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The effect of self-instruction and component attentional skills training on cerebral palsied children's performance on visuo-motor reproduction tasks

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THE EFFECT OF SELF-INSTRUCTION AND COMPONENT ATTENTIONAL SKILLS TRAINING ON CEREBRAL PALSIED CHILDREN'S PERFORMANCE ON VISUO-MOTOR REPRODUCTION TASKS

by

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The present research is dedicated to both my wife, Sharon, whose support and love made this endeavor possible and to my son, Noah, whose birth and development continues to be a source of inspiration.

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1. INTRODUCTION

Cognitive behavioral self-instruction techniques have been the focus of much research over the past two decades. Self-instruction training has been shown to be effective in helping to focus, direct and adapt behavior through a series of self-mediating statements (Kendall and Wilcox, 1980). Studies have demonstrated the effectiveness of self-instruction training in teaching discriminations (Bem, 1967), finger tapping (Meichenbaum and Goodman, 1969), resistance to temptation (Kanfer and Hartig, 1973) and responses on various psychometric tests (Kendall and Finch, 1976; Palkes, Stewart and Freedman, 1972). Self-instruction training has been applied to the remediation of reading, arithmetic and a variety of other academically-oriented skills (Ryan, Short and Weed, 1986).

Although impulsive and hyperactive children were originally targeted for self-instruction training (Meichenbaum and Goodman, 1971; Palkes, Steward and Kahana, 1968), various other academic and clinical populations have also been studied in their response to self-instruction training. Self-instruction training has been applied successfully to schizophrenics (Gumaer and Heathspeth, 1985), the mentally retarded (Ward and Bella, 1985), aggressive children (Camp, Bloom, Herbert and Van Doorninck, 1977), the aging (Meichenbaum, 1974) and heavy drinkers (Sanchez-Craig, 1975).

Training in component attentional skills has been another procedure used by several researchers (Douglas, Parry, Marton and Garson, 1976; Egelund, 1974). The training attempts to help the subject remember essential aspects of a stimulus configuration by teaching more efficient search strategies. The goal is to teach subjects how to visually break geometric figures into component parts and then to compare stimuli for similarities and differences on components. Component attentional skills training is based upon research which has demonstrated that impulsive children use inefficient visual search and scanning behaviors (Drake, 1970).

The present research extends the self-instruction training research by examining two issues:

1) The effectiveness of the self-instruction/component attentional skills group (SI/CAS group) in improving the performance of a sample of cerebral palsied children on a visuo-motor reproduction task that is also used in training (ie. Block Design subtest of the Wechsler Intelligence Scale for Children, Revised) as compared to a comparable control group trained only in component attentional skills (CAS group). Cerebral palsied children have motor deficits and research indicates that, as a group, they have particular difficulty on visuo-motor reproduction tasks.

2) The effectiveness of the self-instruction/component attentional skills group in promoting generalization of training effects to other visuo-motor reproduction tasks ie. the Block Design tasks on the Leiter International Performance Scale and the Developmental Test of Visual-motor Integration.

The primary focus of the research is to demonstrate that the directive influence of speech remains intact enough in this group of brain damaged subjects to compensate for their visuo-motor impairments. The hypotheses of this study specifically state that the subjects who are trained in self-instruction/component attentional skills techniques will perform better on the Block Design subtest (WISC-R) than subjects trained only in component attentional skills. Furthermore, this superior performance will generalize to two similar visuo-motor reproduction tasks (ie. Block Designs from the Leiter International Performance Scale and the Developmental Test of Visual-motor Integration).

Self-instruction training is concerned with changing the maladaptive behavior rather than the varied causal agents that precipitate and sustain them. The approach recognizes that the most effective remediation may be removed from the original precipitating physiological and/or neurological causes. The focus is performance based and improvements in cognitive processing are related to improvements in the targeted behavior.

Luria, one of the precursors of present self-instruction theory and research, was interested in the neurological underpinnings of language and behavior and drew much of his research evidence from subjects inflicted with congenital and traumatic brain injuries. Luria (1961) stressed that in the case of loss of automatic movements associated with lower levels of control, the patient can substitute higher level cognitive processes such as language to aid action. Since Luria's earlier studies, however, less attention has been focused on the impact of self-verbalization on subjects with direct brain injuries and more attention focused on the treatment of less pervasive and functionally deficient populations. The present research will attempt to capture the spirit of some of Luria's earlier studies.

The present study is of important educational significance. The ability of a child to recognize and reproduce letters, words or figures in the proper spatial relationship is a prerequisite to basic educational tasks such as reading, writing and arithmetic. For the cerebral palsied child, characterized as having a visuo-motor disorder, mastery of these skills may be difficult since the ability to reproduce a form without rotation or distortion may be impaired.

Much of the relevant research on cerebral palsy was conducted in the 1950's and 1960's. More recent research is lacking and, as such, many of the references to research on cerebral palsy are from previous decades. That is not to imply, however, that the research on cerebral palsy included in the present proposal is out of date. Many of the references document the specific type and degree of problem associated with cerebral palsy. This research, such as scores on cognitive or perceptual tests, continues to be valid today since no more recent research evidence stands to contradict it. References to more interpretive work have also not been found to be empirically contradicted and continues to have an impact on the field today.

The cerebral palsied child has traditionally been viewed by educators and psychologists as possessing little control over his/her own behavior. In the past, therapeutic methods have been emphasized that attempt to strengthen developmental deficiencies through repetitive practice (Cratty, 1970) or through the manipulation of external agents of change (Cruickshank and Dolphin, 1951).

A number of specific theories have addressed the perceptual-motor deficiencies of brain-damaged children. A popular biologically-oriented view implies that sensory and motor disturbances reflect pronounced brain damage and can be remediated by recapitulating the stages of perceptual-motor development through which a child passes. The assertion that perceptual-motor development underlies conceptual growth is central to the theoretical formulations of Piaget (1971). It is also important to the rationales and techniques associated with a number of remediation therapies (Barsch,1965; Kephart, 1971). Cratty (1970) has reviewed a number of these approaches to the remediation of perceptual-motor skills and concludes that most promote extravagant claims. In addition, Saphier (1973) briefly reviewed several methods used to remediate perceptual-motor deficiencies and concludes that most of these programs lack sufficient research to document their effectiveness.

These approaches view the individual as the passive recipient of remediation techniques that are initiated and implemented by an external agent such as a teacher or therapist. In this sense, Cruickshank and Dolphin (1951) also view the cerebral palsied child as being essentially passive and as having no active role in his/her own treatment. The remediation of perceptual-motor deficiencies is seen as coming from the alteration of environmental conditions. The cerebral palsied child is viewed as being unable to refrain from reacting to stimuli in the environment. Since the authors see cerebral palsied children as exhibiting forced responsiveness to external stimuli, Cruickshank and Dolphin (1951) conclude that all extraneous stimuli must be reduced to a minimum in order to increase the chances of optimal educational adjustment.

Cruickshank and Dolphin (1951) advocate the radical reduction of stimuli in the classroom. On the one hand, the normal classroom is characterized as providing numerous sources of visual stimulation through which the "normal" child is stimulated to learn. Cruickshank and Dolphin (1951), on the other hand, suggest that the cerebral palsied child requires minimal stimulation and that the special classroom that promotes optimal learning would be one that is windowless, painted in a uniform and neutral color, has a concealed blackboard and relies heavily on instruction being carried out in distraction free cubicles.

This traditional view holds that the needs of normal and cerebral palsied children are divergent and implies that the integration of the cerebral palsied child into the normal classroom would not meet the needs of either group. The above viewpoints are in marked contrast to the cognitive behavioral approach which promotes the child as the primary agent in controlling his/her own behavior. The cognitive behavioral approach recognizes the contribution of cognitive processes in behavior change and promotes the view that individuals can regulate their own behavior.

O'Leary and Dubey (1979) point out several reasons why teaching children self-control procedures has wide appeal. The authors first mention cultural expectations that value independent behavior.

Secondly, the internalization of control takes into consideration the possibility that others will not be available to implement external control and, thirdly, it allows others the time to spend teaching other important skills. The emphasis on self-control is also thought to lead to more durable behavior change than change that relies solely on external means of influence.

In specific reference to the cerebral palsied child, the use of self-control procedures has its own particular advantage. The cerebral palsied child generally develops in a milieu that reinforces the belief that ones needs are most effectively met through appeal to external sources. The use of methods that take advantage of the child's personal resources should ultimately enhance the child's sense of self-efficacy and self-esteem. Henker, Whalen and Hinshaw (1980) suggest that self-instruction training may be effective in changing a child's attributional style from the external to the internal.

The research literature on cognitive behavioral psychology and developmental disabilities has largely developed in relative isolation of one another. The present study attempts to integrate some of the research in these two areas. The extension of self-instruction training to cerebral palsied children adds to our knowledge of the effects of language on deficient visuo-motor performance. Hobbs, Moguin, Tyroler and Lahey (1980) note that cognitive behavioral techniques have traditionally focused on a limited range of clinical populations and problems, which has prevented one from drawing conclusions regarding the widespread clinical utility of these techniques.

Webster and Scott (1983), more specifically, call for further research in the use of self-instruction training with brain-impaired populations. The authors emphasize the need to determine the types of problems to which self-instruction training is applicable and the prerequisite skills that the brain-injured individual requires for the successful use of private speech as a self-regulating technique.

11. REVIEW OF LITERATURE.

The self-instruction approach was first formally developed by Meichenbaum and Goodman (1971) as a means of teaching self-control to hyperactive and impulsive children. Researchers have introduced their own modifications into the procedure. The present study attempts to maintain the general framework of Meichenbaum and Goodman's (1971) original methodology while introducing modifications through the addition of component attentional skills training in order to maximize the visuo-motor reproduction performance of children with cerebral palsy. Self-instruction/component attentional skills training was used by Douglas, Parry, Marton and Garson (1976) to improve the visual scanning and analysis skills of hyperactive boys. The authors characterized their training method as self-instructional but, as Abikoff (1979) points out, the study incorporated component attentional skills training as well.

The self-instruction method utilizes combinations of modeling, overt and covert rehearsal, prompting, feedback and social reinforcement. The subject is trained to rehearse, first aloud and then silently, a set of self-guiding strategy statements with accompanying behavioral demonstrations in order to alleviate faulty or incomplete verbal mediation. The self-instruction strategy focuses on teaching subjects to improve their visual scanning and analysis skills through the use of component attentional skills training (Douglas, Parry, Marton and Garson, 1976).

Meichenbaum (1975) has suggested that self-guiding statements contain strategies for self-directing, self-evaluating, self-monitoring and self-reinforcing behavior. The focus of self-instruction is to teach the subject to identify the problem through self-directed verbalizations such as "what do I do next". Attention is focused on the problem, and responses are generated to help answer the question. The method breaks up the problem into manageable segments and enhances motivation through the use of self-reinforcing statements such as, "good, I'm doing fine". Coping skills and error-correcting options are also taught in the form of self-statements.

More recently, researchers have attempted to isolate the effective components of treatment packages for both treatment and generalization effects. Leon and Pepe (1983) compared traditional methods of modeling, instruction and positive practice with and without self-instruction. Both procedures appeared effective but greater generalization to math operations not directly taught was observed for the self-instruction group. Others have found that modeling is an important component of training but other components add to the efficacy of results (Gow, Ward and Balla, 1985). Fisher and Wallersheim (1986), for example, emphasize the importance of social reinforcement in the self-instruction method.

The self-instruction approach has evolved from a number of research efforts. It was not the work of a single individual or a particular research study but rather the accumulation of work that finally culminated in self-instruction theory and methodology in the early 1970's. In fact, Meichenbaum and Goodman (1971) extended the work of Palkes and colleagues (Palkes, Steward and Freedman, 1972; Palkes, Steward and Kahana, 1968). Palkes' procedure employed cognitive modeling and rehearsal strategies to teach hyperactive children what to say to themselves prior to performing a task. The studies increased the self-control of hyperactive children by teaching them to "stop, look and listen". The following briefly describes the most important research influences on self-instruction.

II.A. SELF-INSTRUCTION.

1. Research on cognitive deficiencies:

Several studies found that impulsive children do not spontaneously and habitually analyze their experiences in cognitively mediated terms and do not formulate and internalize rules that might guide them in new learning situations (Kagan and Kagan, 1970). A need arose in the literature to determine at which point in the cognitive process hyperactive and impulsive children exhibit verbal deficiencies. A number of studies found that problems could occur during comprehension, production and mediation.

Bem (1971) called attention to the possibility that the child may not comprehend the nature of the problem and consequently may not know what mediators to produce. Bem (1971) emphasized the necessity of having some representation of the desired outcome of a task prior to developing a strategy. The importance of comprehension is particularly stressed in tasks that are sufficiently complex. Flavell, Beach and Chinsky (1966) found that the child may possess the appropriate mediators in his/her repertoire but not know how to spontaneously and appropriately produce them. The failure of the young child to produce adequate verbalizations may reflect linguistic immaturity. The development of linguistic competence requires that the child not only have a command of language but also how and when to use it. Reese (1967) suggested that the child's spontaneously-produced mediators may not guide his/her ongoing behavior. A deficiency in mediation is considered to be largely a developmental problem that is most frequently manifested in younger children and tends to disappear with age.

The combined results of these research studies indicated that the cognitive process may be viewed as a three-stage process which is composed of comprehension, production and mediation. Deficits in performance may result from incomplete or erroneous processing at any one of these stages. The research suggests that the improvement in task performance necessitates explicit training in the comprehension of the task, the spontaneous production of mediators and the use of such mediators to control non-verbal behavior.

2. Contemporary Social Learning Theory:

Contemporary social learning theory was instrumental in shifting academic and therapeutic thinking away from the once prevalent view that all behavior change stems from the alteration of conditions in the environment. A shift occurred toward conceptualizing people as active, rather than passive, organisms who influence their own fates and, at the same time, are also impacted upon by their environments. Reciprocal causation was thought to occur, encompassing both internal and external determinants of change.

Bandura's (1977) social learning theory has helped integrate cognitive-mediational processes into an analysis of performance based behavior change. Social learning theory has sprung from the experimental lab and has been long concerned with the interface between overt and covert events. It has furthered the process of operationalizing covert cognitive processes into testable formulations that are easily integrated with behavioral paradigms.

Modeling has been found to be effective not only with concrete activities but also with complex behaviors that involve cognitive-symbolic mediation. There is evidence to suggest that much of learned behavior can be acquired through the observation of another person. Bandura focused on the influences of social experience.

More specifically, emphasis was placed upon the information that children gain from models and its subsequent influence upon development and functioning. Social learning research indicates that a "wide spectrum of texture-like response features and abstract solution strategies can be altered by configural modeling" (Rosenthal and Zimmerman, 1978, p.247).

Bandura was thorough in outlining the learning process involved in modeling. The observer's cognitive orientation toward the object of modeling was considered to be a preliminary requirement. The observer must first attend to the model. The information must then be encoded and retained by the observer. Bandura (1971) emphasized that the information that the observer gains from the model be converted to cognitive images and covert rehearsal responses that are retained by the observer and later used by him/her as symbolic cues to overt behavior. The observer's failure to symbolically encode the events was thought to impede acquisition. The failure to retain the event would interfere with its subsequent retrieval and use.

Bandura (1980) also emphasized the importance of motoric learning and skill in the modeling process. One could observe a complex motor act being performed but the subsequent modeled performance would be deficient unless one had the opportunity to practice the act and the basic motoric skill that is required to reproduce it. The importance of motoric learning as a prerequisite for further learning has also been the focus of research on self-instruction training. Higa, Tharp and Calkins (1978) found that unless kindergarten and first-grade children had practiced making a motor response, self-instructions actually interfered with performance.

Bandura's (1969) research on patterns of self-reinforcement has also had an important impact upon the self-instruction approach. Self-reinforcement is stressed in its relationship to self-evaluation and criterion-setting. Bandura and Perloff (1967) found that when combined with either an explicit or an implicit self-evaluation, self-reinforcement effectively modifies children's behavior and produces effects equivalent to those achieved when evaluations and reinforcement are externally derived.

