Cognitive Orientation to Daily Occupational Performance (CO-OP): Part I– Theoretical Foundations

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SUMMARY. This paper is the first in a series of three papers that present the systematic development and evaluation of Cognitive Orien-

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tation to daily Occupational Performance (CO-OP). CO-OP is a cognitively based, child-centred intervention that enables children to achieve their functional goals. In Part I, the breadth of literature that provides the theoretical underpinnings for the approach is reviewed. Parts II and III provide a description of the approach and present the evidence to support its use with children with developmental coordination disorder.

KEYWORDS. DCD, rehabilitation, therapy, functional outcomes

Nearly a decade ago, when it became apparent that the intervention approaches which had been used in pediatric therapy were relatively ineffective with children with developmental coordination disorder (DCD), a number of researchers determined that it was time to develop a new frame of reference, a new way of approaching intervention with these children.[1,2] In the early 1990s, Polatajko and colleagues (see parts II and III in this volume) set out to develop a new approach to the treatment of children with DCD. Ideally, therapeutic interventions are based upon our knowledge of the population of children to be served, are grounded in associated theories of disability and treatment, and are systematically tested, refined and elucidated. A series of questions, therefore, needed to be addressed.

First, what did we know about children with DCD? Research studies conducted with these children had produced some very interesting observations. Children with DCD were consistently delayed in the acquisition of motor skills, but their intellectual abilities did not seem to be affected.[3,4] Although they were able to learn both novel and familiar motor tasks, they never reached the level of proficiency of their age-matched, non-DCD peers.[5] Further, for some unexplainable reason, children with DCD appeared to continue to perform a task the same way, over and over again, whether it was successful or not.[6,7] They seemed to have difficulty selecting a motor response that would be appropriate for any given situation[8,9] and, even when they had learned a skill, seemed to be unable to transfer or generalize it to other tasks or environments.[5,10] All of these observations appeared to be consistent with the idea that children with DCD have difficulty learning and generalizing motor skills. If one assumes that motor skills need to be

learned and retained in a similar fashion to other types of skills, then it seems reasonable to explore this as a problem of skill acquisition.

Secondly, we asked what theories of treatment might be appropriate, given the nature of the disability? In order to develop a cohesive approach that would guide intervention with these children, theories were sought that might provide a foundation for a new acquisition-based approach. The theories that provide guidance for a cognitive, or problem-solving, orientation arise from the fields of cognitive and educational psychology. In recent years, it has become evident that these theories are also entirely compatible with the evolution of theory that has taken place in the fields of motor learning and motor control. When this theoretical frame of reference is applied within occupational therapy, then additional thought needs to be given to models of client-centred practice. Finally, since cognitive strategies are an important aspect of problem-solving interventions, theories regarding the teaching and use of strategies also need to be considered. The purpose of this paper is to provide a concise overview of the theories that have served to provide the foundation for the cognitive approach to intervention, the Cognitive Orientation to daily Occupational Performance (CO-OP), that is described in parts two and three of this series.

*THEORIES OF LEARNING AND PROBLEM-SOLVING**

Many theories within cognitive and educational psychology can be traced back to the writings of L. S. Vygotsky (1896-1934). Vygotsky[11] was a Russian psychologist who spent time observing the problem-solving attempts of young children. He noted that, during problem-solving tasks (e.g., when children were asked to draw but not given crayons), young children spoke aloud at points of difficulty. In contrast, older children appeared to think about a solution, then act. When children were asked about their problem-solving, however, it became apparent that the thoughts of the older children were very similar to

*The theories within this section only were previously reviewed by the authors in the publication, Missiuna C, Malloy-Miller T, Mandich A. Mediational techniques: Origins and application to occupational therapy in pediatrics. *Cdn Jour Occup Ther.* 1998; 65(4), 202-209. A summarized version of that review is reproduced here with permission.

the overt speech used by the younger children. Vygotsky[11] concluded that children need to be able to talk themselves through a problem and that this served to help the child formulate a plan. Vygotsky believed that cognitive development occurred through the gradual internalization of concepts and relationships that were learned through interaction with others who were more cognitively competent. He suggested that children first experience cognitive activities such as problem-solving in situations in which there is a child, an activity, and a significant other. The adult initially does most of the cognitive work; however, gradually the adult's speech is internalized by the child and, with experience and application, becomes part of the child's repertoire.

