of the task, or parts of the task, or any action to change the task, or parts of the task, that facilitate motor performance.
Body Position	Verbalization of attention to, or shifting, of the body, whole or in part, relative to the task.
Feeling the Movement	Verbalization of attention to the feeling of the movement.
Attention to Doing	Verbalization to cue attending to the doing of the task.
Verbal Guidance	The therapist talks the child through the motor sequence.
Verbal Self-Guidance	The child talks him/her self through the motor sequence.
Verbal Rote Script	A rote pattern of words used to guide the motor sequence.
Motor Pneumonic	Attachment of a label to the task or component of the task which evokes a mental image to guide motor performance.

It was clear from this videotape analysis that the children frequently did not possess the basic knowledge necessary to execute the motor task in question. In the segments observed, the children appeared to lack an understanding of what the motoric task requirements were.

This component was observed to be used during a variety of segments, including developing an understanding of aiming during hockey and understanding that when you print you start at the left margin and that the letters need to sit on the line.

Scenario

During the task of printing, SG did not always start at the left margin. The printing would be started at various points on the line. It was clear from the discussion that the child did not understand that he needed to start all his printing at the red margin line. The therapist drew the child's focus to this by stating, "we start all our sentences at the red line." This additional knowledge of the task assisted the child in performing the task. It appeared that different circumstances elicited use of the various domain-specific strategies. Table 10 reflects the circumstance that elicited the strategy, and the framework for the GSU components.

Table 10

Framework for the GSU Components (Pressley et al., 1989)

Circumstance that elicited the strategy	Component that facilitated performance
When the child did not have enough information to specify the goal or the plan	Supplementing Task Knowledge
	Task Specification
	Motor Pneumonic
When the child could not "do" the movement	Task Modification
	Body Position
	Feeling the Movement
	Attention to Doing
When the child could do the movement but required verbal guidance to practice	Verbal Guidance
	Verbal Self-Guidance
	Verbal Rote Script

It appeared that different circumstances elicited use of the various domain-specific strategies. Table 10 reflects the circumstance that elicited the strategy, and the framework for the GSU components.

Task Specification/Modification

Observed Behaviour

Any discussions regarding the specifics or modification of the task, or parts of the task, or any action to change the task, or parts of the task, that facilitate motor performance.

Circumstance

This strategy was again used by both therapists across all segments observed. The therapists used this strategy to develop the specific skill in question. When the child did not know the goal, or could not define the plan, this strategy was evoked.

Task specification was observed when the child did not understand the specifics of the goal and the plan; task modification was observed when the child knew the plan, but could not perform the whole movement. The therapist would modify the task so the child could perform the modified task. Examples of this strategy were observed during the

tasks of paper airplane making, learning to manipulate chopsticks, and learning to shoot a basketball.

Scenario

An example of task specification was observed with CT during skipping. CT had figured out that she needed to stand in the middle of the rope and jump, but she had trouble maintaining her body in the middle of the rope. The therapist said, "let's put tape on the floor so you know where to stand". This specification assisted the child in monitoring where her body was relative to the rope. After the therapist placed the tape on the floor the child was able to maintain her body in the middle, using the tape as a guide.

An example of task modification was observed during the task of making paper airplanes. CT was having difficulty folding the paper on the line. CT stated " I can't do it, the paper keeps moving". The therapist stated, "I will hold the corner, you fold it". Once the therapist secured the corner, CT was able to attend to folding the corner and thus, performing the required motor behaviour.

Motor Mnemonic

Observed Behaviour

Attachment of a label to the task or component of the task that evokes a mental image to guide motor performance.

Circumstance

Motor mnemonic was usually used when the child was specifying the goal or plan or had difficulty remembering a movement pattern. It seemed that, by naming the movement in a way that had meaning for the child, motor performance improved. It was used by both therapists.

Scenario

When JW was learning to cut bread, he could not cut even slices. The therapist suggested, "let's notice what these fingers are doing" The child was able to discern, "I need to hold the bread" but could not figure out the position of the index finger. Through discussion, the child and the therapist identified his index finger as "Mr. Guard". Attaching this label to this particular behaviour elicited the desired behaviour in the child. The therapist then cued, "remember Mr. Guard."

When JB learned to use chopsticks in session 3, she was having difficulty remembering how to hold the chopsticks and making them move together. When the therapist began to say "make those bunny ears move", this seemed to have meaning for the child and assisted her in beginning to understand the movement plan that was required.