Research indicates that modeling is an important component of the self-instruction package (Gow, Ward and Balla, 1985). Meichenbaum and Goodman's (1971) methodology specified a five step process used in training that emphasizes the use of modeling procedures. Guralnick (1976), however, found that modeling used alone in an instructional package was not as effective as modeling used within a self-instruction package in developing problem-solving strategies for complex perceptual discriminations with a group of educable mentally retarded children. Leon and Pepe (1983) also found that modeling produced greater generalization to math operations when combined with self-instruction techniques. Meichenbaum and Goodman (1971) examined the efficacy of components of their cognitive treatment procedure in decreasing impulsivity on the Matching Familiar Figures Test (MFFT). The results indicated that modeling alone was sufficient to slow down the impulsive child's response time. However, a decrease in errors only occurred with the introduction of self-instruction training.

3. Soviet Psychology: Vygotsky and Luria:

Developmental theorizing and research was conducted by the Soviet psychologists, Vygotsky (1962) and Luria (1961). These researchers suggested that a child is socialized by means of internalizing the interpersonal communications of others. A stage model was proposed to describe the sequence by which children abbreviate and transform interpersonal communications into covert intrapersonal speech which in turn comes to guide and control the child's behavior.

L.S. Vygotsky (1962) theorized that language shapes cognition by mediating and integrating the basic psychological processes of attention, perception, memory and emotion. He indicated that cognition begins non-verbally and verbalization begins non-cognitively and that these two functions become fused by the age of about 2 years. At about this age, the developing child realizes that each thing has a name and begins to use language as a vehicle for thinking. Vygotsky noted that the overt verbalizations of the three to four year old child becomes internalized as inner speech or verbal thinking by about the age of 8 years.

Luria reported that under situations of stress a child will typically speak out loud to him/herself. For example, a child who is asked to trace a picture and is given a pencil that breaks during the task will often talk to him/herself to describe the difficulty and seek a solution. The child might say to him/herself, "Oh, no, the pencil's broken, where can I find another one".

In older children, whispered speech is more likely to occur in a similar situation. The essential nature of self-verbalization for a five or six year old is evidenced by the observations that if he/she is forbidden to speak while performing a task he/she will often become severely impeded or upset and speak anyway. By the age of 9 years, overt speech becomes less necessary but it is still called upon during very difficult tasks.

Luria (1961) was also interested in studying persons with neurological deficits. He observed that persons of varying ages afflicted with organic brain disorders but retaining intact language functioning may use overt speech to direct their motor functions.

> There are many forms of disturbances of normal cortical activity when the system of complex verbal processes remains relatively intact and when the consolidation of verbal connections proves to be one of the most essential ways of compensating for the resulting neuro-dynamic (Luria, 1961, p. 107).

Luria believed that it was erroneous to think that brain lesions inevitably affect the more complex system, such as speech, more severely and leave the comparatively simpler motor functions intact. He initially observed patients inflicted with Parkinson's disease who exhibited lesions in the subcortical ganglis. Many

Parkinsons patients exhibited profoundly disturbed motor patterns but the more complex systems of cortical connections, such as the verbal system, remained relatively uneffected. Luria believed that the verbal system could be used to compensate for the deficient motor system.

In one experiment, Parkinsons patients were first asked to make a temporary conditioned connection to winking as a signal for motor reaction (Luria, 1961). Instructions were given to wink and press a balloon as a way of switching the motor act over to voluntary cortical regulation. Luria extrapolated that since these self-directed external signals were successful in initiating motor movement, then maybe the motor movements could also come within the control of the intact system of verbal connections.

In a further experiment, Luria (1961) had the Parkinsons patients answer a number of verbally-presented questions through the movement of their fingers. Subjects were asked "how many wheels are there on a car", "how many brothers do you have" and so on. In this case, Luria observed that "the movements of the hands lost their primary character: turned into answers to verbal questions and entered the complex verbal functional system" (Luria, 1961, p.107). Similar results were found with children suffering from cerebro-asthenic syndrome.

Luria believed that self-instruction could be used to facilitate attentional abilities in patients with frontal lobe lesions and with injury to other nonfrontal areas of the brain. Some research by Luria and associates involving the use of simple self-verbalization techniques with brain-injured subjects will be reviewed in a later section. Luria's research into the use of self-verbalization with brain-injured persons, however, can be characterized as original albeit sketchy. Luria was more interested in the failures of self-instruction than in its successes (Webster and Scott, 1983) and it wasn't until Meichenbaum and his associates focused on the facilitating the effects of self-instruction that it became recognized as an important rehabilitative tool.

II.B. SELF-INSTRUCTION AND COMPONENT ATTENTIONAL SKILLS TRAINING:

In the present study, a group trained in self-instruction/component attentional skills is compared to a component attentional skills only training group. The intent of the research is to demonstrate the important impact of self-instruction on the visuo-motor reproduction performance of cerebral palsied children. The term, component attentional skills training, however, is not used by all the following authors to describe their techniques. Abikoff (1979) was the first to use component attentional skills as the label to describe explicit training in visual scanning and analysis.

Research examining children's visual scanning was originally based upon Kagan's (1966) distinction between impulsive and reflective children. Based upon children's performance on the MFFT, Kagan (1966) proposed that some children tend toward rapid, careless and impulsive responding while other children take more time, have fewer errors and are more reflective. Siegelman (1969) and Drake (1970) examined the visual search strategies of both impulsive and reflective children and found a number of distinctions in the visual search strategies of these two groups of children.

Both authors found that impulsive children ignore substantially more alternative responses on the MFFT than do reflective children. The impulsive children also spend proportionally more time looking at the alternative that they have already chosen and appear to quickly select their answer without further examining the remaining alternatives. Reflective children, however, spend more time comparing the alternatives. The group of reflective children were found to differentiate the component parts of the alternative, compare these components and consult the standard. The research of both Siegelman (1969) and Drake (1970) found that the impulsive child's approach is more global in nature while the reflective child's is more thorough and analytic.

Zelniker, Jeffrey, Ault and Parsons (1972) attempted to encourage a more thorough and analytic approach to the MFFT performance of impulsive children. The authors gave impulsive children a different match-to-sample task where five of the alternatives were identical to the standard and only one differed from the standard. Subjects were administered the MFFT as a pretest and as a posttest. The results indicated that the impulsive children made fewer errors on the posttest administration of the MFFT. Zelniker, Jeffrey, Ault and Parsons (1972) suggest that the match-to-sample task slowed down the performance of the subjects, possibly encouraging more efficient visual scanning and information processing.

Egelund (1974) examined the effect of direct training in the use of more efficient visual scanning techniques on the match-to-sample performance of impulsive, second grade children. Seventy-two impulsive children were assigned to one of one of the following groups: a group trained to improve search strategies and scanning techniques (ie. component attentional skills training group), a group trained only to delay responses at least 10 to 15 seconds and a no-training control group. Subjects were pretested and posttested on the MFFT and two generalization tests, the Stanford Achievement Test and the Gates-MacGinitie Reading task. The MFFT was readministered two months after the end of training. Each training group received eight 30-minute training sessions over a 4 week period. The results indicated that both training groups exhibited significant increases in response time and decreases in errors on the MFFT while the no-training control group showed no changes. The component attentional skills group, however, was able to maintain a low level of errors on a 2 month follow-up test while the group trained to delay responses showed an increase of errors at the time of the follow-up. Although both training groups exhibited improved performance on the vocabulary subtest of the Gates-MacGinitie Test, only the component attentional skills groups showed improvement on the comprehension subtest.

Egelund's (1974) study demonstrated that component attentional skills training could be used to improve the search strategies and scanning techniques of impulsive children on visual discrimination tasks. The training attempted to induce the child to attend to the relevant features of the stimulus. The children in the component attentional skills group were taught to follow a number of rules and strategies such as the following: 1) look at the standard and all the alternatives; 2) break down the alternatives into component parts; 3) choose one component part and compare it to all the alternatives; 4) check standard to determine the correct form of the component part; 5) eliminate alternatives that are different from the standard on the the particular component under inspection.

Egelund's (1974) study represents the first attempt to empirically investigate the effects of component attentional skills training. In a later study by Douglas, Parry, Marton and Garson (1976), component attentional skills training was included as part of a self-instruction training program. The authors used a self-instruction training program that incorporated aspects of a scanning and search strategy similar to that used by Egelund (1974).

Douglas, Parry, Marton and Garson (1976) investigated the performance of 26 hyperactive boys on a number of dependent measures including the MFFT, the Porteus Mazes, the Story Completion test, memory tests from the Detroit Tests of Learning Aptitude (DTLA), the Durrell Analysis of Reading Difficulty (DARD), the Wide Range Achievement Test (WRAT) arithmetic subtest and the Bender-Gestalt test. The children ranged in age from 6 years to 10 years, 11 months and were in either a self-instruction group or a no-treatment control group. Results indicated that the self-instruction/component attentional skills group exhibited significant improvement on the oral and listening comprehension section of the

DARD, the MFFT, Story Completion test and the time measure on the Bender-Gestalt.

II.C. SELF-INSTRUCTION AND CEREBRAL PALSY:

1. Introductory comments:

One of the objectives of this research study is to attempt to apply the findings on self-instruction training to those populations with problems in visuo-motor reproduction. There are a number of populations that demonstrate difficulties in motor control such as those groups with muscular dystrophy and multiple sclerosis. Certain other medical conditions are also associated with poor performance, eg. low birth weight and sickle cell anemia. Some factors associated with these conditions include physiological limitations and muscular weakness. (Sattler, 1983). The present study, however, limits its focus to only those children with a diagnosis of cerebral palsy.

The next sub-section will examine the diagnosis of cerebral palsy and its associated deficits including difficulties in performing visuo-motor tasks as well as problems in maintaining attention to task. The following sub-section will focus on research studies which have examined the effect of self-instruction training on attentional disorders such as hyperactivity. The fourth sub-section examines the problems that cerebral palsied children exhibit in performing visuo-motor reproduction tasks. Evidence suggests that it is not exclusively a perceptual deficit but rather a difficulty in translating perceptual stimuli into motor behavior. The "translation" interpretation would provide a framework for conceptualizing the impact of self-instruction training on the visuo-motor reproduction performance of children with cerebral palsy. The last sub-section examines the self-instruction training methods that have previously been used in improving performance on visuo-motor reproduction tasks.

2. Cerebral palsy and associated deficits:

Cerebral palsy has been defined in a variety of ways by a number of independent researchers. However, the standard definition of the term is used to designate "any paralysis, weakness, incoordination or functional deviation of the motor system resulting from an intracranial lesion" (Denhoff, 1960). Cerebral palsy is diagnosed when the neuromotor deficits dominate over other possible problems. In the past, various other terms have been used to describe this clinical diagnosis including the "brain-injured child", "the brain-damaged child" or neurophrenia (Denhoff, 1960). In defining cerebral palsy, Boone (1972) emphasizes three factors:

1. the prominent symptoms are motor deficits.
2. the etiology is some kind of brain pathology.
3. originates in the developing nervous system.

A common system for classifying types of cerebral palsy involves specifying the type of brain damage and the consequent type of motor disability. Batshaw and Parret (1986) use the following categories to classify cerebral palsied children according to the type of brain damage and motor involvement.

1. Pyramidal (spastic) - Brain damage to the motor cortex or the pyramidal tract of the brain. The results involve difficulties with voluntary movements and spasticity (stiffness of the muscles).

2. Extrapyramidal (choreoathetoid, rigid and atonic) Damage is outside the pyramidal tracts and results in abrupt involuntary movements (choreoathetoid), muscle rigidity (rigid) or floppy muscle tone (atonic).

3. Mixed - Damage to both pyramidal and extrapyramidal regions of the brain with a mixture of effects.

Since the brain is the center not only of muscular control but also of perception, behavioral control, intelligence and other functions, the presence of brain lesions associated with cerebral palsy can result in sensory deficits, behavior problems, mental deficiencies, convulsions and other problems.

Many researchers have noted the frequency with which people with cerebral palsy exhibit impairments in tasks that require perceptual judgement (Cruickshank and Bice, 1966; Dunsdon, 1952). On the basis of responses to the Stanford-Binet, WISC and the Bender Visual Motor Gestalt test, Hopkins, Bice and Colton (1954) concluded that the majority of children with cerebral palsy cannot handle spatial concepts at the same intellectual level as they handle verbal concepts. Reisseweber (1952) tested 50 brain-damaged patients, including mostly cerebral palsied patients, with the Wechsler-Bellvue Intelligence Test and found that 50% of the group average a 30-point discrepancy between verbal and performance scores. Other research has demonstrated similar discrepancies as well (Dolphin and Cruickshank, 1951).

Research has shown that cerebral palsied persons often exhibit particular difficulties in tasks that require visuo-motor reproduction. A number of studies have demonstrated that the cerebral palsied child has difficulty in performing the Block Design of the original Wechsler Intelligence Scale for Children, (WISC), (Jewell and Wursten, 1952; Shochi, 1983) and the revised Wechsler Intelligence Scale for Children, (WISC-R) (Sekiyoma, 1984).

The cerebral palsied child's visuo-motor deficit appears to have a negative impact on academic performance. Large-scale studies of groups of cerebral palsied children have generally shown them to be lower than mean normal intelligence on various intelligence scales (Cruickshank, Hallahan and Bice, 1976). However, many persons with cerebral palsy have even greater academic difficulties than one would expect on the basis of their intelligence alone (Seidel, Chadwick and Rutter, 1975). Although it is not clear as to why academic performance is lowered in such persons, most researchers have focused on perceptual motor difficulties as the most probable source (Aliotti, 1980).

3. The effect of self-instruction training on attentional deficits:

In addition to difficulty in translating visual stimuli into motor behavior, children with cerebral palsy have also been found to exhibit a number of other related problems associated with deficient perceptual motor performance. Cerebral palsied children often exhibit perseverative motor responses (Boone, 1972).

Perseveration is described as the continued repetition of a response after the original stimulus is no longer present (Oswin, 1967). Research on the effects of self-instruction training with mentally retarded subjects suggests that self-instruction training suppresses perseverative responses while increasing on-task behavior.

Children with cerebral palsy also frequently exhibit hyperactivity and distractibility (Boone, 1972; Oswin, 1967). Mecham, Berko, Berko and Palmer (1966) describe hyperactivity as gross and random motor reaction to the environment due to an inability to achieve selective focus of attention. A number of studies on self-instruction training have focused on children who exhibit hyperactive behavior. Cruickshank and Dolphin (1951) describe a number of behaviors characteristic of children with cerebral palsy that they write can best be viewed as hyperactive.

Cerebral palsied children, as a group, have difficulty focusing their attention on a single task (Cruickshank and Dolphin, 1951). These children exhibit a hypersensitivity and reactivity to the myriad of stimuli that impinge upon their senses. The cerebral palsied child not only attends but also reacts to more objects than does the normal child of the same sex, chronological age and mental age (Cruickshank and Dolphin, 1951). It appears that the typical responses of many cerebral palsied children are reactive in nature and lack appropriate cognitive mediation, often leading to rapid responses with many errors on structured tests and a gross and random reaction to the environment.

While not directly examining the effect of self-instruction training on cerebral palsied children, the self-instruction research has targeted children exhibiting two categories of behaviors: impulsive and hyperactive. Classification of a child as impulsive is generally based on performance on a standardized test such as the Matching Familiar Figures Test (MFFT), which has been shown to be sensitive to impulsive responding, while hyperactive children are generally classified based on parental or teacher reports of the child's behavior at home or school. The two relatively loosely defined response classes seem to have quite a bit of overlap. Messer (1976), for example, demonstrated a relationship between the dimension of impulsivity on the MFFT and hyperactivity as well as inattention, learning difficulties and brain damage.

Meichenbaum and Goodman (1969) found that hyperactive and impulsive children tend to exhibit less verbal control of inhibitory responses and to have a greater number of errors on motor tasks. Many researchers have found that self-instruction training is effective in improving the performance of hyperactive and impulsive children on a number of cognitive and sensory-motor tasks.

Palkes, Steward and Kahana (1968) and Palkes, Steward and Freedman (1972) taught impulsive children to slow down their performance on the Porteus Maze Test using self-instruction training. The Porteus Maze Test was selected in these two studies due to substantial research indicating its usefulness in demonstrating impulsiveness and distractibility (Porteus, 1965). Meichenbaum and Goodman (1971) also used self-instructions to teach impulsive children to alter their response style on the Porteus Maze Test as well as a number of other standardized tests.

