Cognitive Rehabilitation: A Model for Occupational Therapy

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A theoretical model that provides a foundation for understanding function and dysfunction in cognition and perception is needed as a prerequisite for the development of effective assessment and treatment tools to be used with the brain-injured adult. Such a model and clear definitions are absent in the occupational therapy literature on adult brain function and dysfunction. This paper represents a cognitive rehabilitation model adapted for occupational therapy from the fields of neuropsychology and cognitive psychology. Differentiation of terms, an overview of the model's theory, and evaluation principles are discussed. Cognitive rehabilitation is presented from an information processing perspective. Three other treatment approaches identified in the literature are discussed and compared with cognitive rehabilitation.

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Cognition and perception are primary concerns in occupational therapy. A disturbance of cognitive and perceptual skills, which frequently occurs after brain damage, has a detrimental effect on a person's independent function (Lorenze & Cancro, 1962; Warren, 1981). Traditionally, the emphasis in evaluating and treating the brain-injured adult has been on visual perceptual dysfunction. However, visual perception problems cannot be interpreted in isolation. Cognitive skills such as orientation, insight, attention, memory, problem solving, and organization also need to be considered. Several tests standardized on adults are available to assess visual perception. Examples include the Revised Motor Free Visual Perceptual Test (Bouska & Kwatny, 1980), Benton Form Discrimination Test, and Benton Facial Recognition test (Bouska & Kwatny, 1980; Benton, Hamsher, Varney, & Spreen, 1983). In general, the objective evaluation methods for evaluating cognitive skills in the brain-damaged adult are not well documented in the occupational therapy literature.

The American Journal of Occupational Therapy and related publications have identified cognition as an area of practice since 1940 (Allen, 1985; Ayres, 1958; Baum, 1981; Fidler, 1948; Goldstein, Gershaw, & Sprafkin, 1979; Lundgren & Persechino, 1986; Lyons, 1984; McDaniel, 1954; Mosey, 1968, Pankoff, 1983; Schwartz, Shipkin, & Cermak, 1979); yet Ottenbacher (1980) found that the majority of clinicians who tested cognition did so by clinical observations. He found that 54% of the evaluation forms used with CVA patients did not include a section on cognition and concluded that “therapists using a subjective level of evaluation information cannot validly document treatment successes in measurable terms” (p. 271).

Differentiation of Terms

Perception is viewed as the personal, subjective, and sometimes puzzling process by which a person actively searches and judges the external environment (Abreu, 1981). A person uses all the performance components skills—motor skills, sensory integration, visual perception, cognition, psychological components, and social interaction—to perceive the environment. The process of perception includes sensory detection, sensory analysis, hypothesis formation, and a decision response (Klatzy, 1980).

Visual perception and cognition are both subcomponents of perception. Visual perception is defined as the ability to process and interpret visual information. Cognition is defined as the method that the central nervous system uses to process information. Cognition involves a number of interrelated processes, which occur during the acquisition and...
Theoretical Foundation for Cognitive Rehabilitation

For the purposes of this study, we combined the analysis of the perceptual process from an information processing perspective with Luria's (1970) functional classification of the brain to form the theoretical foundation for a cognitive rehabilitation model.

Figure 1 illustrates that the central nervous system processes information in three stages. First, the nervous system registers the stimulus event. Secondly, at the analysis level, the system interprets and organizes the raw sensory information. Finally, at the hypothesis formation level, the system compares the stimulus with experiences in long-term memory and relates the stimulus to the overall purpose and goal (Klatzky, 1980). Failure in processing can occur at any point of these three stages of information processing.

The process of perception elicits two different styles of responses: a data-driven response and a conceptually driven response (Norman, 1969, 1979). The data-driven response, also known as bottom-up analysis, is dependent on the external stimulus. It represents the processing of information based on incoming data through detailed analysis such as pattern recognition. The conceptually driven response, also known as top-down analysis, proceeds from the internal expectation of the incoming data (Norman, 1969, 1979). The response depends on the context of the stimulus event and is shaped by the person's culture, personality, and prior experience (Norman, 1979). The ability to process information cannot be explained by either response alone. Perceptual processes elicit both types of responses. The processes' frequency depend on the person's characteristics in cerebral lateralization, cerebral damage, and the cognitive task.