Body Position

Observed Behaviour

Verbalization of attention to, or shifting of, the body, whole or in part, relative to the task.

Circumstance

This strategy was used by both therapists, across all segments observed, and concerned many positions, including holding the pencil properly, assuming a running stance, and sitting in an upright position while writing.

Common to all the children was a difficulty with body positioning relative to the task at times. This strategy appeared to be used at times to adjust background positions, while at other times it became the focus of the activity. Once the child had an understanding of the task, the body position strategy facilitated the "doing" of the task.

Background Position Scenario

During the task of writing, when AB was focusing on the formation of the letter, the therapist would gently push in his chair to bring AB's body closer to the table; "let's do this".

Often using AB's own words, the therapist would guide him to an understanding of his body position relative to the task. The therapist questioned, "how close is your body to

the table?", or "how should your back be in the chair?". She reflected AB's response back to him; "Let's try writing when your back is against the back of the chair". The therapist had AB pull himself close to the table and identify the difference. Eventually AB discovered and verbalized, "I think my chair needs to be a bit closer to the table".

In a final segment, AB was observed to sit down but, before beginning to write, pull in his chair and correct his position without verbalizations.

Focus of the Activity Scenario

During the activity of writing, JW said "my hand is all cramped". Using JW's words, the therapist responded, "what is making your hand cramped?". JW figured out that the position of his fingers on the pencil was too tight. JW adjusted the position of his fingers on the pencil and continued writing with increased success and limited fatigue, stating, "my hand is not as tired when I hold my pencil like this".

Feeling the Movement

Observed Behaviour

Verbalization of attention to the feeling of the movement as it is being carried out.

Circumstances

This strategy was used by both therapists and was always initiated by the therapist. It was observed to be used only during the tasks of printing and writing. Once the child seemed to have a clear understanding of the task but was still unable to perform the movement, this strategy was evoked.

Scenario

AC was having difficulty learning the movement pattern, of the capital letter B. Frustrated by the difficulties she was having, AC stated, " I can't do them!" The therapist initiated the use of feeling the movement strategy. The therapist stated, " well let's pretend, let's do it in the air; let's feel the bumps in the B." AC responded "OK". The therapist continued "feel the bump, it splits in the middle." The therapist guided AC's finger through the formation of the letter and stated, "now you make my finger move". AC stated "I think I get it".

Attention to Doing

Observed Behaviour

Verbalization to cue attending to the doing of the task.

Circumstances

Attention to doing was used by both therapists. It was observed to be used effectively during the tasks of cutting tomatoes, learning to print, and nail painting. Generally, the children appeared to have some difficulty attending to what they were doing. This strategy was evoked once the child had an understanding of the task requirements but was getting stuck doing the task. Drawing the children's attention to what was required seemed to facilitate task performance.

Scenario

When cutting tomatoes, AC was having substantial difficulty. The therapist stated "keep looking at what you are doing". AC was able to re-focus on the task and cut the tomato. During refinement of the behaviour of cutting tomatoes, the therapist would direct the child, "let's notice the difference", "look at which ones are the same." By attending to what the task required, the child was able to compare and make appropriate accommodations that positively influenced motor performance.

Verbal Guidance

Observed Behaviour

The therapist talks the child through the motor sequence.

Circumstances

This strategy was always initiated by the therapist to elicit the desired motor pattern, once the child could perform the movement. Both therapists used this strategy in all segments observed. During some motor tasks, tasks that have an arbitrary beginning and end, the therapist would talk the child through the sequence while the child was performing the movement. During other activities, the verbal guidance was provided before, or after, the execution of the desired behaviour.

Scenario

During the task of writing, AB was learning the formation of the letter p. AB was having difficulty orienting the letter to baseline. While he was completing the movement, the therapist stated, "first start at the top line and go all the way and touch the bottom line, then top of the line around and down".

Verbal Self-Guidance

Observed Behaviour

The child talks himself/herself through the motor sequence.

Circumstance

This strategy was observed being used once the child had an understanding of the motor pattern required.

Scenario.

During the task of writing, the therapist verbalized the sequence, "down to this line then up to the top", while the child performed the movement. In a subsequent segment, DS was observed quietly stating to himself, "down, then up to the top."

Verbal Rote Script

Behaviour Observed

Any rote pattern of words to guide the motor sequence.

Circumstance

This strategy was used to capture the essence of the movement in four or five clear, concise words that were meaningful to the child. It was observed to be used by both therapist during the segments of activities, including cuttings cheese and karate. This sequence of words seemed to facilitate the execution of the movement. The therapist would recite the verbal script while the child performed the task. This strategy appeared to be used most often once the component parts of the skill had been mastered.