Douglas, Parry, Marton and Garson (1976) also examined the effect of self-instruction training on the performance of hyperactive boys on a number of standardized tests. The hyperactive boys in the self-instruction group significantly improved on several measures including the MFFT, oral and listening comprehension on the Durrel Analysis of Reading, realistic responses on the Story Completion task and time measure of the Bender-Gestalt. The authors suggest that the improved performance of their subjects on the above tests was due to the modification of response styles.

Some researchers have specifically focused on the use of self-instruction training in treating distractibility. Burgio, Whitman and Johnson (1980) trained three highly distractible, mentally retarded children, ranging in age from 9 to 11 years, to use self-instruction techniques. During training, the subjects were taught through self-instruction to focus their attention on math and printing tasks. During self-instruction training, the subjects were systematically and sequentially exposed to photo slides of distracting situations as well as in vivo distractions provided by kindergarten children playing with wooden blocks. A decrease in off-task behavior occurred during the math and printing tasks in a one-to-one situation and in the classroom setting. The authors, however, report that no reliable changes were observed in academic performance.

Bornstein and Quevillon (1976) studied the effects of self-instruction training on the on-task performance of three hyperactive boys. The results indicated that the subjects increased on-task performance on the experimental measure and this increase is reported to have generalized to the classroom as well. Friedling and O'Leary (1979), however, were unable to replicate Bornstein and Quevillon's (1976) findings using second and third grade hyperactive children. Their results indicated that the self-instruction group improved accuracy on the mathematical measure but no other changes were reported.

Bryant and Budd (1982) examined the effect of self-instruction training on the independent on-task performance of three impulsive preschool children in the classroom. The three subjects trained in self-instruction techniques exhibited improved on-task performance. Kendall and Finch (1976) examined the performance of a single impulsive-hyperactive subject on the MFFT before and after self-instruction training. The authors found that the subject exhibited improved performance on the MFFT at the end of the treatment and at a 6 month follow-up administration of the test. The results of the above studies have provided evidence for the effectiveness of self-instruction training in modifying the response patterns of impulsive and hyperactive children.

4. Cerebral palsied children's deficits in visuo-motor reproduction: perception or translation?

Although no studies have directly examined the effect of self-instruction training on the perceptual motor functioning of cerebral palsied persons, several studies have investigated the effect of self-instruction training on visuo-motor tasks with other populations. Research has examined the effect of self-instruction training on prorated WISC-R IQ scores (Camp, Bloom, Herbert and Van Doornick, 1977; Meichenbaum and Goodman, 1971). Other studies have found self-instruction training to be effective in motor responding (Meichenbaum and Goodman, 1969) and copying letters (Robin, Armel and O'Leary, 1975).

Previous studies examining the effect of self-instruction training on visuo-motor performance have focused on groups of subjects who are impulsive or deficient in a particular skill area (ie. writing). However, research has not focused on populations whose performance deficit stems from intracranial lesions directly affecting perceptual motor responding. The present study examines the effect of self-instruction training on a brain-damaged population whose deficient motor performance stems directly from intracranial lesions.

Aberrant motor responses are by definition a prominent feature of cerebral palsy. While perceptual problems are associated with cerebral palsy, they are not necessary for correct usage of the diagnosis and may or may not be present in a particular individual. Perception is defined for the present purposes as the process of organizing sensory stimuli into some kind of meaning, the intermediate step between sensation and cognition.

Researchers have questioned whether perceptual problems are as prevalent among cerebral palsied children as some writers suggest. The difficulty that cerebral palsied children exhibit on many visuo-motor tests may not be the result of strictly perceptual deficits but rather a problem in motorically reproducing visual stimuli. Cruikshank (1955) summarized a number of investigations of perceptual problems of cerebral palsied children by stating that as a group many of these children have difficulty translating visual stimuli into motor activity. Later, Cruickshank (1966) suggested that with many cerebral palsied persons their failure may be less a problem of perception and more a problem of association and execution.

Bortner and Birch (1962) provide further evidence to suggest that what appears at first to be a strictly visual-perceptual problem is actually an inability to translate a perceptual organization into an action pattern. The study tested 28 cerebral palsied children on a series of Block Designs. After failing three consecutive designs, the subject was presented with a stimulus card as well as three assembled Block Designs: one was an accurate copy, another was the subject's own incorrect solution and the third was another incorrect solution. The subject was then asked to indicate which looked like the design on the stimulus card. The results indicated that the ability to discriminate was intact in four-fifths of the cases even though the ability to motorically reproduce the design was impaired.

Ball and Wilsoncraft (1967) used a paper-and-pencil copying task to distinguish between the cerebral palsied child's visuo-perceptual ability and their motor reproduction ability. The authors examined the ability of cerebral palsied children, mentally retarded and normal children above 8 years of age to copy a diamond. The children were then assessed using the phi (apparent motion) techniques. The phi phenomenon was used to directly measure basic perceptual processes such as form discrimination. The results indicated that cerebral palsied children differed significantly from normal children in their overall reactivity to phi. However, the cerebral palsied children who failed the diamond copying task were able to discriminate forms as well as normals who succeeded with the copying task.

Morozas and May (1985) were interested in extending previous studies which indicated that figure-ground reversals of visual stimuli positively affected the performance of cerebral palsied children on perceptual motor tasks. The study focused specifically on whether the figure-ground reversals affected the perception of the stimuli or the perceptual motor performance. The effects of figure-ground reversals were examined in the performance of 5 to 8 year old cerebral palsied children and normal children. The Developmental Test of Visual-motor Integration was used as a measure of visuo-motor performance while the Motor-Free Visual Perception Test was used as a test of visuo-perceptual ability which required no motor manipulation of materials. The results indicated that the reversals affected only the cerebral palsied children's performance on the Motor-Free Visual Perception Test. Performance on the visuo-motor test, the Developmental Test of Visual-motor Integration, was not influenced by the reversals. The authors found that the cerebral palsied children's visuo-perception was improved by the reversals but the reversals did not affect their ability to reproduce the figures on the Developmental Test of Visual-motor Integration. Furthermore, the results provide further evidence for the suggestion that the cerebral palsied child's primary problem in the performance of visuo-motor tasks is not in the perception of the visual stimuli itself but rather in the translation of the perception into motor action.

The above studies seem to suggest that the cerebral palsied child's problem in performing visuo-motor reproduction tasks is not strictly perceptual but rather is the result of difficulty in translating the stimulus into the appropriate motor behavior. As such, the possibility exists that the cerebral palsied child with deficient performance on such tasks as the Block Design, although with adequate verbal skills, could help facilitate his/her own performance by using language as an intermediate step between perception and motor behavior. The use of language concerning the spatial location of elements of the stimulus could help the cerebral palsied child interpret the Block Design motorically.

The hypothesis that cerebral palsied children can benefit from self-instruction training in the performance of visuo-motor activities seems to be further suggested by the research literature regarding the effect of language level on behavior. In children with high activity level, self-instruction research indicates that high language ability enables the sufficient exercise of control despite behavioral impulsivity. Weithorn and Kagan (1978) compared the performance of high activity first graders and low activity first graders on the Visual Matching Test and found that language maturity was a significant variable only for the high activity children. The high activity/high language group demonstrated improved cognitive performance and overall school performance.

The above research suggests that language may have a compensatory function in the cognitive functioning of children exhibiting high levels of activity. The results are relevant to the present proposal in that research has found that cerebral palsied children do not differ on the verbal subtests of the Stanford-Binet Intelligence Scale from normal children but their performance is inferior to them on the performance subtests (Luszaki, 1966). Cerebral palsied children are also frequently characterized as hyperactive. The research might suggest that the cerebral palsied child's relatively high language maturity may serve a compensatory function in the cerebral palsied child's performance of certain performance tests.

Some further indirect evidence may also suggest that cerebral palsied children have not adequately developed sufficient inner speech to control behavior. Luria (1961) states that inner speech is dependent upon the internalization of overt speech. As such, it is interesting to note some evidence indicating that cerebral palsied children do not develop expressive language, as measured by words spoken, to the degree that they develop receptive language, as measured by word recognition in a picture vocabulary test (Irvin, 1972). Poor articulation due to such factors as dysarthria may interfere with the normal development of expressive language and may disrupt the internalization of speech.

5. The use of self-instruction training in the remediation of visuo-motor performance:

Many of the previous studies examining the effect of self-instruction training on perceptual motor tasks have used Meichenbaum and Goodman's (1971) self-instruction training procedure which when strictly applied has shown to have only a variable impact on the performance of visuo-motor tasks. Meichenbaum and Goodman's (1971) procedure concentrated on developing answers to the following four basic questions: What is my problem, What is my plan, Am I using my plan and How did I do? While one of the many dependent variables in Meichenbaum and Goodman's (1971) study was the Block Design subtest (WISC-R), the procedure was developed in order to provide a general framework for using self-instruction with a wide variety of different tasks. Positive results were reported for a number of the dependent variables including the Matching Familiar Figures Test, the Porteus Maze Test and the prorated Performance IQ of the WISC-R. Further analysis of the prorated Performance IQ of the WISC-R, however, indicated that the self-instruction training group's performance on the Block Design subtest was not significant. Other studies examining the effect of Meichenbaum and Goodman's (1971) self-instruction training procedure on perceptual motor tasks have yielded similar results (Camp, Bloom, Herbert and Van Doorninck, 1977; Douglas, Parry, Marton and Garson, 1976).

The above studies employed a general self-instruction procedure, based upon the work of Meichenbaum and Goodman (1969, 1971) and did not directly address the specific task requirements of a perceptual motor task. Some authors emphasize the importance of considering the specific task requirements (Evangelista, Whitman and Johnston, 1986; Whitman, 1986). The studies did not include the use of spatial self-verbalizations to help guide motor movements and overcome performance deficiencies.

Robin, Armel and O'Leary (1975), however, did modify Meichenbaum and Goodman's (1971) training procedure in their investigation of the effects of self-instruction on the writing deficiencies of 30 kindergarten children. The self-instruction training procedure basically followed the Meichenbaum and Goodman (1971) procedure with some modifications. The procedure included the use of appropriate self-verbalizations concerning spatial directives as a way of providing an intermediary function between visual perception and motor movements. The following sequence (Robin, Armel and O'Leary, 1975, p. 182) illustrates their self-instruction paradigm used to facilitate writing the letter P:

1. Questions about the task: "What is it I have to do?"
2. Answer in the form of planning: "I have to make a P".
3. Appropriate directive comment: "I have to go down, down, slow, stop at the bottom, stop."
4. Correction of error: "No, that's not straight, I have to make a straight line, like a stick".
5. Self-reinforcement: "It's done and I made a good letter".

The subjects were assigned to one of three groups: self-instruction, direct training and a no-treatment control. Results indicated that the self-instruction group performed significantly better on the letter copying task than the direct training group and the no-treatment group.

Robin, Armel and O'Leary's (1975) study employed a more specific, perceptual motor oriented training procedure that differs from other more general self-instruction procedures. The procedure provides the subject with the opportunity to produce a narrative description of behavior, both preceding and accompanying performance. Emphasis in the self-instruction training procedure is placed on the production phase of the cognitive mediational process.

6. Summary:

Cerebral palsy is a medical diagnosis used to designate motor deficits resulting from brain pathology in the young developing nervous system (Boone, 1972). A number of research studies have shown that people with cerebral palsy often have difficulty with tasks that require visuo-motor reproduction. The cerebral palsied child's difficulty in motorically reproducing visual stimuli is manifested in severe performance deficiencies on such tasks as the Block Design subtest (WISC-R). Children with cerebral palsy have also been found to exhibit hyperactivity and distractibility which may also interfere with performance on measures of visuo-motor reproduction. A number of research studies have documented the effectiveness of self-instruction training in reducing impulsive responding and increasing attention to task. The subjects in these studies, however, were not diagnosed as having cerebral palsy but rather were characterized as impulsive or hyperactive based upon standardized test performance or behavioral reports.

The lack of self-instruction research using developmentally disabled populations may be traced to the assertion by some researchers that cognitive behavioral techniques may not be effective with behaviors closely associated with brain damage and that the effectiveness of these techniques are limited to the improvement of task approach behaviors. Perceptual disturbances are often considered to be too closely linked to irreversible brain pathology. Research, however, indicates that what at first may appear to be exclusively a perceptual deficit is actually an inability to translate a perceptual organization into an action pattern.

Previous studies examining the effect of self-instruction training on the visuo-motor performance of various populations have frequently used Meichenbaum and Goodman's (1971) self-instruction procedure. Although this procedure provides a general framework for using self-instruction with a wide variety of different tasks, it does not directly address the specific task requirements of a perceptual motor task. Robin, Armel and O'Leary (1975), however, used a self-instruction training program that is more specifically oriented toward use with perceptual motor tasks.

II.D. SELF-INSTRUCTION AND VISUO-MOTOR TASKS: SUBJECT, TASK AND TREATMENT VARIABLES.

1. Introductory comments:

In the present section, a number of research studies examining the effects of self-instruction training on various visuo-motor reproduction tasks will be examined with reference to the current body of literature concerning subject, treatment and task variables. Numerous researchers have emphasized the importance of considering the effect of these variables on the outcomes of self-instruction training (Fish and Pervan, 1983; Kendall, 1985; O'Leary and Dubey, 1979; Whalen, Henker and Hinshaw, 1985;). The results of research studying the effects of self-instruction training on visuo-motor reproduction tasks are equivocal. Many of these studies, however, have failed to consider the impact of subject, treatment and task variables on their research and consequently a review of these studies in view of these variables may be helpful in understanding the inconsistent pattern of results.

The relevant studies reviewed in this section examine a relatively broad range of dependent measures, all of which are considered to be visuo-motor reproduction tasks. These studies include dependent measures such as copying letters (Robin, Armel and O'Leary, 1975), the reproduction of the Block Design subtest of both the Wechsler Intelligence Scale for Children (WISC) (Meichenbaum and Goodman, 1971) and the revised Wechsler Intelligence Scale for Children (WISC-R) (Camp, Bloom, Herbert and Van Doorninck, 1977; Litrownik, 1981) and the Bender-Gestalt test (Douglas, Parry, Martan and Garson, 1976).

The dependent measures that are reviewed all involve activities that require the coordination of visual and motor skills in the reproduction of a model. Such visuo-motor tasks as the Porteus Maze Test are not considered visuo-motor reproduction tasks because of their exclusion of the reproduction component. Factor analytic research has not been successful in determining distinct elements in the perceptual motor spectrum (Hammill, Colaruso, Weiderholt, 1972; Saphier, 1973). As such, there are no consistent research results that agree on the elements that define such perceptual motor concepts as visuo-motor reproduction.

2. The impact of subject and treatment variables on one study's limited results:

Much of the self-instruction research incorporating visuo-motor reproduction tasks as dependent measures have focused on either hyperactive or skill-deficient children. The use of visuo-motor reproduction tasks with hyperactive children stems largely from the research that indicates that hyperactive children are deficient in the performance of many visuo-motor tasks (Douglas, 1975). Visuo-motor reproduction tasks are sometimes included in the battery of dependent measures that usually also incorporate cognitive and academic measures and sometimes assessments of interpersonal functioning. The research has generally not specifically addressed visuo-motor reproduction performance but rather has examined it as one class of dependent measures among many.

Robin, Armel and O'Leary's (1975) study, however, is one exception. The authors investigated the effects of self-instruction training on the ability of 30 writing-deficient kindergarten children to copy letters. The children were pretested and posttested on their performance on a task involving the copying of four target letters and on their performance on a generalization task to copy two letters, two numbers and five geometrical shapes that were not specifically included in training. The children were assigned to either a self-instruction group, a direct training control group (ie. feedback and reinforcement) or a no-treatment control group. Training in the self-instruction and direct training groups consisted of 20 individualized sessions 3 times a week over a 7 week period. The results indicated that the self-instruction group performed on the posttest with significantly greater accuracy than the direct treatment group. Both the self-instruction group and the direct treatment group were significantly superior to the no-treatment group in copying the target letters. The generalization test, however, involving the copying of novel letters, numbers and forms revealed no significant differences between groups.

Robin, Armel and O'Leary's (1975) unsuccessful generalization results may be due to the failure to consider the limitations and characteristics of the subjects being studied. A number of authors have emphasized the importance of considering the subject variables as they influence responsiveness to self-instruction training. Copeland (1981) stresses the relevance of subject variables inasmuch as they are important in enhancing the effectiveness of self-instruction intervention plans. Craighead, Meyers and Craighead (1985) have emphasized the importance of evaluating cognitive behavioral interventions in reference to developmental factors. Cole and Kazdin (1980) have argued that definitive statements regarding the clinical and educational utility of self-instruction can not be made until age and other measures of cognitive development have been thoroughly examined.