Luria,[12,13] a student of Vygotsky, further detailed the process involved when one is learning a new concept or exploring a problem. He suggested that there were five stages to the problem-solving process: (1) discovery of the problem; (2) investigation of the problem; (3) selection of alternative solutions; (4) attempt to solve the problem; (5) comparison of results of the solution. Luria[12,13] strongly supported Vygotsky's belief that a child initially talks aloud to direct problem-solving and that the steps of the process are then rehearsed by the child internally as covert speech. It was this aspect of Vygotsky's work-the use of internal speech to guide and regulate one's behaviour-that Meichenbaum drew upon to develop his ideas for cognitive-behavioural approaches.

Meichenbaum[14,15] proposed that a child could learn to regulate his behaviour by instructing himself to identify a goal, develop a plan, enact the plan, and evaluate its success. Meichenbaum and Goodman[16] described a series of self-instructional steps in which problem-solving stages would be modeled by a competent adult, then stated aloud by the child, then internalized and recalled covertly by the child. Meichenbaum[15] outlined a problem-solving structure that could be easily learned by the child because it had just four simple steps, Goal-Plan-Do-Check, that were similar to the stages described earlier by Luria.[13] In order to ensure that this problem-solving structure would be learned and generalized by the child, Meichenbaum emphasized the importance of scaffolding the child's learning, i.e., using everyday activities, learning the structure in a context in which it could be used, bridging to other real life examples, individualizing the plan and having a significant adult provide feedback to the child.

While this type of global problem-solving structure was being

detailed in North America, Feuerstein and colleagues in Israel were delineating the type of adult guidance that would be needed to foster cognitive development and problem-solving within a child.[17] Feuerstein believed that cognitive development resulted from two types of interactions: the first, direct exposure to tasks within the environment, was consistent with Piagetian models of development. The second type of interaction that Feuerstein believed to be essential was a newer idea that was termed ''mediated learning experience.''[17,18] He believed that daily experiences needed to be interpreted by an adult who would select and organize environmental stimuli until it was appropriate for the child's level of learning. Feuerstein assumed that any ''deficiency'' in the child or the environment that appeared to hinder learning (e.g., motor or learning problems, poverty) was only of secondary concern since that deficiency might not be able to be changed. He suggested that the essential factor determining whether or not a child's cognitive abilities could be improved was the presence of a mediator, someone who would be able to help the child make sense out of his or her life experiences.[19] Becoming a mediator meant that the adult would take an active role as an intermediary between the child and the task, assisting the child to derive a more generalized meaning from it. Feuerstein et al.[19] and subsequently Haywood[20,21] outlined the techniques that would be used by an adult in order to mediate effectively with a child. These interactive techniques include process questioning, bridging, comparison/describing, modeling, challenging and elaborated feedback (for a detailed description, please see Missiuna, Malloy-Miller, and Mandich[22]).

In Cognitive Orientation to daily Occupational Performance (CO-OP, described in detail in Polatajko et al., this volume), Vygotsky's belief that a child needs to guide him or herself through problem-solving by talking aloud is strongly maintained. Meichenbaum's problem solving structure-Goal, Plan, Do, Check-is used as the global strategy that is applied to every daily task that the child works on in therapy and many of his ideas about how to teach this approach to children have been retained. These ideas are combined with the mediational techniques outlined by Feuerstein and Haywood to facilitate guided discovery and provide the method through which the therapist elicits responses from the child and bridges that learning to other daily living situations.

THEORIES OF MOTOR LEARNING AND MOTOR CONTROL

Since the 1960s, motor learning and motor control theories have been grounded in the idea that changes in motor behaviour and skill occurred as a result of maturation of the central nervous system. This system was originally believed to be organized hierarchically with the cortex gradually gaining control over primitive reflexes and integrating these to produce functional movement patterns.[23] Back in 1967, Bernstein[24] had proposed that motor learning should be thought of as a process of solving movement problems. Practice of a motor skill, according to Bernstein, was not meant to be for the purpose of repeating the solution to a motor problem but in order to repeat, and learn, the process needed to solve it. For the next twenty years, Bernstein's ideas were largely overlooked as theorists continued to support hierarchical models of motor learning. Schmidt,[25] for example, proposed that generalized motor programs resided within the central nervous system that stored the initial conditions of a movement, the parameters that were used to make it and the results of the movement. New movement patterns were generated during practice of the movement as feedback was utilized to specify and refine parameters such as force and distance. Schmidt's theories reinforced the hierarchical view of motor learning; however, they also contributed significantly to our understanding of the importance of knowing and learning from the outcome of a movement, called ''knowledge of results.''[26]