This view of perceptual processing is compatible with Luria's (1970) concept of brain blocks (see Figure 2). The first block includes the brain stem and the old cortex. It regulates wakefulness and the response to stimuli. The second block, including the temporal, parietal, and occipital lobes, plays a key role in the analysis, coding, and storage of information. The third block or frontal lobe is involved in the formation of intentions and programs. All three blocks work together in any given task (Luria, 1970, 1980).

The continuum provided by the three stages of the perceptual process and Luria's brain blocks classification provide the foundation for identifying the six critical evaluation areas in the adult population with acquired brain injury (see Figure 3).

These areas include (a) orientation and insight, (b) attention, (c) motor planning, (d) visual processing, (e) cognition, and (f) occupational behavior (Abreu, 1985).

The emphasis of the evaluation depends upon factors such as the premorbid status, the expected discharge environment, the perceptual dysfunction, and the location or nature of the brain damage.

The model of cognitive rehabilitation proposed in this paper uses teaching/learning tools which are based on information processing theory. The emphasis is on broadening a person's ability to handle increasing amounts of information by incorporating ef-
Figure 2
Classification of Brain Blocks


Normally, the perceptual processing system can handle only a limited amount of information at any given time. This limitation in capacity can be seen in everyday situations. For example, when two people talk at the same time, a listener may process half of each conversation but is unable to fully comprehend both conversations simultaneously. Healthy persons use their limited processing capacity in the most effective manner by employing strategies to structure and organize information (selectively processing only relevant information, clustering or grouping information into smaller units, formulating new associations with previous experiences) (Adamovich et al., 1985; Bolger, 1982; Trexler, 1982; Van Zomeren, 1981). The quality and quantity of the information processing directly influences learning.

The brain-damaged person has less available processing capacity than the normal person. The amount of information that can be assimilated at any one time is significantly reduced after brain damage (Van Zomeren, 1981; Rahmani, 1982). This reduction in information processing capacity can result in global or specific deficits depending on the nature of the brain damage. Global deficits are not related to any particular lesion or sensory modality; but they are generally characteristic of head injury. In contrast, specific deficits in motor, language, visual, or sensory areas are more typical of a cerebral vascular accident. Frequently, a combination of both types of deficits are seen (Boll, O'Leary, & Barth, 1981). The brain-damaged person has difficulty structuring and organizing information. Strategies to efficiently process information are not employed automatically. Clinically, the patient may not automatically attend to the relevant feature of the task, group similar items together, formulate a plan, or break the task down into steps. Therefore, the teaching of strategies is of critical importance in assisting brain-damaged persons in assimilating information.

The use of strategies with brain-damaged adults is documented from both a cognitive remediation and cognitive rehabilitation perspective (Diller & Gordon, 1981a, 1981b). Cognitive rehabilitation includes remediation and training and goes beyond the specific strategies used for cognitive deficits (Diller & Gordon, 1981a). All the cognitive rehabilitation models, as well as cognitive training methods, use learning principles (Allen, 1985; Carter, Howard & O'Neill, 1983; Carter, Caruso, Languirand & Berard, 1980; Diller & Gordon, 1981a, 1981b).
Cognitive remediation and training use table top activities, constant environments, and similar activities for testing and training purposes (Carter et al., 1980; Carter et al., 1983). The cognitive rehabilitation model uses tasks with a variety of environments, body positions, and active movement patterns.

Assessment

Traditionally, occupational therapists have assessed cognitive-perceptual processes in adults using a “skill-specific approach.” A test battery typically consists of separate categories such as figure ground, position in space, spatial relations, body scheme, or constructional praxis. The patient who fails on a figure ground task is considered to have a figure ground problem. The person who fails on a constructional praxis test, is considered to have constructional apraxia (Siev, Freishat, & Zoltan, 1986). This approach fails to emphasize quality of performance. For example, a person can do poorly on both a figure ground task and a constructional task for the same reason, namely, because he or she has a tendency to focus on details irrespective of the whole.