Luria's (1961) work on inner speech was the first to generate interest and research in the 1960's into the subject variables that affect the child's developing verbal control over motor behavior. Luria proposed a sequence of three stages in the use of speech to direct motor behavior based upon his research with children. In the first stage, the child is able to speak but verbal production does not direct motor behavior. The speech of others, however, can direct and control behavior to some extent. During this initial stage, the verbal content is basically irrelevant and control is obtained as a consequence of stimulus properties rather than the semantic aspects of speech.

The second stage introduces limited control of motor behavior through overt verbalization. While the child's speech is able to initiate a motor act, it cannot inhibit the motor act at this stage. As in the first stage, the verbal control is not semantic in essence. In the third stage, the child begins to be able to use covert speech to inhibit behavior. As this occurs, however, the use of overt speech-for-oneself is generally no longer needed because speech-for-oneself has been internalized.

Meichenbaum and Goodman (1969) investigated the relationship of age to mode of delivery of verbalizations in a self-instruction study and found evidence for a developmental sequence substantiating the motoric rather than the semantic function of speech in younger children, similar to that outlined by Luria. The effects of verbal operants on the motor responding of kindergarten children, aged 5 years, and first graders, aged 6 years, were examined. Three conditions simulating various modes of verbal delivery were employed. The first condition required that the subjects tap "slower" or "faster" as the experimenter verbalized the verbal operants. In the second condition, the subjects tapped "slower" or "faster" while overtly verbalizing the operants. In the third condition, subjects tapped and whispered the verbal operants using only lip movements.

Meichenbaum and Goodman (1969) found that the performance of kindergarten children on the motor task approximated the performance of the first grade children in the overt verbalization condition while the covert self-verbalization condition had minimal impact upon the kindergartners. The first graders benefited most from covert self-instructions. The results suggest that the kindergarten children had not yet developed control over motor behavior through the use of covert, internalized speech that is sensitive to verbal content.

Miller, Shelton and Flavell (1970) found that the young child, ranging in age from 3 years to 5 years, typically exhibited a temporal relationship between verbal and motor responses that did not facilitate verbal control over motor behavior. The authors report that at this young age motor responses typically precede the verbal self-instruction. The results suggest that children 5 years and younger do not exhibit the ability to direct motor responses through self-verbalization.

Higa, Tharp and Calkins (1978) report that 5 1/2 years appears to be the critical age at which children begin to exhibit self-directed control over motor behavior through speech. Children that are younger than 5 1/2 years have difficulty with the coordination of verbal and non-verbal responses and tend to perform motor tasks involving self-instruction as though it were composed of two separate tasks, one motor and the other verbal.

Higa, Tharp and Calkins (1978) examined the age differences of kindergarten, first and second grade children to control motor behavior by self-verbalization. The subjects were given a verbal control task to initiate a motor response to a positive stimuli and inhibit a motor response to a negative stimuli. Subjects were divided into one of two conditions. The first condition required that subjects first perform only motor responding which was then followed by verbal self-directed motor responding. This condition provided subjects with the opportunity to practice motor responding before performing the motor task with verbal self-instructions. Subjects in the second condition performed the sequence in the reverse order: first verbal self-directed responding followed by motor responding. The second condition did not allow for motor only practice prior to self-directed responding.

The results indicated that the kindergarten and first grade children performed at a level significantly below the second grade children in the second condition in which verbal self-directed responding preceded motor response practice. The two younger groups, however, performed at a level comparable to the older group when motor response practice occurred prior to verbal self-directed responding. The authors suggest that practice on the motor component was necessary to facilitate adequate coordination between verbal and motor responding in the younger children. While kindergarten and first grade children performed the verbal and motor responses as two separate tasks, the second graders had apparently developed sufficient coordination between motor and verbal functioning.

These findings suggest that Robin, Armel and O'Leary's (1975) limited success in improving the letter copying performance of writing-deficient kindergarten children may have been due to the age of the subjects. Meichenbaum and Goodman's (1969) study suggests that the modified self-instruction approach (ie. whispering) may not have been as effective with younger subjects as self-instructions performed out loud. Furthermore, Higa, Tharp and Calkin's (1978) findings suggest that the young subject's self-instructions in the Robin et al. study may have actually interfered with the letter copying task.

Robin, Armel and O'Leary (1975), in fact, note that many of their subjects shortened their verbalizations to a single word, uttered the word rapidly and in many cases not in coordination with the motor response. These observations are consistent with Miller, Shelton and Flavell's (1970) findings that younger children, ranging in age from 3 years to 5 years, do not exhibit a temporal relationship between verbal and motor responses that facilitates verbal control over motor behaviors. In addition, Robin, Armel and O'Leary (1975) observed that many of their subjects self-instructed correctly while failing to make correct writing responses which suggests that the motor and verbal systems were operating independently.

Note that some issues regarding generalization of training will be presently discussed as they relate to the Robin, Armel and O'Leary (1975) study. However, a more general treatment of generalization and self-instruction training will be presented in the next section (See Self-instruction and Generalization). Robin, Armel and O'Leary (1975) did not obtain generalization of treatment effects to copying novel letters, numbers or forms. Research suggests that Robin, Armel and O'Leary's (1975) failure to obtain generalization effects may be due to the narrow focus of their self-instruction package (Brown, 1978; Schleser, Meyers and Cohen, 1981).

Schleser, Myers and Cohen (1981) provide evidence to suggest that generalization is enhanced when self-instruction interventions incorporate a more general problem-solving strategy. Subjects consisted of 70 second and third grade children classified as either preoperational or concrete operational. The subjects were randomly divided into one of five groups: specific self-instructions, general self-instructions, specific didactic control, general didactic control and no-training. The specific groups were designed to enhance performance on the specific task while the general groups were designed to provide a more comprehensive problem-solving strategy, applicable to a variety of tasks. The subjects were pretested and posttested on a target test (MFFT) and a generalization test, a perceptual perspective-taking task. The results indicated that the specific self-instruction group performed better on the target task than all other groups while the general self-instruction group performed better on the generalization task than all other groups.

The specific and restrictive nature of the Robin et al. self-instruction package may have failed to promote generalization to novel letters. While the Robin, Armel and O'Leary (1975) training procedure was lengthy, spanning 20 individual sessions over a 7 week period, the procedure was extremely task specific. During each session, subjects were required to copy 2 of the 4 target letters 7 times each. By the end of the 20 sessions, each subject had copied each of the four target letters 70 times each. There was no opportunity to practice generalization to novel letters. The subjects, in effect, learned only to copy those four letters and not to apply the skill in a more general fashion. Brown (1978) has suggested that if one of the goals of self-instruction training is generalization of performance then the emphasis of training should be on general skills designed to meet a variety of task demands.

Studies by Nichol, Cohen, Meyers and schleser (1982) and Schleser, Cohen, Meyers and Rodrick (1984) suggest that more cognitively mature children exhibit improvements in their ability to generalize from self-instruction training. Nichol, Cohen, Myers and Schleser (1982) examined the effect of cognitive level, as defined by Piagetian conservation tasks, on performance on a generalization task following self-instruction training. Forty-eight first and second grade children were classified as either preoperational or concrete operational and then assigned to either a no-training control group or a self-instruction group which was delivered through a directed discovery procedure. Performance was measured on a training task (MFFT) and a generalization task, which was a perceptual perspective-taking test. The authors report that both the preoperational group and the concrete operational group improved significantly on the training task but only the concrete operational group improved on the generalization task.

Schleser, Cohen, Meyers and Roderick (1984) compared the performance of preoperational and concrete operational first and second graders on a training task (MFFT) and a generalization task, a perceptual perspective-taking test. This study differed from the previous study in that subjects were divided into the following groups: a faded self-instruction group, a directed discovery self-instruction group, a didactic instruction group and a no-training control group. Results indicated that the two self-instruction groups improved significantly on the target task compared to all other groups. The concrete operational children, however, in the directed discovery self-instruction group were the only subjects to exhibit improvement on the generalization task. The above findings indicate that the kindergarten children in the Robin, Armel and O'Leary (1975) study may not have generalized from treatment due to such age-related variables as cognitive maturity.

3. Task variables: The research argument against the use of visuo-motor reproduction tasks:

Some research studies have examined the effects of cognitive behavioral methods on the performance on Block Design tasks. In the Block Design subtest (WISC-R), the subject is presented with two-dimensional, red-and-white pictures of abstract designs. The task requires using the blocks to assemble a design that is identical to the design on each picture. The Block Design test involves the reproductive aspects of visuo-motor coordination (Sattler, 1983).

Meichenbaum and Goodman (1971) examined the effects of self-instruction on the performance of impulsive children on a number of visuo-motor and cognitive tasks. The subjects ranged in age from 7 years to 9 years and were pretested and posttested on the following measures: the Porteus Maze Test, Matching Familiar Figures Test (MFFT), prorated Wechsler Intelligence Scale for Children (WISC) Performance IQ and classroom observations of appropriate behaviors. The WISC Performance IQ consisted of three subtests: the

Block Design, Picture Arrangement and Coding. The children were divided into a self-instruction training group, an attention only control group and a no-training control group. Subjects in the two treatment groups were seen individually for four sessions lasting half an hour over a 2 week period.

Meichenbaum and Goodman (1971) report that the self-instruction group exhibited significant improvement compared to the other groups on the Porteus Maze Test, the MFFT and the prorated WISC Performance IQ. No significant differences were reported for generalization to the classroom. Closer inspection of the subtest data of the prorated WISC Performance IQ, however, reveals that performance on the Picture Arrangement and Coding subtests improved significantly following self-instruction training but performance on the Block Design subtest did not exhibit significant improvement.

Camp, Bloom, Herbert and Van Doorninck (1975) developed a self-instruction program which they called "Think Aloud". Procedures used in training were very similar to those described by Meichenbaum and Goodman (1971). The authors examined the effect of self-instruction training on a number of visuo-motor, cognitive, academic and interpersonal measures. The subjects consisted of second grade aggressive boys. The subjects were pretested and posttested on the prorated WISC-R Performance IQ, the Reading Test from the Wide Range Achievement Test (WRAT), auditory reception from the Illinois Test of Psycholinguistic Abilities (ITPA), MFFT, the Preschool Interpersonal Problem-solving Test and teacher ratings of classroom behavior. The WISC-R Performance IQ consisted of the

Block Design subtest, the Object Assembly subtest and the Mazes subtest. The aggressive boys were either divided into a self-instruction group that received daily, 30-minute individual sessions over a 6 week period or a no-intervention control group. Comparison was also made to a "normal" no-intervention control group.

The results indicated that the children in the self-instruction group differed significantly on the MFFT and Mazes subtest of the WISC-R Performance IQ. Performance showed a trend toward significance on a number of measures including the prorated WISC-R Performance IQ. Examination of the subtest data on the prorated WISC-R IQ again indicated that there was no significant differences on the Block Design subtest. While the results were generally seen as being quite encouraging, the authors attributed failure to produce changes in all areas examined to inappropriate verbal activity (ie. chatter, silliness) which was thought to have interfered with performance.

Douglas, Parry, Marton and Garson (1977) examined performance on another visuo-motor reproduction task, the Bender-Gestalt test. The subjects consisted of 29 hyperactive boys who were either assigned to a self-instruction group which met for 24 one-hour sessions or to a no-treatment control group. The subjects ranged in age from 6 years, 1 month to 10 years, 11 months and were pretested, posttested and tested a month after treatment on the MFFT, the Story Completion Test, the Porteus Mazes, the Memory tests from the Detroit Tests of Learning Aptitude (DTLA), the Durrell Analysis of Reading Difficulty (DARD), the Wide Range Achievement Test (WRAT) Arithmetic subtest and the Bender Visual

Motor Gestalt test. The Bender-Gestalt requires that the subject copy a series of figures in a paper-and-pencil format. The Bender-Gestalt is considered to be a measure of visuo-motor reproduction skill and has been shown to demonstrate differences between hyperactive and normal children (Douglas, 1972). The Bender-Gestalt yields two scores: a time score and an error score.

The results indicated that performance on the MFFT, the Story Completion Task and time measure on the Bender-Gestalt test improved significantly after self-instruction training while the Porteus Maze Test and the Memory for Unrelated Words on the DTLA approached significance. The error score on the Bender-Gestalt and the Memory Test for Related Words on the DTLA were nonsignificant. In interpreting their results, Douglas, Parry, Marton and Garson (1977) suggest that obtaining significant results on the time measure while obtaining nonsignificant results on the error measure of the Bender-Gestalt may reflect a genuine perceptual motor problem as opposed to a task approach problem.

A number of researchers have emphasized the importance of considering task variables, as well as age and age-related variables, in assessing the efficacy of self-instruction training (Cole and Kazdin, 1980; Whitman, 1986). In examining the relevance of task variables, some authors have suggested that dependent measures that are associated with stable ability factors may not be responsive to self-control strategies. Bornstein and Quevillon (1976) argued that on-task behaviors may be successfully modified by self-instruction but performance related to task ability may not be as affected. The authors suggest that Robin, Armel and O'Leary

(1975) may have altered motor control deficiencies through self-instruction but abilities such as spatial representation were not affected (Bornstein and Quevillon, 1976).

Fox and Kendall (1983) also suggest that self-instruction training will not affect ability but will produce changes in content learning through the improvement of task approach behaviors. Roberts and Dicks (1982) continue this line of argument by suggesting that self-instruction training may be more useful for task approach behaviors than for task acquisition behaviors.

The argument that self-instruction training's usefulness is limited to the remediation of task approach behaviors can be applied to Meichenbaum and Goodman's (1971) and Camp, Bloom, Herbert and Van Doorninck's (1977) failure to modify performance on the Block Design subtest and Douglas, Parry, Marton and Garson's (1977) failure to obtain positive results on the error score of the Bender-Gestalt. The Block Design task has, in fact, been implicated in the prediction of lesions in the posterior region of the brain (Klove and Rietan, 1958; McFie, 1975). Satz (1966) also obtained high validity in predicting the likelihood of brain disorders using a Block Design task.

4. Task variables: The research argument for the use of visuo-motor reproduction tasks:

Many authors seem to suggest that behaviors closely associated with injury to the brain may not be remediated by cognitive behavioral methods. Litrownik (1981), however, demonstrated the effectiveness of cognitive behavioral techniques in improving performance on the Block Design task. The subjects were 16 moderately mentally retarded individuals ranging in age from 17 to 21 years. Eight of the subjects were assigned to the cognitive behavioral intervention group while the eight others were assigned to a no-treatment control group. The experimental group received training in self-evaluation and self-reward during a 70 minute training session. The subjects in the self-evaluation and reward group significantly outperformed subjects in the control group on the Block Design task and a Symbol Matching task.

. Luria and Tsvetkova (1964) examined the effect of various training techniques to improve the performance of brain-injured patients on a Block Design task. The authors were able to retrain a 41 year old female with a parietal lobe injury to decrease her number of mistakes on a Block Design task. The patient exhibited a severe deficit in spatial analysis and had difficulty analyzing a complex design into simpler components. Performance on the Block Design was facilitated by providing external cues to help dissect the design into elementary units.

Luria and Tsvetkova (1964) also employed a self-verbalization technique, delivered through a written plan, to dramatically improve the performance of a patient with a frontal lobe injury on a Block Design task. The authors attributed the patient's impaired ability to formulate and execute a plan consisting of sequenced steps to a frontal lobe injury. The patient was first given a written plan consisting of a sequence of steps to enhance performance on the Block Design. Performance improved after the patient learned to overtly verbalize the instructions. The written plan is reproduced as follows:

1. A. Look at the pattern.
   B. Count how many squares there are in the figure given.
   C. Look at colors in the figure.
   D. Try to single out structure.

11. A. Find out the necessary number of blocks.
   B. Begin to construct the figure from the top, by the blocks from left to right.
   C. Count how many squares there are in the first row.
   D. Arrange them as needed to the number.
   E. Compare your row with the row given in the pattern.
   F. Count how many squares there are in the second row.
   G. Arrange them as needed to the number.
   H. Compare your row with the row given in the pattern (Luria and Tsvetkova, 1964, p. 100).