In the 1990s, we have seen a strong return to the type of thinking originally espoused by Bernstein.[24] Modern day theorists argue against the idea that motor patterns are formed and represented hierarchically. Instead, they suggest that motor control and development emerge as a result of the interaction of multiple, cooperative systems as the child tries to solve movement problems.[27] These theories, captured by the term ''dynamic systems theories,'' propose that the systems of the person-musculoskeletal, neural, cognitive-interact with the person's motivation to perform the task, with the structure and requirements of the task itself and within the constraints of the environment.[28] New movements and motor control result from the collaboration of all of these parts of the system as they organize themselves in order to solve a movement problem. The parameters of the task, the environment, and the level of readiness of the child influence the type of learning that can take place and the movement strategies that will be developed.[29] If a therapist wants to facilitate motor learning, he or she

has to determine the factors that might be changed in order to move the system forward.[30] In some instances, these factors may involve trying to change the positioning or body mechanics of the child. In other instances, however, factors such as practice, knowledge about the task and motivation to improve performance may have more impact.[31]

Gentile[32] recently described two types of learning processes that she believes occur concurrently during the acquisition of a functional motor skill. Explicit learning processes take place as the child consciously attempts to put into place a known movement that will approximate the demands of the task. For example, if a child has already learned how to catch a beach ball, he will have a general idea of the body and arm position that might be required to catch a basketball. With practice, postural stability, specific joint positioning, muscle contraction patterns and other forces become more refined through a process called implicit learning. Explicit learning, since it is a conscious process, may be able to be facilitated through verbal instruction whereas it is probable that implicit learning is less accessible to this type of intervention.[32]

In CO-OP, the child is learning a new motor skill or improving performance on one that has not yet developed sufficiently to be functional for the child. If motor learning is viewed as the child solving a movement problem[29] then children need to learn the process involved in discovering a solution for themselves.[33] This type of problem-solving involves generating alternative ways of solving the movement problem and then ''discovering'' which method works most efficiently. Guided discovery is described in more detail in the next section and in subsequent papers. It involves the therapist setting up the environment to draw the child's attention to the specific point at which he or she is getting stuck, to discover the relevant features of the task, the environment and their body and then to generate alternative solutions to the movement(s) that the child is currently using. In this way, appropriate movement strategies will become evident to the child.

CHILD-CENTRED INTERVENTION AND CHILD-CHOSEN GOALS

The interaction of the individual, the task and the environment that has been emphasized recently in motor learning theories has been

stressed with equal importance in occupational therapy literature. Numerous theorists have identified that successful performance of daily activities results from an optimal match between the person, the environment and the occupation (e.g.,[34,35,36,37]). While this may seem to be an obvious observation, this way of thinking about maximizing performance has moved us toward prioritizing intervention that focuses on the goal or task itself, rather than on the component skills and abilities that are believed to underlie performance of the task. Traditionally, therapists might have analysed the tasks or goals that were selected by the child, identified underlying component deficits (e.g., eye hand coordination difficulties, poor balance) and then remediated those areas. This ''bottom-up'' approach[38] was grounded in the hierarchical models of neurodevelopment, referred to earlier, that suggested that motor control would emerge when underlying skills were adequately developed.[39] With the advent of dynamic systems theories of motor learning, therapists such as Mathiewitz and Haugen[40] have suggested that, because motor learning is a multistage process of interaction between the individual, the environment, and the occupation, motor control will emerge as the individual becomes more efficient and effective at performing a specific task.[40] Intervention approaches that begin and end with an emphasis upon the child's selected goal have therefore been referred to as ''top-down''[38] or ''occupation based'' approaches.[41]

Focusing on child-chosen goals is also important from the perspective of the ecological relevance of the task. Bandura[42,43,44] has suggested that children's actual experiences performing an activity contribute most significantly to their self-perceptions. As children develop metacognitive abilities, they become able to reflect upon their task performance and to judge their capabilities and limitations quite accurately. When children identify areas of difficulty and then set goals, they usually feel empowered.[43,45] These feelings of empowerment lead to increased goal commitment which may, in turn, increase performance and perceived competence and foster the setting of new goals.[46] Children also become able to consider how expenditure of effort, persistence and other factors can compensate for lack of ability.[44]

In CO-OP, a child-centred approach is taken and children are encouraged to select their own goals for intervention. At the age at which children participate in CO-OP, their metacognitive skills are developed sufficiently for them to be able to consider their task perfor-

mance across situations. They are motivated to work on achieving goals that they have set personally.