Scenario

During the activity of cutting cheese, JW was able to perform all the movements required with the use of the verbal rote script strategy. The therapist verbalized, "hold, finger guard, down and push, hold, finger guard, down and push." This repeated sequence assisted JW in eliciting the movement.

Similarly during the activity of karate, once DS was able to perform all the component parts of the skill, the therapist would elicit the movement in DS by using this strategy. The therapist stated, "block, kick, step punch, block, kick, step punch". This repetition guided the child to perform the movement accurately and in the proper sequence.

Summary of Results

Several components of GSU Model were evident during VSG intervention. Table 11 provides a comparison between the GSU model and VSG. Among these critical components are supplementing task knowledge and domain-specific strategies. These results suggest that there are several features of VSG intervention that occurred, that were not articulated in the results of Martini (1994) and Wilcox (1994). Both therapists reported success with the use of the global, executive strategy. Neither reported any other

Table 11

**Comparison of The Good Strategy User Model
and VSG Components as Identified by This Investigator**

The Good Strategy User Model Pressley, Borkowski, Schneider (1987)		Verbal Self-Guidance (Wilcox, 1994; Martini, 1994)
Domain Specific Strategies		Domain Specific Strategies
Higher-order Strategies		Global Strategy Goal Plan Do Check
Knowledge Base		Supplementing Task Knowledge
Specific Strategy Knowledge		*
Motivational Beliefs		*

* Due to the nature of this observational study this components were not identified, however these components require further investigation.

strategy use. However, both therapists used domain-specific strategies, as needed, when the child was experiencing difficulty.

CHAPTER FIVE: DISCUSSION

The impetus for this study was to identify and classify the cognitive strategies observed in videotapes of VSG intervention with children with DCD. Results of this study identify several mutually exclusive and exhaustive categories of strategies, including global, domain-specific, and supplementing task knowledge. Further, the nature and application of the global strategy, Goal Plan Do Check, was elucidated.

Cognitive Issues

The findings of this study are consistent with the cognitive psychology literature, specifically, the works of Vygotsky (1962), Luria (1961) and Meichenbaum (1977), which indicate that cognition plays an active role in the early stages of all learning. From behavioural observation of videotaped intervention sessions, it was also found that the child's cognition plays a pivotal role in the learning of new motor behaviour during VSG intervention. Through self-discovery and/or discoveries guided by the therapist, the child discovers the strategies necessary to make motor performance possible.

Specifically, some of the domain-specific strategies, such as verbal guidance, verbal rote script and verbal self-guidance seemed to played a central role in this cognitive intervention. There appeared to be a progression from verbalization by the therapist to verbalization by the children. This is congruent with the finding of Vygotsky (1962), Luria (1961) and Meichenbaum (1977). Vygotsky suggested that from overt use of speech the next stage is covert speech. Whether the verbalizations observed in the children videotaped became covert remains to be seen. Wilcox (1994) and Martini (1994) suggested this was the case. However, without the opportunity to probe the children with the use of a think aloud protocol, such observation is only speculative. Further research in this area is necessary.

There appears to be a goodness-of-fit between the Good Strategy User Model (Pressley et al., 1987) and the observation of what transpired with regard to strategies used during the VSG intervention sessions (see Table 11). Consistent with this cognitive strategy perspective, several categories were observed. The synergistic interaction of the strategies of global and domain-specific strategies and supplementing task knowledge seemed to positively influenced motor behaviour. This study provides evidence that VSG is a complex intervention process. It seems that verbal self-guidance is, in fact, only one strategy embedded among many. It appears that the cognitive approach observed in the

videotapes involves much more than VSG; hence, a change of name is suggested to **Cognitive Orientation to Occupational Performance (CO-OP)**.

Martini (1994) and Wilcox (1994) recognized that using VSG may precipitate the use of other strategies. In fact, Martini stated "...many factors involved in this approach remain unexplored. Exactly which aspects of this multifaceted approach are crucial for the clinician to comply with and which are not, still have to be determined" (p. 114).

From the results reported here, it would appear that domain-specific strategy use was an important, but unrecognized, part of VSG. How is this possible? Sternberg, Wagner, Williams, and Horvath (1995) suggest that individuals possess a vast repertoire of tacit knowledge, and that, by nature, this knowledge is not readily accessible to description. Tacit knowledge is described as procedural. It may be that therapists use domain-specific strategies procedurally, without conscious realization of their use.