The patient's performance on the Block Design continued to improve after he was able to memorize the written plan and overtly self-verbalize the sequence without reference to the written plan. Although the method of training lacks many of the refinements currently used in self-instruction training (eg. modeling, fading from overt to covert self-verbalizations, self-reward), this procedure incorporates the essential strategic goal of learning to self-verbalize a set of instructions. It also incorporates a component attentional skills component in that the subject is taught to break down the stimulus array into its component parts and then to compare differences and similarities.

Webster and Scott (1983) examined the effect of self-instruction training on the attentional and memory skills of a patient with closed head injury. A self-instruction program was used that was closely modeled after the Meichenbaum and Goodman (1971) procedure. The specific training involved verbalizing a number of self-statements as preparation for listening eg. I must focus on what is being said, not on other thoughts which want to intrude. Finally, the subject repeated subvocally each word spoken to him. The subject was pretested and posttested on the Story Memory Test. The results indicated substantial improvement on the Story Memory Test. The authors conclude that a cognitive self-instruction program holds promise as a rehabilitative technique for some brain-impaired patients.

5. Summary:

A study by Robin, Armel and O'Leary (1975) examined the effect of self-instruction training on the letter copying performance of kindergarten children. The results indicated a significant difference between groups on those letters that were included in training but no significant difference on generalization letters. Research on the influence of subject variables suggests that the subjects may have been too young and cognitively immature to allow for the verbal system to have developed adequate control over the motor system. Subject variables as well as the narrow and restrictive nature of the treatment package may have also limited generalization effects.

Research has been used to support the assertion that self-instruction is effective with only some tasks and not with other tasks. While this position views self-instruction as having an impact on task approach behaviors, it does not view abilities and skills as being within its limited scope. Limitations associated with brain damage would not, according to this view, be amenable to effective intervention through self-instruction training. Contradictory research, however, has indicated that self-instruction is effective with tasks that are dependent upon ability and skill level.

The Block Design (WISC-R) task has been shown to be modifiable through self-instruction. In addition, patients with neurological dysfunction have been responsive to self-instruction training.

II.E. SELF-INSTRUCTION AND GENERALIZATION.

1. Introductory comments:

The present study attempts to train cerebral palsied children to improve their performance on a circumscribed group of tasks: visuo-motor reproduction tasks. The training task as well as the generalization tasks all require visuo-motor coordination in the reproduction of a stimulus array. Many previous self-instruction studies, however, have frequently not focused on a particular type of task but rather have attempted to teach self-instruction strategies as a general skill, transferable to a wide variety of unrelated behaviors (Camp et al, 1977; Douglas et al, 1976; Meichenbaum and

Goodman, 1971). The present study's attempt to target a task-specific domain is supported by the research on the generalization of self-instruction training.

Contingency management interventions are frequently associated with the failure to generalize treatment gains to non-treatment settings and tasks. The appeal of self-instruction training to many researchers, familiar with the failure of behavior modification to produce generalization, lay in its potential for promoting the acquisition of problem-solving skills that would facilitate generalization. Meichenbaum (1977) has suggested that self-instruction techniques alter the individual's internal dialogue which would effect a more generalized and enduring change in the person's behavior.

2. Equivocal generalization results:

Numerous researchers have noted the failure of self-instruction training to produce consistent generalization (Copeland, 1981; Fish and Pervan, 1985; Hobbs, Moguin, Tyroller and Lahey,1980; O'Leary and Dubey, 1979). The issue of generalization of self-instruction training arose early in the research due largely to high expectations and the initial failure of Meichenbaum and Goodman (1971) to generalize treatment effects to classroom measures. Although Meichenbaum and Goodman successfully trained subjects to improve performance on the MFFT, the Porteus Mazes and the prorated WISC-R IQ, the authors were unable to demonstrate generalization of effects to measures of classroom behavior and teacher's ratings of self-control.

Douglas, Parry, Marton and Garson (1976) developed a self-instruction program that also incorporated component attentional skills training. The program addressed behavior changes in a number of settings, including the classroom. Children in the self-instruction group were given training on tasks such as matching to sample, sorting to sample and pattern recognition. A wide battery of assessment measures revealed significant improvement on tasks very similar to those used in training but mixed improvement on dissimilar measures of academic competence such as reading and arithmetic. Teacher's rating also indicated no generalization of effects to the classroom.

Bornstein and Quevillon (1976), however, reported that self-instruction training did generalize to classroom behavior. A multiple baseline design across subjects was employed with three overactive preschool boys. On-task behavior in the classroom was used as the dependent variable. The results indicated that on-task performance improved after the subjects were trained in the use of self-instruction techniques. The authors also report that on-task improvements generalized to classroom performance and were maintained over a three month period. In a well-controlled study, Friedling and O'Leary (1979) report a failure to replicate the Bornstein and Quevillon results with older hyperactive children.

Burgio, Whitman and Johnson (1980) found limited support for generalization in a study that examined the effect of self-instruction training on the attending behavior of highly distractible, mentally retarded children. The children ranged in age between 9 and 11 years of age. The results indicated that the children improved in their attentional behavior only in the specific academic areas that were included in training ie. math and printing. The children were able to generalize on-task behavior to the classroom but only for those behaviors for which they were trained. The authors report that there were no improvements in academic performance in either the experimental setting or the classroom setting.

Barkley, Copeland and Sivage (1980) also report limited generalization. The authors conducted a self-control classroom for six hyperactive boys who ranged in age from 7 years to 10 years. The children received self-instruction training for problem-solving every afternoon for 8 weeks. The results indicated significant increases on on-task behavior and decreases in disruptive behavior but no changes in achievement measures.

Robin, Armel and O'Leary (1975) trained children to copy letters in either a self-instruction group or a direct training group. A no-treatment control group was also included. The children in the two training groups were trained to copy four target letters. The results indicated that the children in the self-instruction training group performed significantly better on the target letters than either the direct training group or the no-treatment group but no generalization to novel letters, numbers or geometrical shapes occurred for any of the three groups.

Kendall and Finch (1976) found generalization in a case study of an impulsive child. The generalization was reported to have occurred across settings, tasks and therapists and to have been maintained in a six month follow-up. Kendall and Finch (1979), however, later used a group design to examine self-instruction and generalization in impulsive children. The authors found generalization to MFFT scores and teacher's ratings of impulsive behaviors in the classroom. No generalization was found in the children's self-report of impulsivity or teacher's ratings of conflict in the classroom.

3. Possible sources of the equivocal generalization results:

The failure to obtain unequivocal generalization results has generated substantial inquiry into the sources of the problem. An important problem that impedes the ready examination of the generalization of self-instructions is the great number of differences that exist in these studies. Although most self-instruction training programs are patterned after the Meichenbaum and Goodman (1971) procedure, a number of variations still exist in these self-instruction programs. As elaborated in a previous section, the variations in subject and task variables can also have differing effects on generalization. The variation in research has led Stokes and Baer (1977) to recommend a more systematic examination of variables that they have referred to as a "technology of generalization".

Fox and Kendall (1983) suggest that the lack of consistent generalization findings is not surprising considering the rather narrow focus of training programs to impart skills with little emphasis placed on generalization. Self-instruction training programs do not teach the child to use these skills in various natural environments with its high degree of competing stimuli. The importance of teaching generalization has also been emphasized by a number of other researchers (Brown, 1978; Stokes and Baer, 1977). Brown, Campione and Murphy (1977) have also cited the need for direct training to teach the component skills of generalization, especially in regard to those populations with demonstrated deficiencies in the ability to generalize such as the mentally retarded and the learning disabled.

A number of researchers have attempted to investigate the metacognitive process that often occurs in conjunction with problem-solving. Metacognition is referred to as the awareness of thinking that occurs in such processes as deciding what strategies to use in problem-solving. Brown (1978) specified some elements of metacognition which are considered to be fundamental to the process of generalization: 1) stopping to think, plan and predict prior to initiating work on a problem; 2) asking oneself questions regarding the proper understanding of the problem; 3) checking solutions against external standards to determine if the plan is working.

Denney, Denney and Ziobrowski (1973) consider the development of "cognitive representations" of new behaviors as necessary to the process of generalization. It is thought that "cognitive representations" of new behaviors can be taught individuals and that self-instruction training can promote this learning process through encouraging children to verbalize strategies in their own words. Douglas, Parry, Marton and Garson (1976) were able to document some limited generalization in their study and attributed the outcome to not training self-instructions in a rote and mechanical manner but rather allowing for a greater compatibility between the language of the subject and the language of self-instruction.

Meichenbaum and Goodman (1971) gave impulsive children exposure to a verbalizing model and practice in generalizing their own verbalizations but did not specify what the exact substance of the verbalizations should be in performing a variety of tasks. The authors were able to demonstrate that the self-instruction group significantly improved on a number of generalization measures that were not included in training but the results did not generalize to measures of classroom behavior.

The content of the self-verbalizations have been shown to be an important element in self-instruction programs. Mischel and Walters (1976) examined the effect of varying the content of self-verbalizations on the ability to facilitate self-control in a resistance-to-temptation task. The authors compared the children's ability to use plans of varying degrees of elaboration. The children were assigned to either a condition that provided specific plans as to the verbalizations or to a condition that provided information that only specified the nature but not the content of the verbalizations. The findings indicated that the efficacy of the elaborated plans depended upon the substantive content.

The degree to which the self-verbalizations are conceptual or task-specific has also been shown to affect generalization. Kendall and Wilcox (1980) have shown that there are more generalized effects of training when the self-instructions are presented in training as conceptual statements rather than task-specific statements The children were assigned to either a conceptual self-instruction group, which referred to self-instruction strategies designed to facilitate any problem-solving situation, or to a concrete self-instruction group, which referred to self-instruction strategies to facilitate the solution of a specific task. Dependent measures included a variety of psychoeducational and interpersonal measures: MFFT, Porteus Mazes, Impulsive Control Categorization Instrument, Conner's Teacher Rating Scale, Self-control in Children Rating Scale and the Hyperactivity Scale. The training consisted of six 40-minute sessions spread over a 3 week period. While most of the performance measures indicated that both of the groups improved equally, children in the conceptual group were rated by their teachers as exhibiting more self-control in the classroom.

As previously elaborated, the ability to generalize the effects of self-instruction training may be related to age and age-related variables such as cognitive maturity (Nichol, Cohen, Meyers and Schleser, 1982). The effectiveness of a more conceptual self-instruction strategy in facilitating generalization may also be related to cognitive maturity. Schleser, Cohen, Meyers and Rodrick (1984) compared the effects of cognitive level and types of training methods on generalization. Children were classified as either preoperational or concrete operational based upon performance on Piagetian tasks and were assigned to either a directed discovery self-instruction group, a faded self-instruction group, a didactic instruction group or a no-training control group. The faded self-instruction group received the overt-to-covert fading traditionally associated with self-instruction training while the directed discovery self-instruction group was directed to "discover" for themselves the self-instructions through a dialogue with the trainer. The children classified as concrete operational in the directed discovery group were the only subjects that exhibited significant improvement on a generalization task. The results seem to suggest that the more cognitively mature subjects were better able to use a more conceptual problem-solving strategy to effect generalization.

O'Leary and Dubey (1979) note in their review article that generalization of training does not usually occur when training is conducted on a very restrictive range of tasks with rote and mechanical self-instructions. O'Leary and Dubey (1979) point to the study by Robin, Armel and O'Leary (1975) as an example of self-instruction training that was highly task-specific with no documented generalization effects.

4. Generalization within a specific task domain:

Lloyd (1980) argues that attempting to teach children general strategies may be futile unless the children have the necessary component skills. Fox and Kendall (1983) indicate that many cognitive training programs have not produced generalization due to their failure to ensure that the children had the specific component skills prior to being trained at a more general level. In order to enhance generalization, Meichenbaum (1977) has suggested using task analysis to break a task down into its component parts as a means of identifying the necessary skills. Douglas, Parry, Marston and Garson (1976) have also suggested that self-instruction training should include training in the prerequisite skills necessary for performance.

Abikoff (1979) suggests that self-instruction is more effective when it is more task-specific and focused. Abikoff (1979) argues that to the extent that training and assessment tasks require similar skills, generalization effects can be expected to occur. However, when there is little or no overlap of skill requirements on these tasks, generalization should not be expected to occur. Other researchers have also found that overlap between training tasks and dependent measures are necessary for generalization (Borkowski and Cavenaugh, 1979). Abikoff (1979) notes that generalization to similar tasks tends to be particularly effective with perceptual motor tasks:

The research literature seems to indicate that generalization is most likely to occur when training tasks and dependent measures are similar. In the second of two experiments on the effects of self-instruction training on the academic performance of emotionally disturbed children, Swanson (1985) found generalization only on those tasks similar to the tasks used in training. Three educationally handicapped children were used in a multiple baseline procedure across subjects with math and spelling improvement as dependent measures. All subjects received self-instruction training. Math performance was measured through performance on the math series, "Arithmetic Step by Step" and spelling improvement through performance on words obtained from the Merrill Linguistic Readers and the Barbe and Dolch Word List. Swanson (1985) reports improvement in math and spelling performance after self-instruction training with generalization only to highly similar problems.

Leon and Pepe (1983) investigated the effects of self-instruction training on the arithmetic performance of educable mentally retarded children and learning disabled children. The children were divided into either a self-instruction training group or a control group. The results indicated that the self-instruction group performed significantly better on the dependent measure: Key Math Diagnostic Test. Generalization was obtained only for those problems that required similar arithmetic skills to those taught in training.

As previously noted, Bryant and Budd (1982) also reported generalization to tasks that were highly similar to those used in training. Douglas, Parry, Marton and Garson (1976) also report that generalization from training tasks to other measures improved when there was greater similarity on those skills that were incorporated although not directly taught in training.

5. Summary:

Many researchers have noted the failure of self-instruction training to produce consistent generalization results. The lack of consistent generalization results has generated substantial inquiry into the sources of the problem and has led to a number of suggestions for improving generalization in self-instruction studies. These suggestions have included direct attempts to teach generalization, encouraging children to verbalize strategies in their own words and promoting the use of elaborated plans with substantive content. Generalization has been shown to be enhanced through the use of conceptual self-verbalizations as opposed to task-specific self-verbalizations. Conceptual self-verbalizations, however, may interact with the cognitive maturity of the subject and their ability to fully take advantage of training.

Research has demonstrated that generalization is most likely to occur when there is some overlap between the training task and the dependent measure. Identifying a specific task domain, wherein all included tasks share common attributes, such as visuo-motor reproduction tasks, may be an effective means of obtaining generalization. Specifying a task-domain area appears to be most effective when the cognitive maturity of the subject is questionable and when the subjects only require remediation within a specific deficit area.

The present research incorporated four considerations outlined in the literature to help promote generalization. First, subjects were given direct practice on three tasks designed to exercise generalization skills. Secondly, subjects in the self-instruction/component attentional skills group were encouraged to use their own language when self-instructing. Thirdly, all subjects were at least 7 years of age in order to ensure the developmental basis for verbal control over motor behavior. The last consideration involved increasing similarities between the training tasks and dependent measures by circumscribing a specific task domain that required similar skills.

111. HYPOTHESES:

The following hypotheses were tested:

1) The self-instruction/component attentional skills group will show a significant increase on the dependent measure that was used as a training task (the Block Design subtest of the WISC-R) compared to the component attentional skills group.

2) The self-instruction/component attentional skills group will show a significant increase on the generalization measure (the Block Designs of the Leiter International Performance Scale) compared to the component attentional skills group.

3) The self-instruction/component attentional skills group will exhibit a significant increase on the generalization measure (the Developmental Test of Visual-motor Integration) compared to the component attentional skills group.

IV. METHOD

The research was conducted in three phases: The pretesting, the training and the posttesting. The following outlines the sequence of the study.

	CONDITIONS	
	SI/CAS	CAS
Time 1	The three pretests were administered.	The three pre-tests were administered.
Time 2	Session 1 (SI/CAS training procedure)	Session 1 (CAS training procedure)
Time 3	Session 2	Session 2
Time 4	Session 3	Session 3
Time 5	Session 4	Session 4
Time 6	Session.5	Session 5
Time 7	Session 6	Session 6
Time 8	Session 7	Session 7

Time 9	Session 8	Session 8
Time 10	The three posttests were administered.	The three post-tests were administered.