There are many standardized cognitive perceptual assessment tools available in psychology. These tests emphasize normative comparison, for example, the brain-damaged individual is compared with non-brain-damaged peers on a selected cognitive-perceptual dimension. This approach is useful in determining the presence and severity of dysfunction, but test scores alone reveal little about the patient’s functioning (Lezak, 1983).

Because it is not the role of the occupational therapist to diagnose the disabling condition but to evaluate function and dysfunction as a foundation for treatment, a portion of the occupational therapy cognitive-perceptual evaluation should emphasize quality more than quantity and function more than dysfunction.

In developing such an occupational therapy test, the following should be considered:

1. Test items need to be arranged in a hierarchical manner. This means that the client’s capacity to process information is tested by first using test items that require minimal processing effort.

2. Tests should not be terminated when the client fails to perform the task after standard instructions are given. It is not enough to know that the client cannot perform a task.

3. Test scores with yes/no data alone reveal little about the person’s function and should be eliminated. The therapist needs to know how the person solved a problem or approached the task. It is necessary to identify (a) conditions that improve the processing of information and facilitate performance and (b) conditions under which skills deteriorate.

4. Strategies that the client uses should be evaluated to determine if and when they are effective or maladaptive (Lezak, 1983; Luria, 1980).

Such an evaluation can be accomplished by giving the client additional specific standardized cues to see if they affect performance. The overall score is reduced when the client cannot perform the test task with standardized instruction, but the client’s ability to reach the correct solution when guided by the therapist is noted. This method can help in predicting how much a person will profit from instructions and cues (Brown & French, 1979; Lezak, 1983; Lyons, 1984; Meichenbaum & Asarnow, 1979). Cues can be used to (a) provide feedback, (b) direct attention to relevant features, (c) pace the speed of performance, and (d) direct attention toward relevant features (Diller, 1985). Test modifications made and reasons for using cues need to be identified and standardized.

An information-processing approach to evaluation consists of a series of tasks that are graded in accordance with information-processing demands. The following are characteristics that can be manipulated to increase or decrease processing demands in both evaluation and treatment (Barth & Boll, 1981; Hagen, 1982).

1. Rate—Increase, decrease, or speed maintenance of item(s) presented and client’s response

2. Amount—The number of items in the presentation

3. Duration—The time during which an attitude
Treatment

Treatment is designed to ameliorate deficiencies along the continuum of the perceptual system. Activities that gradually increase demands on the information processing system are systematically presented. The treatment program offers gradations from simple to complex, automatic to effortful, and from the ability to respond to the external environment to the ability to manipulate the internal environment (Ben-Yishay & Diller, 1983). Three treatment phases are identified in the model. Phase 1 emphasizes the ability to detect and respond appropriately to the environment. Clients at this level typically demonstrate confusion and only gross attention to the environment. Treatment tasks are automatic and require only minimal processing capacity. Phase 2 addresses the ability to discriminate, organize, and manipulate information in the external environment. Clients at this level demonstrate the ability to detect and respond to relevant information; however, they have difficulty discriminating information in the external environment. Treatment tasks require moderate processing capacity. Phase 3 emphasizes the ability to manipulate and organize internal information, for example, thoughts, emotions, and ideas. Clients at this level have difficulty in planning, organizing, and problem solving. Treatment tasks require maximum effort, concentration, and analysis (Ben-Yishay & Diller, 1983; Luria, 1980).

Treatment may begin at any of the phases depending on the client's level of processing capacity. Although the phases represent an information-processing continuum, they do not constitute a fixed hierarchy. Treatment activities begin at the breakdown point in performance and are matched with the client's information processing capacity (Hagen, 1982). An activity that requires cues 50% of the time or more is considered to be well above the client's level. Activities are graded by increasing the rate, duration, and amount of information presented prior to increasing the complexity and amount of integration required from sensory modalities. Activities are also graded by increasing the amount of sensory integration required from another sensory modality such as auditory, kinesthetic, and visual modalities.