THEORIES OF STRATEGY USE

A related body of literature that provides underpinnings for this approach is drawn from the work of Pressley and colleagues[47,48,49] on the use of cognitive strategies to facilitate learning. Strategies have been defined as ''an individual's approach to a task when it includes how a person thinks and acts when planning, executing and evaluating performance on a task and its outcomes'' (p. 5).[50] This planful approach to task performance is potentially conscious and may involve the implementation of both cognitive and metacognitive strategies. Normally, cognitive strategies are put in place efficiently and automatically in order to plan and execute a task. When the task becomes difficult, relative to the child's skill level, then metacognitive (or executive) strategies are required to select appropriate cognitive strategies, monitor and evaluate their application. Implementing these metacognitive strategies involves going through the problem solving structure described earlier. Once strategy use becomes automatic and efficient, then metacognition, thinking about and monitoring the strategies consciously, will no longer be necessary.[49] Like Meichenbaum, Borkowski and colleagues have argued in favour of the child using self-instructional routines to guide their problem solving as these routines ''force the child to consider the demands of both the task and the strategy and to match the strategy to the task on the basis of shared features''(p. 66).[49]

Concepts implicit in strategy instruction address the question of transfer and generalization very directly. In order to generalize a strategy, the child must have knowledge of how, when and where to use the strategy.[48] The optimal way to facilitate transfer is inherent in the method of learning the strategies in the first place. Pressley and colleagues recommend guided discovery learning which involves posing questions to the child that focus on factors that are relevant and irrelevant in order to help children figure out the relevant cues. They then ask the child to form and state a cognitive rule that includes specifying the conditions that must be in place for that strategy to apply. Guided discovery is remarkably similar to the scaffolding concepts of Meichenbaum and the mediational techniques described by Feuerstein and Haywood who recommend the use of process questions- questions that

focus on the problem solving process and that highlight relevant features of the task. All groups of theorists emphasize the importance of individual instruction being provided at the level of the child's skill. Application of a strategy across tasks facilitates transfer but generalization to other learning situations must be addressed as well. Pressley and colleagues believe that guided discovery facilitates transfer and generalization because the child obtains a more complete understanding of the strategies and their usage. Feuerstein et al. have suggested the importance of the mediator ''bridging,'' deliberately asking questions that prompt the child to think about other times when that task might be performed or that strategy might be useful.

In CO-OP, cognitive strategies are used to influence skill acquisition. Generalization and transfer of skills is supported through the use of an executive, or problem-solving strategy, that trains the child to monitor his performance and self-evaluate the outcome. Domain-specific strategies form the bridge between the child's ability and skill level and help them to develop appropriate motor plans.

CONCLUSIONS

Kramer and Hinojosa[51] indicate that the theoretical base ''sets the stage for the entire frame of reference'' (p. 73) of an approach to intervention and outlines the relationship between all of its elements. The elements of CO-OP include theories regarding problem-solving, children's learning, motor learning, cognitive strategies, client-centred practice, goal setting and motivation: they are drawn from many different fields but are internally consistent with one another in providing a foundation for a cognitive approach to intervention. The literature reviewed in this paper provides support for the following conclusions:

a. Current motor learning theories offer support for an approach that focuses on child-chosen goals. Motor control can be expected to emerge as a child works on a task that he or she is motivated to learn;
b. Goals, or tasks, will need to be ecologically valid, performed in a realistic setting, with practice opportunities and feedback focusing on the child learning to solve movement problems;
c. A global problem-solving structure will be needed that will develop the child's ability to select, apply, evaluate and monitor task-specific cognitive strategies;

d. In order to facilitate transfer and generalization of learned strategies, the child will need to be guided to discover these strategies and encouraged, through questioning, to focus on the process of selecting them and on evaluating their outcome.

The next step in developing a model for practice is described in Part II of this series and involves the systematic development and testing of a protocol for intervention with children with DCD.

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