IV. A. SUBJECTS:

The subjects in this study consist of 34 children who have a medical diagnosis of cerebral palsy. The children and adolescents are from a private school for the physically handicapped in the metropolitan New York area. The subjects range in age from 7 years to 17 years of age. The subjects consist of 20 males and 14 females. They are either at grade level or one, but no more than two, years behind in their grade level as assessed informally by their teachers. All of the children and adolescents exhibit motor deficits in the performance of fine motor tasks. The following criteria were required for subjects in the sample:

1) medical diagnosis of cerebral palsy.

2) Verbal Scale IQ of at least 80 on the Wechsler Intelligence Scale for Children, Revised (WISC-R). In previous self-instruction studies, the intelligence cut-offs have generally been in the 80 to 85 range (Douglas, Parry, Marton and Garson, 1976; Meichenbaum and Goodman, 1971).

3) visual and auditory acuity in the normal range. Information on the subject's intellectual, ophthalmolgical and auditory status was obtained from assessments current to within 3 years and with the majority within 1 to 2 years.

The degree of motor impairment among subjects varied. Some of the subjects had severely restricted use of their hands while others had only mild motor impairments. As Batshaw and Parret (1986) note, classification according to severity of involvement has not been successful because it involves subjective judgements.

IV. B. INSTRUMENTS:

The Block Design subtest (Wechsler Intelligence Scale for Children, Revised).

The present study used the Block Design subtest of the WISC-R as a dependent measure. The Block Design (WISC-R) was also used as a practice task in training. The Block Design is the sixth subtest of the WISC-R. The WISC-R is divided into the Performance Scale (6 tests) and the Verbal Scale (6 tests) with the Block Design contributing to the Performance Scale.

In the Block Design, the child is presented with two-dimensional, red-and-white pictures of abstract designs. The task requires using blocks to assemble a design that is identical to the design on each picture. The subtest has eleven items with each item arranged according to increasing difficulty. Four blocks are used for the first eight designs and nine blocks are used for the last designs. The Block Design involves the ability to visually organize a geometric pattern. It also involves the reproductive aspects of visuo-motor coordination (Sattler, 1983).

The average reliability coefficient across the eight age groups for the Block Design is .85 (ie. split-half technique, odd-even items). The Standard Error of Measurement (SEm) for the Block Design is 1.17. The average corrected stability coefficient across age groups is .81.

The Block Design correlated with the Stanford-Binet Intelligence Test at .52. Performance on the Block Design also correlated with performance on other subtests on the WISC-R. The Block Design correlates most highly with Object Assembly (.65) on the

Performance Scale and Similarities (.50) on the Verbal Scale. The lowest correlation on the Performance Scale was for Coding (.33). On the Verbal Scale, the lowest correlation was for the Digit Span (.31).

The Block Design (WISC-R) is the only dependent measure in this study that has time limits. The time limits are 45 seconds for the first four items, 75 seconds for items 5 through 8 and 2 minutes for the last three items. The Block Design also includes bonus points for rapid performance. Time limits are very restrictive for cerebral palsied children who exhibit difficulties in the motor manipulation of objects (Denhoff, 1960). As such, time limits and bonus points were eliminated from the scoring procedure of the Block Design (WISC-R). In the present study, the first two items were scored for 2 points each if correct. Since these two items are not timed, this is the same score prescribed by the WISC-R manual. The WISC-R manual prescribes additional points for rapid performance for the remaining items. Subjects in the present study, however, obtained 4 points per item for the remaining items with no additional points rewarded for rapid performance. The subtest was scored using raw scores.

Block Designs (Leiter International Performance Scale), items: 11-2, 111-2, V-4, V1-4:

The above four test items are all Block Designs from the Leiter International Performance Scale. These items are used in the present study as dependent measures, included to demonstrate the generalization of training.

The Leiter International Performance Scale (LIPS) is a 54-item non-verbal test which is appropriate for use with individuals ages 2 years through adult. The LIPS is composed of square wooden blocks, each of which has a color, design, shape or picture on one side. A paper strip with a color, design, shape or picture corresponding to each block is included. An additional component of the test materials is the wooden frame which has eight square stalls. Above the stalls is a sliding metal frame in which the examiner places the paper strip corresponding to each test item. The subject's task is to place the blocks in the stall corresponding to the appropriate color, design, shape or picture. Subjects may include those with hearing impairments or language disabilities. The Leiter International Performance Scale was scored using raw scores.

Leiter (1959) reports high split-half reliability coefficients but does not report any studies examining test-retest reliability. Weiner (1971) examined test-retest reliability with preschool language disordered children after 6 months and again after 2 years of the initial administration. Weiner (1971) obtained correlations of .64 and .63 for 6 month and 2 year retests, respectively.

Ratcliffe and Ratcliffe (1979) reviewed 13 studies that examined the concurrent validity of the Leiter International Performance Scale with the Stanford-Binet Intelligence Test and the Wechsler Intelligence Scale for Children. The results of their review indicated that correlations ranged from .40 to .86 with a median of .77.

Developmental Test of Visual-motor Integration, (Long-form).

The Developmental Test of Visual-motor Integration was developed by Beery (1967). The test purports to measure the integration of visual perception and motor behavior in young children. The long-form of the Developmental Test of Visual-motor Integration consists of 24 geometric forms that are to be copied in a test booklet. These geometric forms are arranged in order of increasing difficulty and an individual score is calculated as the number of forms that have been copied successfully prior to three consecutive failures. The scale was scored based upon raw scores.

The Developmental Test of Visual-motor Integration was standardized on children between the ages of 2 and 16 years. Standardization of the test was accomplished by using a group of 1,039 children from Illinois. Fifty-seven percent were from suburban schools, 26 percent from urban schools and 17 percent from rural schools. A correlation of .89 was obtained between scores on the Developmental Test of Visual-motor Integration and chronological age and is presented as evidence of a developmental sequence of items. Test-retest reliability over a 2 week period, obtained from a portion of the standardized population consisting of 171 children from rural schools, was .83 for boys and .87 for girls. These coefficients were obtained from the entire age range.

IV. C. PRETEST AND POSTTEST ASSESSMENTS:

The study was run in three phases: pretest assessments, training and posttest assessments. Pretesting and posttesting took place in the children's school building during actual programming hours. The assessments were conducted individually by a graduate student who was trained in the administration of psychological tests. The examiner was not involved with the actual training and was "blind" to the group assignments of the individual examinees. The subjects were scheduled in advance for administration of the tests and met with the examiner in a private office or conference room. The Block Designs from the Leiter International Performance Scale were first administered, followed by the Block Designs from the Wechsler Intelligence Scale for Children, Revised and the Developmental Test of Visual-motor Integration. The tests were administered according to their corresponding protocols.

IV. D. EXPERIMENTAL ASSIGNMENTS:

The assignment of the subjects to the two groups was based upon the matching of subjects on two dimensions related to performance on the dependent measure: age and Verbal IQ (WISC-R). The two subjects within a pair were required to meet the following two criteria:

1) Verbal Scale IQ (WISC-R) scores within 10 IQ points of each other.

2) Chronological age within 2 years of each other.

When subjects had been paired according to these two criteria, they were randomly assigned to either the self-instruction/component attentional skills group (n=17) or the component attentional skills group (n=17).

IV.E. TRAINING TASKS AND MATERIALS:

Training materials for both groups were identical. The training materials included all 11 items from the Block Design subtest of the WISC-R. All of the subjects in both the groups had the opportunity to work on each of the 11 items (Block Designs of the WISC-R) for one trial.

The posttest measures used to determine generalization were not included in the training of either of the two groups. The posttests, which were not included in training, were the Block Designs from the Leiter International Performance Scale and the Developmental Test of Visual-motor Integration. The following tasks attempted to exercise the subject's ability to generalize the self-instructions to tasks not explicitly included in training:

Training tasks

1. build a small structure from a model with red and white blocks
2. copy the following sentence, "I AM LEARNING SOMETHING NEW" in print.
3. copy a design made with sticks. The sticks of equal size will be laid on the table to form a design.

Corresponding Training materials

1. two sets of five red and white blocks (ie. same blocks as used in the Block Designs of the WISC-R).

2. paper and pencil. As a model, blackboard with the words "I AM LEARNING SOMETHING NEW" written in capital letters on it.

3. set of six equal sized, unsharpened pencils.

1V. F. TRAINING SESSIONS:

The subjects in both groups received eight 40-minute sessions spread over a 1 month period. The number and length of the training sessions were based upon the focused content of self-instruction (ie. visuo-motor reproduction tasks) and previous studies examining the effects of self-instruction training on cognitive, academic and perceptual motor tasks. There is extensive variation in the length and number of training sessions. On one end of the continuum, Bornstein and Quevillon (1976) employed one 2-hour session while, on the other end of the continuum, Douglas, Parry, Marton and Garson (1976) used 24 one-hour sessions. In between, Leon and Pepe (1980) used two 1-hour sessions, Meichenbaum and Goodman (1971) employed 4 half-hour sessions, Camp, Bloom, Herbert and Van Doornink (1975) used 6 half-hour sessions, Kendall and Zuppan (1981) used twelve 55-minute sessions and Robin, Armel and O'Leary (1975) used 20 half-hour sessions.

There were 17 subjects in each of the two groups: self-instruction/component attentional skills group and the component attentional skills group. Each training condition of 17 subjects was broken down into two groups of six subjects and one group of five subjects The use of smaller groups allows for greater individual attention, increased manageability and enhanced participation. Kendall and Wilcox (1980) found that small group instruction was effective due to the readiness of the participants to observe and identify with their peers who were also undergoing treatment.

Three individuals conducted the training including the present writer. The other trainers were graduate students in education with experience in teaching special populations. The possibility of confounding the trainers with the treatments exists if each trainer is assigned to the exclusive training of a particular condition. In order to control for this possibility, each trainer conducted training in both conditions. There were a total of six small groups. Each trainer conducted training in two groups, one in each condition. A total of 48 forty-minute sessions were conducted. Each trainer ran 16 sessions with eight sessions in each condition. Assignments of trainers to sessions were random.

The training of the trainer was done with reference to the script. In an initial meeting with all trainers, the present writer read both scripts out loud with the trainers, answering questions and reinforcing the idea that training must exactly follow the script. Prior to each training session, the present writer met with the specific trainer and read out loud the script for that particular session. A log was kept during training in order to document deviations from the script. Each trainer kept a log which was reviewed by the trainers and the present writer after each training session.

IV.G. TRAINING CONDITIONS:

Self-instruction/Component attentional skills group:

The self-instruction/component attentional skills group received training similar to the procedures employed by Douglas, Parry, Marton and Garson (1976). The subjects were trained to use self-statements and gestures to facilitate more effective visual scanning. Self-instruction was based upon the five-step procedure used by Meichenbaum and Goodman (1971). The procedure attempts to facilitate the internalization of self-statements through modeling, active participation and rehearsal. The following is the training procedure first introduced by Meichenbaum and Goodman (1971).

1) The trainer performs the task talking aloud while being observed by the child.

2) The subject performs the task while the trainer says the instructions aloud.

3) The subject performs the task while saying the instructions aloud.

4) The subject performs the task while whispering.

5) The subject performs the task using covert self-instructions (ie. silently).

The actual content of the self-statements have varied slightly from study to study but basically retain the essence of Meichenbaum and Goodman's four statements. Meichenbaum and Goodman's four self-statements involve task-relevant statements to identify the problem, self-guiding statements to plan an appropriate strategy, self-monitoring statements to evaluate progress and self-reinforcing statements to reward correct performance. The present study used Robin, Armel and O'Leary's self-statements, a variant of Meichenbaum and Goodman's, which includes an additional statement in the form of appropriate directive comments. The statements included an additional component in order to facilitate performance. In this particular study, the performance deficits are the actual motor acts involved in the reproduction of the perceptual stimulus. Robin, Armel and O'Leary (1975) suggest that the subjects ask questions about the task, answer in the form of planning, apply appropriate directive comments, correct errors and use self-reinforcing statements.

Self-instruction training included a component attentional skills component. The emphasis was on improving visual scanning and analysis (ie. component attentional skills) through the use of self-verbalization (ie. self-instruction). Training in component attentional skills was adapted from the procedures used by Egelund (1974) and Douglas, Parry, Marton and Garson (1976). Component attentional skills involves learning to systematically break down a perceptual stimulus into component parts. The procedure also includes visual scanning for mistakes with the possibility that corrections will be required. The self-correction process involves making comparisons between the model and the reproduction.

As part of self-instruction training, the subjects were trained to self-verbalize a five step sequence. Below are the five steps of self-instruction in conjunction with the four steps associated with component attentional skills training which are in parentheses.

1. Questions about the task. (Look at model).

2. Statements in the form of planning. (Visually break down the task into component parts and choose one part. Point to the component).

3. Appropriate directive comment. (Focus on duplicating it).

4. Correction of error. (Compare and point to both the model and the copy to check for accuracy).

5. Self-reinforcement.

Below is an example of the five step self-instruction sequence used in conjunction with component attentional skills training to reproduce a simple Block Design. The following is an example of the procedure that was modeled by the trainer.

1. Question about the task: What is it I have to do? (Look at model).

2. Statements in the form of planning: First, I have to decide where to start. I'll start with the right upper hand corner. What is that? It's a red block! (Point to the red block in the right upper hand corner of the model).

3. Appropriate directive comment: I have to pick up a red block, that's right, and now place it over here. (Focus on duplicating).

4. Correction of Error: That's right. It looks like the model so far. (Point to the block in both the model and the copy).

5. Self-reinforcement: So far, so good.

1. What do I have to do next? (Look at model).

2. I'll place another block and this time I'll go to the upper left hand corner. That's a white block. It goes to the left of the red

block. (Point to the white block in the upper left hand corner of the model).

3. Okay, I'll pick up the white block and put it to the left of the red block. Right over here. (Focus on duplicating).

4. Now, look at the model.....and look at my block.....they look the same. (Point to the block in both the model and the copy).

5. I'm doing well so far.

1. What do I do next?

2. I'll go to the lower right hand corner. That's a white block.

3. Okay, I'll pick up the white block, like this, and put it below the red block.

4. I'll look at the model . . . . and look back at my blocks . . . . Yeah, they look alike.

5. I'm doing a real good job so far.

1. Now, what do I have to do?

2. I have to place the last block. It looks like it goes in the lower left-hand corner. It's a red block.

3. I'll take the last red block, like this, and place it next to the white block and below the white block.

4. Now, I've finished. But, first I have to check my work. Does the model and my blocks look the same. Look at the top right.. . . . .top left. . . . .bottom right . . . . bottom left . . . . .Yup, it looks completely the same.

5. I'm finished and I did a great job.

It should be noted that the above example illustrates the words of the trainer. The subjects were encouraged to use their own words for each of the five steps. A number of researchers have emphasized the importance of allowing the subjects to use the words with which they feel most comfortable. Douglas, Parry, Marton and Garson (1976) attributed their study's success at obtaining generalization results to allowing for a greater compatibility between the subject's actual everyday language and the language they use in self-instruction.

Component attentional skills group:

The component attentional skills group received training similar to the self-instruction/component attentional skills group. As the name suggests and as previously explained, however, the component attentional skills group did not receive self-instruction training. The subjects in this group were trained to facilitate visual scanning and analysis through the use of gestures. The procedure for teaching component attentional skills attempted to parallel the self-instruction/component attentional skills group as closely as possible. The similar procedure in the component attentional skills group attempted to equalize the exposure to training tasks between both groups. It also allowed the subjects in the component attentional skills group to be trained through modeling, active participation and rehearsal as was also the case in the self-instruction/component attentional skills group. The following is the training procedure employed:

1. Modeling: the trainer performed the task while pointing to the four steps of component attentional skills training written on the blackboard and gesturing. The subjects were instructed to point to and outline components of the task as they went along in order to enhance attention and visual perception.

2. The subject performed the task while the trainer pointed to the four steps of component attentional skills training written on the blackboard and gestures: The subject performed the necessary motor movements while the trainer provided the instruction.

3. The subject performed the task while pointing to the four steps of component attentional skills training written on the blackboard and gesturing.

4. The subject performed the task without pointing to the blackboard or gesturing.

5. The subject performed the task without pointing to the blackboard or gesturing.

The four steps of component attentional skills training were written on the blackboard for much of the training. The subjects were asked to refer to these steps during segments of the training. The steps were the same as those used in conjunction with self-instruction in the self-instruction/component attentional skills group. The steps helped the subject break down the model into component parts and approach each as a separate task. It also encouraged the subject to attend to details.