Three treatment tools are advocated in this model. These are the teaching/learning process, the environment, and the use of the self (refers to body alignment, positioning, and active movement pattern). These tools are matched, graded, and varied to meet the individual client's needs.

Teaching/Learning

The teaching/learning process is an interaction between the client and the therapist designed to help the client acquire new and more adaptive knowledge, strategies, skills, and attitudes (Mosey, 1986).

Webster's New Collegiate Dictionary (1980) defines teaching as the process of instructing by precept, example, or experience. It facilitates the acquisition of knowledge, skills, and attitudes. Learning is the process whereby the individual person modifies his or her response to stimuli or acquires new patterns of behavior as a result of previous interaction with the environment (Schwartz, 1985). These changes are recorded in the nervous system and are not attributable to maturation or medications. Learning is reduced in the brain-injured adult because the capacity to process and organize new information is diminished. Because teaching facilitates learning, modifications that are made in the teaching process to account for the new learning impediments can enhance the brain-injured client's learning process.

A therapist as a teacher can only design a situation believed to enhance learning for that particular client; the client does the actual learning. The therapist can only help a client want to learn through the design of appropriate learning techniques (Mosey, 1986).

The emphasis in treatment is not on individual tasks but on the cognitive strategies which underlie task performance. Strategies are organized sets of rules that operate to select and guide the ability to process information (Gagné & Briggs, 1974). Strategies that may be emphasized in treatment include planning ahead, choosing a starting point, controlling the speed of response, checking work, searching for more information before verbalizing a plan prior to performing an activity, generating alternatives, and scanning from left to right (Adamovich et al., 1985; Craine & Gudeman, 1981; Diller & Gordon, 1981a). These strategies are not specific to any particular task; therefore, they can be emphasized in a variety of different tasks and environments. Computer activities, gross motor tasks, group activities, games and crafts.
can all be used (Lundgren & Persechino, 1986; Toglia, 1985). Training attempts to ensure that a generalization of strategies occurs. The client is given the opportunity to use learned strategies in different situations that involve similar skills. The client is not moved to the next step until there is some evidence of generalization.

A major thrust in treatment is helping the client learn how to monitor and control his or her own performance. This involves teaching the client to recognize and correct errors in performance. Error detection can be facilitated by the therapist through the use of feedback. Feedback can be general or specific (Craine, 1985; Diller & Gordon, 1981b; Diller & Johnston, 1983). An example of general feedback is a therapist telling a client who displays poor visual processing in picture recognition that the error was due to his or her poor eye movements in scanning the important features of the object in the picture. An example of specific feedback is a therapist telling such a client to direct his or her eye to the critical aspect of the picture and pointing out what was missed.

Error detection can also be facilitated by self-monitoring techniques such as activity prediction. In activity prediction the client identifies and quantifies anticipated results. The prediction will include expected errors in timing and accuracy. A comparison of prediction and actual performance helps the client gain awareness of his or her errors and facilitates performance (Brown & French, 1979; Diller & Johnston, 1983; Lyons, 1984).

Error correction is facilitated by helping the client generate alternate methods for approaching the task. A client who is aware of his or her errors but persists in making the same error benefits from being shown that there is more than one way to solve or correct a problem (Diller & Johnston, 1983; Konow & Pribram, 1970). This can be done by providing several alternatives to the client or by encouraging the client to generate alternative responses.

Environment

Teaching/learning strategies are emphasized in a variety of different environments, including cultural, social, and physical environments. Different environments elicit different information-processing demands. It is of critical importance for this treatment approach to mix, match, and vary the demands of the environment.

The material surroundings in which the individual lives or is likely to live in the future constitute the physical environment. The complexity of the environment, the degree of safety, and the opportunity for the client to be surrounded by objects that are meaningful to him or her are important factors in the intervention process. The social environment is the matrix of people whom an individual is relating to or will need to relate to in the future (Mosey, 1986). The cultural environment involves the client’s integrated pattern of human behavior: the social structures, values, mores, and expectations that are accepted by his group (Mosey, 1986).