The problem of identification of treatment variables has a long standing history in the cognitive behaviour modification literature. Etscheidt (1991) articulates that, under the auspices of cognitive behaviour modification, different studies use different components, such as self-instruction training, reinforcement, and attributional

training, yet do not clearly classify all components. It is difficult to determine the effectiveness of a program without the nature of the study components being reported consistently. This study lends support to that observation. This study is an initial attempt to identify parts of the VSG/CO-OP treatment that may influence motor behaviour. Whether, in fact, these strategies were integral to this intervention requires further study. However, if domain-specific strategies are integral, it becomes difficult to identify treatment variables or study the efficacy of treatments, when the strategic techniques are at a tacit level. It makes it difficult to teach other therapists an intervention technique if the treatment components are not well understood. This implicates the importance of studies such as the current study. Due to videotape technology, retrospective studies such as this are possible.

Motor Issues

Traditional occupational therapy interventions have been based on neurodevelopmental theories of motor skill acquisition. The studies of Wilcox (1994) and Martini (1994) juxtapose contemporary motor learning theories with traditional theories. The notion that cognition can guide and organize motor behaviour is a novel way of thinking for occupational therapists. The Wilcox and Martini studies,

combined with the results of this present study, suggest that we need to reexamine the theoretical assumptions of these traditional approaches and that further research is necessary. It is increasingly clear that occupational therapists must continue to develop rigorous methods to evaluate interventions.

Cognition and Motor Issues Meet

Congruent with the motor learning literature, the results of this study lend further support to the notion that cognition can influence motor behaviour. The influences of cognition in the early stages of motor learning are well documented in the literature (Schmidt, 1991). The very nature and variety of the occupational performance goals undertaken by the children make comparisons difficult. It may be useful in the future to compare all the children using a common task. However, there is evidence suggesting that cognitive strategies bridge the gap between motor skill acquisition and motor competence.

Future Development

The studies by Martini (1994) and Wilcox (1994) were limited by the small sample sizes and the nature of single case methodology. There is a need to put VSG to the test

using tighter, more rigorous methodologies to determine the efficacy of this intervention relative to traditional treatment as well as a control condition. However, before proceeding to a more rigorous methodology, such as randomized control trial (RCT), it is necessary to complete the descriptive research that lays the foundation for a study using RCT methodology. Fawcett and Downs (1992) argue that clinicians often attempt to begin with experimental studies such as RCT. This compelling urge to determine the efficacy of treatment interventions is often driven by the pressure of clinical practice, despite the limited understanding of the components of the intervention and the underlying theoretical assumptions. This urgency to determine the effectiveness of intervention, before the key variables of the intervention are identified, needs to be tempered with descriptive research to identify those active variables.

If the goal is to build an effective treatment approach based on solid theory, then further descriptive studies, such as the current study, are essential. This exploratory research has helped to identify one such important treatment factor.

Only by collecting data and constructing relevant observations can we have a clear understanding of the nature of VSG. The results of this study provide an important beginning in understanding the components of this

intervention. This study generated many more questions than it answered. For example: Do strategies influence motor performance in children with DCD? And do children generalize and maintain these behaviors? The follow-up study suggests that these behaviours are maintained, although continued use of the strategy did not occur spontaneously.

Videotape analysis is time consuming and costly. Yet, it is one way of recording and analyzing the complex interactions between the child and the therapist that may have influenced motor performance.

A fundamental question remains as to whether cognitive strategies do effect performance. This descriptive study is a small piece in a larger, more complex puzzle. If our ultimate goal is to enhance occupational performance in children with DCD, then we must pursue investigations of VSG, as it appears to be a promising approach.

Obviously no single study can attend to all the salient components of this treatment approach. Only collective research will reveal which therapeutic strategies are important to support clinical application of this promising approach. Ultimately, researchers need to identify which specific variables, in what combination, produce positive outcomes in motor performance. This thesis investigated cognitive strategies in an attempt to identify one salient feature of the VSG approach. This research study examined the nature of the strategies that appeared to enhance motor

performance. The findings of this exploratory study reinforce the need for further analysis into the interface between cognitive strategy use and improvement in motor performance in children with Developmental Coordination Disorder.

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APPENDIX A

Observational C

[illegible]

THER-Therapist initiates strategy use
CH/P-Child prompted initiates strategy use
CH/S-Child spontaneously uses strategy