1. Look at the model.

2. Break down visually the model into component parts and choose one component part. Point to that part.

3. Focus on duplicating it.

4. Compare and point to the model and copy to check for accuracy.

IV.H. DATA ANALYSIS:

Analysis of Covariance (ANCOVA) was used as the primary statistical method for testing the hypotheses. ANCOVA is useful in removing extraneous variation from the dependent variable in order to increase the precision of analysis. In cases where the variance is large, the ANCOVA procedure provides greater precision than the Analysis of Variance which may lack the necessary statistical power. The ANCOVA reduces error variance by subtracting out the variance explained by the covariate. The measure used as a control variable is called the covariate.

In the present study, both ANCOVA and a matching selection procedure were employed. The ANCOVA provided a statistical analogue to the matching selection procedure, which is a direct and experimental method for controlling for extraneous sources of variation. In addition, direct control had been introduced into the present study by attempting to increase the uniformity of conditions under which the experiment was conducted.

The ANCOVA was used to analyze the differences between treatment groups on the dependent measure after adjusting for the variance explained by the covariate. In the present study, the effect of two different types of training methods on a number of measures of visuo-motor reproduction were examined. The independent variable is the training method, the dependent variable is the posttest measure and the covariate is the pretest measure. The analysis adjusted for possible initial differences in visuo-motor reproduction performance among the two groups.

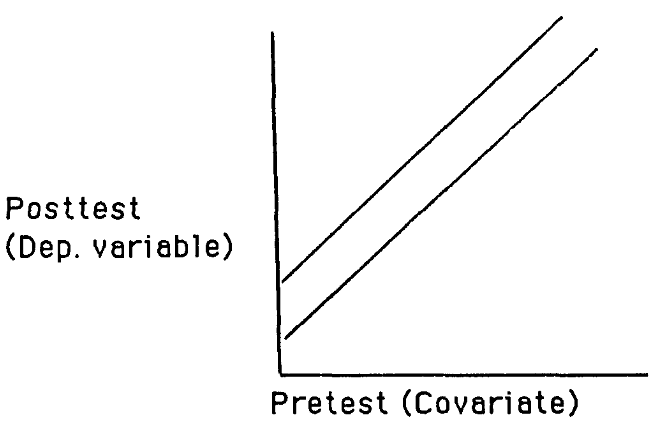
The logic of ANCOVA involves purging the dependent measure of whatever it shared with the covariate (pretest) and then testing for significant differences between the two adjusted groups. The subject's pretest scores can predict their posttest scores on the basis of the regression of posttest scores on pretest scores. If Yij is the actual achievement of individual i in group j then Y'ij is the predicted score. The actual posttest score (Yij) can be subtracted from the predicted posttest score (Y'ij) to yield a residual:
Yij - Y'ij = residual.

All of the individual residual scores taken together produce a set of scores which have zero correlation with the pretest. In other words, the residualized posttest no longer shares any variance with the covariate. A test between the residualized posttest scores of the two training groups will indicate whether the groups differ significantly.

A preliminary step in the statistical analysis of the present study involved calculating a correlation between the pretest (covariate) and the posttest (dependent variable). Statistical evidence indicating a relationship between the covariate and the dependent variable definitively suggests the need for controlling for the extraneous effect of the covariate. If such evidence were lacking, the need for the ANCOVA would be questionable.

In order to provide for more clarity in the interpretation of results, the study employed randomization. The subjects were randomly assigned to training groups after having been matched on the basis of chronological age and verbal intelligence.

An important assumption for the use of the ANCOVA is often referred to as either the equality of slopes or the homogeneity of regression coefficients. ANCOVA depends very much upon this assumption and when the assumption is not met the analysis can be rendered meaningless. Below is a graphic example of the conditions necessary for meeting the assumption of equal slopes. The dependent measure (posttest) is on the abscissa and the covariate (pretest) is on the ordinate. The two treatment groups are plotted below as regression lines and are shown as being parallel to one another.



The assumption is confirmed. The parallel slopes indicate that the effect of the covariate (pretest) is the same in both training groups. When the slopes are unequal, it means that the differences between groups vary for the different values of the covariate (pretest). Another way of conceptualizing the assumption involves the application of a common regression coefficient (b) in the process of adjusting for the covariate. The use of a common regression coefficient is based upon the assumption of homogeneous regression coefficients for the groups. The assumption is that regression of the dependent variable on the covariate in each group is not significantly different.

The assumption of homogeneous regression coefficients is examined by testing the homogeneity of the b weights between the two groups. If the F test indicates that the regression coefficients do not differ significantly, the assumption is satisfied and the use of a common regression coefficient is justified. In this case, the ANCOVA can proceed. If, however, the regression coefficients differ significantly, an alternative method may be necessary.

The Johnson-Neyman technique can be used as an alternative method to establish regions of significance. The technique makes it possible to state within what ranges of the covariate scores, subjects from the different groups differ significantly on the dependent variable. It also determines within what range of the covariate, subjects from the different groups do not differ significantly on the dependent variable.

Assuming that the use of a common regression coefficient is justified, ANCOVA can be employed. The ANCOVA tests whether the training methods add significantly to the proportion of variance accounted for after allowance is made for the covariate. In order to determine the proportion of variance, the difference between Ryx_1x_2c and the Ryc is tested for significance. The y represents the dependent variable, the c stands for the covariate and the x_1 and x_2 are coded vectors representing training groups.

$$\underline{F} = \frac{(Ryx_1x_2c - Ryc/(g-1)}{(1 - Ryx_1x_2c) / (N - g - 1)}$$

Where g is the total number of groups and N is the total number of subjects. The Ryc indicates the proportion of variance accounted for by the covariate. The degree to which Ryx_1x_2c exceeds Ryc indicates the additional variance accounted for by the training groups.

V. RESULTS

A t test indicated that the differences between group means on all of the three pretests were not significant. Table 1 contains the pretest means and standard deviations for the two groups on all three of the pretests. The three pretests are the Block Design subtest, Wechsler Intelligence Scale for Children, Revised (WISC-R), the Block Designs, Leiter International Performance Scale (LIPS) and the Developmental Test of Visual-motor Integration (DTVMI). The experimental control exerted by random assignment and the matching of subjects on verbal IQ (WISC-R) and age in the two groups probably contributed to the lack of significant pretest differences between groups.

A preliminary step was conducted to determine the need for performing an analysis of covariance (ANCOVA). The results indicate a strong statistical relationship between the covariates and the dependent variables. The correlation between the covariate (pretest) and the posttest for the Block Design of the WISC-R was .83. The correlation between the covariate (pretest) and the posttest for Block Designs from the LIPS was .59. The correlation between the covariate (pretest) and posttest for the DTVMI was .97. All of these correlations were significant at less than .01, indicating a strong relationship between the covariate and the posttest for each of the three dependent variables (See Table 2)..

The assumption of the equality of slopes or the homogeneity of regression coefficients was examined through a stepwise regression analysis. The stepwise regression analysis tested whether the interaction effect between the group variable and covariate added significantly to the regression equation.

The t test for adding the interaction variable to the regression equation for the Block Design (WISC-R) was nonsignificant, $\underline{t}(34) = .12$, $\underline{p} > ,05$. The t test for adding the interaction variable to the regression variable was nonsignificant for the Block Designs (LIPS), $\underline{t}(34) = .70$, $\underline{p} > .05$. The t test was also not significant for the DTVMI, $\underline{t}(34) = .40$, $\underline{p} > .05$. The t tests indicated that the regression coefficients did not significantly differ for each dependent variable, that the use of a common regression coefficient was justified and that the ANCOVA could proceed.

The ANCOVA was used to analyze the differences between the two training groups on the dependent measures after controlling for individual group differences by covarying out the effects of the pretest from the posttest. Analyses of Covariances were conducted on the posttest measures for each of the three hypotheses.

The first hypothesis postulated that the Self-instruction/component attentional skills (SI-CAS) group would show a significant increase on the Block Design subtest (WISC-R) compared to the component attentional skills (CAS) group. The pretest scores served as the covariate. The results indicate a significant group effect, $\underline{F}(1, 34) = .009$, $\underline{p} < .01$. Table 3 presents the results of the analysis of covariance for the first hypothesis.

The results of the Analysis of Covariance for the second hypothesis are presented in Table 4. The hypothesis states that the SI-CAS group would exhibit a significant increase on the Block Designs (LIPS) compared to the CAS group. Again, the pretest scores served as the covariate. The group effect was significant, $F(1, 34) = .003$, $p < .01$.

The third hypothesis postulated that the SI-CAS group would show a significant increase on the Developmental Test of Visual-motor Integration. As before, the pretest was the covariate. The group effect was not significant, $F(1, 34) = .57$, $p > .05$. The results of the Analysis of Covariance for the third hypothesis are presented in Table 5.

The results indicate that the first two hypotheses were confirmed. The third hypothesis, however, was not confirmed.

VI. DISCUSSION

Three hypotheses were examined in the present study. The first hypothesis compared the effectiveness of self-instruction/component attentional skills (SI/CAS) training to component attentional skills (CAS) training in improving cerebral palsied children's performance on a visuo-motor reproduction task that was also used in training. The dependent measure that was also used as a training task was the Block Design subtest of the Wechsler Intelligence Scale for Children, Revised (WISC-R). The second and third hypotheses examined the effectiveness of the SI/CAS group compared to the CAS group in promoting generalization of training effects to visuo-motor reproduction tasks that were not included in training. Specifically, the second hypothesis compared the performance of the two groups on the Block Designs from the Leiter

International Performance Scale (LIPS). The third hypothesis compared the performance of the two groups on the Developmental Test of Visual-motor Integration (DTVMI).

The SI/CAS group exhibited significantly improved performance compared to the CAS group only on the dependent measures in the first two hypotheses but not on the dependent measure in the third hypothesis. SI/CAS training proved to be significantly superior to the CAS group on the Block Designs (WISC-R), also used in training, and the Block Designs (LIPS), which was employed as a generalization measure. SI/CAS training, however, did not significantly improve performance on the DTVMI, which was also used as a generalization measure. In summary, subjects in the SI/CAS group significantly improved performance on the training task and the first generalization measure but not on the second generalization measure.

The results suggest that the self-instruction component of SI/CAS training was effective in improving the cerebral palsied children's performance on visuo-motor reproduction tasks. Subjects in both groups received similar training in as many respects as possible except that only the experimental group (SI/CAS) received training in self-instruction. Since both groups received the same training in component attentional skills, the intent and result of the study was to demonstrate the important impact of self-instruction on the visuo-motor reproduction performance of cerebral palsied children.

The assertion that the self-instruction component of SI/CAS training promoted the group differences, as opposed to possible alternative explanations, receives support in two important ways. First, as previously mentioned, both groups were designed to be as equivalent as possible while adding only self-instruction to the experimental group.

In addition to the self-statements, the self-instruction training method includes various combinations of modeling, overt and covert rehearsal, prompting, feedback and social reinforcement. It is possible that any of the above components of the self-instruction training procedure could be the active ingredient which accounts for the treatment effect.

In self-instruction research, modeling, in particular has been postulated to be the active ingredient. As such, all teaching methods associated with self-instruction were included in the training procedures of both groups with, of course, the exception of the actual self-statements. In order to further ensure that the self-instruction component of the SI/CAS training produced the results, both groups were also designed to be equivalent on the amount of training, the training materials used, approach and language of instruction, group size and composition and the teaching procedure used to instruct the subjects.

The second justification for the assertion that self-instruction was the actual active ingredient is based upon several observations from the trainers suggesting that children were actually employing the self-statements. Many of the subjects in the SI/CAS group were observed to move their lips, as if talking to themselves, during the posttest sessions. These informal observations suggest that the self-statements were actually being employed by those trained to use them.

The present study's design and the informal observations collected suggest that the self-instructions may have been instrumental in producing the results. The effectiveness of the self-statements used in the SI/CAS group may also be attributable to modifications introduced into the procedure. The original self-instruction procedure, developed by Meichenbaum and Goodman (1969, 1971), was modified to directly address the specific task requirements of the visuo-motor reproduction task. The training procedure was specifically designed to improve performance on tasks requiring the coordination of vision and motor movements in reproducing a standard.

The present procedure was based upon the modification introduced in the Robin, Armel and O'Leary (1975) study wherein the researchers successfully improved the letter copying performance of kindergarten children with demonstrated writing deficiencies. The use of spatial self-verbalizations were included to help guide motor movements and overcome performance deficiencies.

Many previous self-instruction research studies included visuo-motor reproduction tasks only as one dependent measure among many different types of dependent measures. These studies generally employed Meichenbaum and Goodman's (1971) self-instruction procedure and often did not obtain significant results on the visuo-motor reproduction task (Camp, Bloom, Herbert and van Doorninck, 1977: Douglas, Parry, Marton and Garson, 1976). Most of the research reported in the self-instruction literature which successfully modified performance on such visuo-motor reproduction tasks as the Block Design (WISC-R) were either with a different population (Litrownik, 1981) or were single case studies (Luria and Tsvetkova, 1964).

The effectiveness of the SI/CAS training group was probably also enhanced by the length and content of the training procedure. All subjects received training in eight 40-minute sessions. While the intensity of self-instruction training varies a great deal from one study to another, it appears that the present number of sessions was adequate for establishing treatment effects. Previous research has also indicated that active involvement in training is essential for obtaining maximum learning (Meichenbaum and Asarnow, 1979). Training in the present study focused on providing as much active involvement through group participation and practice as possible.

In the present study, generalization effects were obtained for the Block Designs (LIPS) but were not obtained for the DTVMI. The results of prior studies utilizing self-instruction have been equivocal in achieving generalization of training. The present study incorporated into its design a number of variables that were embodied in prior studies that found generalization of training. Brown, Campione and Murphy (1977) note the need for direct training to teach the skill of generalization. In the present study, subjects were presented with tasks that involved applying self-instruction to types of visuo-motor reproduction tasks that were not explicitly practiced in training. As such, subjects were provided with practice in problem-solving various applications to new visuo-motor reproduction tasks.

Douglas, Parry, Marton and Garson (1976) documented generalization in their self-instruction study and attributed the outcome to encouraging children to verbalize strategies in their own words. Subjects were encouraged in the present study to verbalize strategies in their own words in order to facilitate the development of "cognitive representations" of the new task (Denney, Denney and Ziobrowski, 1973). Encouraging the use of the subject's own language allowed for increased conceptual integration into the subject's own existing cognitive framework.

The ages of the children in the present study were also considered in order to ensure the developmental basis for generalization. Meichenbaum and Goodman (1969) found that silent self-verbalizations were more effective with children in the first grade than children of kindergarten age in improving performance on a tapping task. Higa, Tharp and Calkins (1978) also obtained results suggesting that verbal self-directed responding only developed after the age of 5 1/2 years. Other researchers have also stressed the importance of considering subject variables such as age in the development of self-instruction studies (Copeland, 1981; Craighead, Meyers and Craighead, 1985).

The developmental basis for generalizing to new tasks was considered in the present study. All subjects were 7 years of age or older. The possibility, however, exists that as the demands of generalizing to new tasks increases, as it did with the DTVMI, that additional developmental requirements became necessary. The cognitive maturity of the subjects, as defined by their performance on Piagetian conservation tasks, has also been found to be related to generalization of self-instruction training (Nichol, Cohen, Myers and Schleser, 1982; Schleser, Cohen, Meyers and Roderick, 1984).

While a measure of verbal intelligence was incorporated in the present study, no assessment of the subject's performance on conservation tasks was included. In the present study, subjects were matched on verbal IQ as assessed by their performance on the Verbal Scale of the WISC-R. However, the lack of direct assessment of cognitive maturity as specified in the literature may have introduced subjects into the study who had difficulty generalizing to the most dissimilar task.

A number of researchers have emphasized the importance of similarity between training tasks and assessment tasks (Abikoff, 1979; Borkowski and Cavenaugh, 1979). Swanson (1985) found generalization on only math and spelling items that were highly similar to those taught in self-instruction training. Other studies report similar results (Bryant and Budd, 1982; Douglas, Parry, Marton and Garson, 1976; Leon and Pepe, 1983), suggesting that generalization tasks should share common features with training tasks.