Activities and tasks should use all three types of environments to facilitate the client’s ability to adapt to a variety of situations. The demands of each environment can be increased or decreased depending on the client’s cognitive perceptual deficits.

For example, a person who can perform an activity in a quiet one-to-one session with the therapist may have difficulty with the same activity when it is presented in a group situation. The social environment can place more demands on the individual. The demands of the task need to be balanced with the demands of the environment. Games designed to emphasize cultural differences can also be used to enhance the client’s awareness and motivation.

Body Alignment, Positioning, and Active Movement Patterns

Normal body alignment is the balanced orientation of the head, upper and lower trunk, and upper and lower extremities. This balanced orientation establishes a secure, symmetrical, and nonstereotypic or fixed posture in any particular direction, plane, or axis. The ability to shift and assume various orientations in a rapid fashion is disturbed in brain-damaged clients. Their body alignment suffers a biomechanical rearrangement of varying degrees depending on the extent and severity of the muscle tone abnormalities caused by the brain damage (Ryerson, 1984). Techniques such as those developed by Bobath as well as proprioceptive neuromuscular facilitation involve maneuvers to assist the client to passively or actively assume a better body alignment by using specific key points of control. Cognitive rehabilitation interlaces these neurodevelopmental concepts and suggests that the client be realigned before engaging him or her in cognitive remediation to facilitate higher cortical function. Many brain-damaged clients have typically poor body alignment, a factor which affects visual processing and other higher cortical functions.

Positioning or the bearing of the body in various positions, supine, prone, side-lying, sitting, or standing, is an attribute of a mature and well-integrated nervous system. Positioning has traditionally been used in rehabilitation for assessment and intervention of motor performance dysfunction (Ryerson, 1984). We have used positioning for cognitive rehabilitation purposes. A position that has a wide base of support
and low center of gravity is more secure and enables the brain-injured client to attend to other variables such as cognitive training activities. We have noted that when the client's position is varied either by changing the support base or by shifting the weight on different extremities, the quality of the processing of visual and cognitive information is influenced. For example, when shifted to a less stable position, clients have been noted to suffer a breakdown in visual processing or cognitive tasks they mastered in a more secure position. Therefore, it is suggested that the therapist use the same cognitive remediation activities, starting with various positions in good body alignment and subsequently changing the activity to reflect increasing perceptual demands. This will encourage information processing under various conditions and increase the flexibility and competencies of the client.

Cognitive remediation activities can be upgraded or downgraded through the types of active movement patterns one demands from the activity. The total movement patterns can be performed with bilateral, unilateral, distal, and proximal, or symmetrical, asymmetrical, and reciprocal movements. Each of these movement patterns has different processing demands (Wells & Luttgens, 1976).

For example, a person's speed of response in cognitive perceptual activities may vary depending on the complexity of the movement pattern required. A simple movement pattern such as a bilateral symmetrical movement required in catching a ball may elicit a fast response. When the movement is upgraded to involve an asymmetrical pattern such as in batting a ball, the response may be slower because the demands of motor planning are greater.

### Other Treatment Approaches

The three other approaches identified in the occupational therapy literature for the training of clients who have perceptual deficits are the functional approach, perceptual motor training, and sensory integration therapy. Each of these approaches has limitations.

The emphasis of the functional approach is on the task rather than on the subskills involved in the task. Cognitive-perceptual dysfunction is identified by assessing activities in daily living performance. Intervention involves adapting the client's environment, for example, using color-coded clothes for the repetitive practice of activities in daily living tasks. Splinter skills are fragmented abilities that are learned by repetition without generalization, for example, learning by rote (Siev et al., 1986).

A limitation of this approach is a lack of generalization. Splinter skills, in conjunction with adapting the environment, can enhance performance in a specific task. However, because splinter skills cannot possibly be taught for all areas, techniques that involve cognitive remediation with an emphasis on generalization are more effective strategies for improving overall function.

The focus of perceptual motor training is on the direct remediation of observed perceptual deficits (Price, 1977). These areas of the deficits include figure ground, form constancy, spatial relationships, position in space, right–left discrimination, body scheme, unilateral neglect, and constructional praxis.

This approach was adapted from the work of Frostig in treating perceptual motor deficits in children. Many of the deficit areas mentioned were identified from research with children. Other areas were identified through studies on brain-damaged individuals (e.g., constructional praxis, unilateral neglect).

Intervention involves training in specific areas through table top activities. The emphasis is on cortical skills, namely, visual perception and visual motor skills. Improvement in specific skills is expected to go from general to functional tasks (Scardina, 1981; Siev et al., 1986).

The limitation of this approach is that cognitive skills such as attention, memory, and problem solving are not addressed. Moreover, deficits are perceived as isolated issues with no references as to how brain damage affects the cognitive perceptual system. Subskills are not analyzed and the relationship between the disturbances is not examined.

Sensory integration therapy is an approach designed for learning-disabled children. The literature, however, links sensory integration therapy with other diagnoses such as autism, mental retardation, and psychiatric disorders (Price, 1977; AOTA, 1982). Sensory integration emphasizes the organization of sensory processing as the foundation for cognitive and visual perceptual skills.

Price (1980) states that "sensory integration has a firm base and wide application in acquired brain dysfunction" (p. 287).

The effectiveness of the sensory integration approach with the brain-injured adult has not been documented or researched. Ottenbacher (1982) cautions that although sensory integration techniques are widely used, additional studies are needed to show that these techniques are successful with populations other than learning-disabled children. He refers to the professional and personal risk in applying any treatment procedure that has not been demonstrated to be therapeutically effective by traditional standards.

One must also caution against applying any theory or technique that was designed for children to an adult population without extensive modification. The recovery of cognitive-perceptual function after brain damage cannot simply be described as a recapit-
ulation of an ontogenetic sequence. The neurological organization, activation, and inhibition of the brain varies according to age. Luria (1973) implies that the adult is less dependent on the function of lower brain centers than the child. This is exemplified by the different effects of lesions in identical areas in the child’s brain versus the adult’s brain (Luria, 1980; Moore, 1986).

In addition, an adult has acquired a fund of knowledge based on prior experience, which is stored in long-term memory. This fund of knowledge inevitably affects thinking and perception. Techniques that were designed for a young developing brain and emphasize acquiring new skills may not be easily applied to a brain that has already acquired such skills.

Summary

This paper describes a cognitive rehabilitation model based on information-processing theory and learning concepts as a foundation for occupational therapy evaluation and treatment of the brain-damaged adult. Using this model will help occupational therapists include in evaluation and treatment the total perceptual processing system for all three brain blocks identified by Luria (1970). This evaluation helps identify the essential skills to be screened: orientation, insight, attention, visual processing, motor planning, and cognition. The evaluation of these skills is enhanced by a nontraditional approach to assessment that uses standard cues to facilitate performance.

The purpose of treatment using the cognitive rehabilitation model is to maximize existing potential by providing strategies to enhance the patient’s ability to process and organize information efficiently. Thus treatment involves teaching brain-injured adults how to facilitate their own performance or learning.

The three treatment tools identified in this model are (a) the teaching learning process, (b) the environment, and (c) the patient’s body alignment, positioning, and active movement patterns. All three are analyzed from an information-processing perspective. Because the client’s response to a cognitive activity changes depending on the environment, body alignment, body position, and movement patterns, the integration of movement and environment with cognitive task promotes the ability to use strategies under various conditions.

The theoretical foundation of cognitive rehabilitation is based on models of normal brain function. More research is needed on abnormal brain function before generalizations can be made from the normal to the brain-damaged population. In addition, more evidence is needed to document the effects of cognitive rehabilitation on functional behaviors. Different techniques used in cognitive rehabilitation should be compared to determine which methods are most effective in promoting learning and generalizing information in the brain-injured adult.

Occupational therapy is both an art and a science. The goal of science is to produce an accumulating body of reliable knowledge. More knowledge about abnormal brain function and deficits in essential skills would enable us to explain, understand, and predict the cognitive rehabilitation process from an occupational therapy perspective. This model will permit us to use such knowledge to evaluate and treat patients to promote maximal function.

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