The need for similarity between generalization tasks and training tasks may explain why generalization was obtained for the Block Designs (LIPS) but not for the DTVMI. The training consisted largely of practice on the Block Design subtest (WISC-R). The Block Designs (WISC-R) and the Block Designs (LIPS) are similar tasks in that they both require subjects to assemble a design using blocks that are identical to a picture standard. Although they are dissimilar in that they use different designs and task materials, they are essentially similar in that they require similar component skills: the motoric manipulation of blocks to reproduce a picture standard. The DTVMI, however, is a paper and pencil task that involves copying a picture design into a test booklet. The tasks requires the motoric manipulation of a pencil to reproduce the picture.

All tasks involved fall within the definition of a visuo-motor reproduction task since they require the coordination of vision and motor movements in the reproduction of a standard. However, it is clear that writing with a pencil was introduced into the DTVMI task as a new component skill and that that skill was not required in the other generalization task or the majority of training activities. While the training sessions attempted to take the dissimilarities into account by providing some practice on visuo-motor reproduction tasks that require the use of a pencil, it is apparent that generalization training with a pencil was not sufficient to ensure competence in paper-and-pencil reproduction.

The limited generalization results of the present study may also be due to the brain-impaired population used in the present study. Limited research has been conducted on the ability of brain-impaired children to generalize self-instruction training. As such, the possibility that their disability affected their ability to generalize must be taken into account.

In general, the results of the present study suggest that self-instruction training is effective in modifying the visuo-motor reproduction performance of children with cerebral palsy. The lack of research in this area is related to the view that dependent measures that are associated with stable ability factors may not be responsive to self-control strategies. Block Design tasks have been implicated in the prediction of lesions in the posterior region of the brain. According to this view, limitations associated with brain damage, such as performance on Block Designs, would not be amenable to change through self-instruction training.

The present results provide evidence indicating that performance on measures closely associated with brain deficits can be altered through self-instruction training. The research further supports the notion that cognitive behavioral remediation may be removed from the original physiological and/or neurological causes.

The training effects that were obtained may not have been the result of the direct influence of self-instruction on the subjects' impaired visuo-motor reproduction abilities but may also have been the result of improvements in the subjects' task approach. The present study does not indicate how the cerebral palsied children's' performance was improved. Evidence from other research, however, indicates that cerebral palsied children's' difficulties on visuo-motor reproduction tasks may not be exclusively a perceptual deficit but rather a difficulty in translating perceptual stimuli into motor behavior.

Although no direct evidence supports the idea that the present training in self-instruction provided a means for translating perceptual stimuli into motor behavior, the translation interpretation provides a reasonable framework for conceptualizing the impact of self-instruction on the visuo-motor reproduction performance of children with cerebral palsy. The possibility exists that the cerebral palsied child with deficient performance on such tasks as the Block Design could help facilitate performance by using language as an intermediate step between perception and motor behavior. The use of spatial language could help the cerebral palsed child motorically interpret the Block Design.

Educational significance:

The cerebral palsied child's success in school is dependent to a large degree upon the mastery of visuo-motor reproduction skills. Children with cerebral palsy exhibit academic skills that are below the level that would be expected based solely upon their IQ scores. Perceptual motor deficits are thought to contribute to these academic deficiencies. In particular, children with cerebral palsy have been found to exhibit poor performance on tasks that require the coordination of vision and motor movements in the reproduction of a standard. The ability to reproduce symbols without distortion underlies the acquisition of basic academic skills such as reading, writing and arithmetic.

The present study provides evidence for a method for improving their performance on visuo-motor reproduction tasks, which is the basis for the acquisition of more academically-oriented skills. The results support the proposition that cerebral palsied children can be taught to be the primary agents in controlling their own behavior. Previous approaches to the remediation of visuo-motor reproduction skills have focused upon the teacher or the therapist as the principal source of behavioral change. While environmental changes are not ruled out by the study's support of self-instruction, its influence is deemed less necessary since the technique attempts to teach cognitive strategies that are adaptable to changes in the environment.

The modification of internal cognitive processes is particularly appealing since it may allow classroom personnel additional time to teach other important skills in the classroom. The locus of control is also placed within the individual, allowing children to take advantage of their own personal resources and ultimately enhancing their sense of self-efficacy and self-esteem. This is particularly important for children with developmental disabilities since assistance is often sought from external sources.

Previous research has not directly addressed self-instruction's applicability to cerebral palsy and visuo-motor reproduction tasks. The present study adds to the educational psychology literature by extending self-instruction to a new population's performance on a new type of task. The study helps expand conclusions regarding the widespread clinical and educational utility of these techniques.

The applicability of results, however, should not be extended beyond the parameters of the study. The children in the study were between the ages of 7 and 17 with intact hearing and vision and with Verbal Scale IQ's (WISC-R) above 80. Although not primary factors in the diagnosis of cerebral palsy, brain lesions associated with cerebral palsy can result in sensory deficits, severe mental deficiencies, behavior problems and convulsions. Any of these deficits could potentially interfere with the ability of the child to benefit from self-instruction training. As previously reported, the age of the subject can also affect responsiveness to training.

The children included in the present study do not represent the great variation that exists among those who are diagnosed with cerebral palsy. Those diagnosed with cerebral palsy include many persons who do not meet the present study's requirements for age, sensory functioning and verbal intelligence. Therefore, extreme caution should be exercised in applying these results since they are relevant only to a subgroup within the cerebral palsy diagnostic category.

Future research:

The present study represents only one effort to establish the educational limits of self-instruction. Hobbs, Moguin, Tyroler and Lahey (1980) note the limited range of populations and problems to which self-instruction has traditionally been applied. The authors call for additional self-instruction research to determine the limits of its utility. The present results provide evidence for the effectiveness of self-instruction training with cerebral palsied children and further research should examine its application to other populations.

The present study specifically addresses the deficits associated with a particular neurologically-based disability. Research has been limited in the area of self-instruction and developmental disabilities due largely to certain assumptions concerning the limited applicability of self-instruction training to brain-impaired populations. Further empirical investigations should attempt to examine the relationship of self-instruction training to brain injury and to isolate the mechanisms through which the method has its impact.

The present study received only partial support for generalization of self-instruction training. Only one of the two generalization measures received support in the results. A number of hypotheses were previously postulated as to why the Block Designs (LIPS) received support and the DTVMI did not receive support. One particularly salient argument is that the generalization measure that received significant results was similar to the training tasks while the other generalization measure was dissimilar and introduced a new component skill.

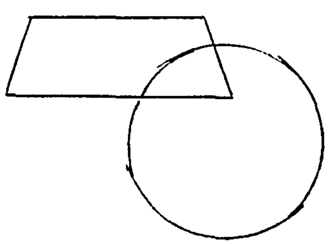
Further research needs to address the conditions under which generalization is most efficiently promoted. In particular, the relationship between training and the dependent measures needs to be further explored.

APPENDIX A: Scripts of Training Conditions

Script for self-instruction/component attentional skills training group:

Session 1:

The first session emphasizes the development of rapport between the trainer and the subjects in the group. The trainer introduces himself and asks that all members of the group introduce themselves. A discussion is initiated that focuses on the purposes of the training. A trapezoid (ie. a quadrilateral having two parallel sides) with an intersecting circle is drawn on the blackboard.



The trainer says:

> Who would have trouble copying these two forms on the blackboard. (Pause for responses). Probably most of you would have some difficulty copying it. The goal of this group will be to improve our copying skills. And when I say that, I mean copying all sorts of things. In this group, we will practice different kinds of copying, not only copying a design with paper and pencil but also copying a design with blocks, copying a written sentence, copying a design with sticks

and other kinds of copying activities. You'll see better what I mean later.

We will be learning to use a new approach to copy. This new approach will hopefully help you to improve your copying skills. The approach is called self-instruction or what we will call "self-talk". (In order to simplify, this training condition will be referred to as "self-talk" to members of the group). The approach called "self-talk" will have us breaking down copying tasks into smaller parts while having us talk our way through the task. It should help us better plan and think about our task.

I'll be meeting with others of your classmates who will be learning other approaches to activities involving copying. All of you have been given tests that involve copying. You'll be given them again at the end of the training sessions to see how much you have improved. We'll be comparing this group's improvement using "self-talk" to the improvement of the other group using another type of approach. This will show us which approach is most useful.
Remember, it's important that we not discuss the things you learn in this group with your classmates. That would confuse things and make it difficult for us to understand what's going on here.

The first session also presents an overview of self-instruction/component attentional skills training. The self-instruction/component attentional skills training steps are written on the blackboard and verbally reviewed by the trainer. The self-instruction steps are written first. The component attentional skills steps follow and are written in parentheses.

1. What do I have to do? (Look at the model).
2. Anwser in order to plan. (Break down the model visually into component parts and choose one component part. Point to that component part).
3. Self-talking to guide. (Focus on duplicating).
4. Are there any errors? (Compare and point to model and copy to check for accuracy).
5. How did I do? (Good Job!)

The steps are explained and reviewed twice during the first session.

Session 2:

The second session focuses on modeling and the active participation of subjects. The practice tasks used in this session are the first, second, third and fourth Block Designs from the WISC-R.

All subjects in the group practice each of these four Block Designs once. The procedure involves five steps:

1. Modeling: The trainer gestures and self-instructs while performing the task.

2. The trainer gestures and says the instruction aloud while the subject performs the task.

3. The subject gestures and says the self-instructions aloud while performing the task.

4. The subject gestures and whispers self-instructions while performing the task.

5. The subject gestures and silently self-instructs while performing the task.

1. Modeling: The trainer self-instructs while performing the task: The trainer uses the first Block Design from the WISC-R in order to demonstrate the self-instruction/component attentional skills method.

1. Question about the task: What is it I have to do? (Look at the model).

2. Statements in the form of planning: First, I have to decide where to start. I'll start with the upper right-hand corner. What is that? It's a red block! (Point to red block in upper right-hand corner of model).

3. Appropriate directive comment: I have to pick up a red block, that's right, and now place it over here. (Focus on duplicating).

4. Correction of Error: That's right. It looks like the model so far. (Point to red block in both the model and the copy).

5. Self-reinforcement: So far, so good.

1. What do I have to do next? (Look at model).

2. I'll place another block and this time I'll go to the upper left

hand corner. That's a white block. It goes to the left of the red block. (Point to white block in the upper left-hand corner of the model).

3. Okay, I'll pick up the white block and put it to the left of the red block. Right over here. (Focus on duplicating).

4. Now, look at the model.....and look at my block.....they look the same. (Point to the white block in the model and also in the copy).

5. I'm doing well so far.

1. What do I do next? (Look at model).

2. I'll go to the lower right-hand corner. That's a white block. (Point to white block in the lower right-hand corner).

3. Okay, I'll pick up the white block, like this, and put it below the red block. (Focus on duplicating).

4. I'll look at the model . . . . and look back at my blocks . . . . Yeah, they look alike. (Point to white block in model and white block in the copy).

5. I'm doing a real good job so far.

1. Now, what do I have to do? (Look at model).

2. I have to place the last block. It looks like it goes in the lower left-hand corner. It's a red block. (Point to red block in lower left-hand corner of the model).

3. I'll take the last red block, like this, and place it next to the white block and below the white block. (Focus on duplicating).

4. Now, I've finished. But, first I have to check my work. Does the model and my blocks look the same. Look at the top right.. . . . .top left. . . . .bottom right . . . . bottom left . . . . .Yup, it looks completely the same. (Point to all the blocks in both the model and the copy).
5. I'm finished and I did a great job.

2. <u>The Trainer gestures and says instructions while the subject performs the task:</u>

The first Block Design from the WISC-R is also used for this demonstration. The same guidance through self-instruction/component attentional skills is provided by the trainer as above while the subject performs the motor movements necessary to the complete the Block Design. A volunteer is selected from the group to initiate the demonstration. The demonstration is repeated for all of the remaining members of the group.

3. <u>The subject gestures and self-instructs aloud while performing the task:</u>

The second Block Design from the WISC-R is used at this stage of the training. The subjects overtly self-instruct while performing the Block Design one at a time in a serial fashion. The subjects are asked to volunteer. Prior to beginning the self-instruction/component attentional skills, each subject is reminded that the steps are written on the blackboard.

Now it's your turn to self-talk through the task by yourself. You will each take a turn. Remember the steps: What do I have to do, answer in terms of planning, self-talk yourself through the task, are there any errors and how did I do? Don't forget to point as you talk your way through the task. Also, remember to do one block at a time. Describe what you have to do before you do it and describe what you're doing while you're doing it. Okay, who will be the first person to volunteer.

4. <u>The student whispers the self-instructions without gesturing while performing the task:</u>

The third Block Design from the WISC-R is used in this exercise. The subjects are each given four red and white blocks and the appropriate stimulus card. The desks of all the group members are spaced far enough apart from each other to minimize interference. The steps are again verbally reviewed by the trainer. They also remain written on the blackboard.

Now we are going to do another design but this time we are going to whisper our words to ourselves. (The trainer demonstrates a whisper).

5. <u>The subject self-instructs silently without gesturing while performing the task:</u>

The fourth Block Design from the WISC-R is used for this exercise.

The subjects now are asked to silently say the self-instructions without gesturing at the blocks. The self-instruction/component attentional skills steps are again reviewed and remain on the blackboard.

Now we are going to practice another design. This time we are going to say the self-talk to ourselves silently. Don't whisper.....say the "self-talk" to yourself. We will not point to the blocks this time. But remember to stick to the five steps just as before and don't leave anything out.

Session 3:

Who remembers from the last time we met what the five steps of "self-talk" are.

The trainer reviews the five steps. Following the verbal review, the five steps are written on the blackboard.

1. Modeling: the trainer gestures and says the self-instructions aloud while performing the task:

The fifth Block Design from the WISC-R is used as a demonstration.

2. The subject gestures and says the self-instructions aloud while performing the task:

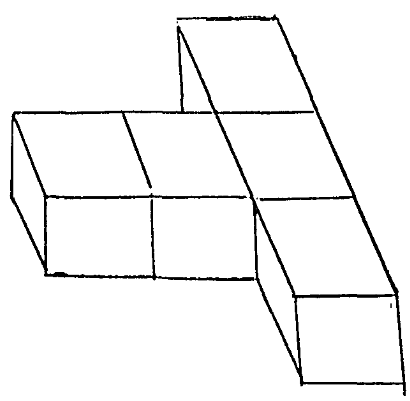
The fifth Block Design from the WISC-R is again used in this demonstration. The subjects volunteer to perform the self-instructions in a serial fashion aloud in front of the rest of the group.

3. The subject whispers the self-instructions without gesturing while performing the task:

The sixth Block Design from the WISC-R is again used in this exercise. The subjects each are given a set of four red and white blocks and the appropriate stimulus card. The subjects all perform this task simultaneously. The desks of all the subjects are spaced far enough apart from each other to minimize interference. The trainer goes around from desk to desk listening and, if necessary, prompting the subjects to whisper the self-instructions.

Session 4:

So far we have been practicing by copying blocks from a piece of paper. But this approach can be used with all copying tasks. Today, we are going to again practice with blocks but instead of copying from a design on a piece of paper, we are going to copy a shape that I will make out of blocks. When we copy it, we have to try and make it as much like the model as we can. This means copying the sides as well as the tops of the model. Remember the five steps of "self-talk". (The five steps will be reviewed verbally by the trainer and then written on the blackboard). Okay, I'll first do the "self-talk".



1. Modeling: the trainer gestures and says the self-instructions while performing the task:

1. What do I have to do? (Look at the model).

2. I have to copy these blocks and decide where I have to start first. I'll start with the block at the top right of the T. (The blocks are oriented toward the trainer so that it looks like a T). Now, the red side is on the top (point to the block), the white side is in the front (point to the block), the red side is also in the back (point to the block) and the half red and half white is on the right side (point to the block). On this side of the block, the red half is on the right side (point to the side) and the white half is on the left side (point to the side of the block).

3. Okay, now I have to place the blocks. I'll take the red block and put it on top . . . .good . . .now, I'll turn it so the white is in the front . . . .that's it. . . . . now, make sure that the red side is in the back. . . .okay . . . .and now make sure that the half red and white side is on the right . . . . .good. . . . .and make sure that the red half is on the right side and the white half is on the left side.

4. Are there any errors? I have to compare with the model. . . . okay, the red is on top like in the model (point to the block in both the model and the copy). . . . . .the white is in front like in the model (point to the block in both the model and the copy) . . . . . the red is in the back (point to the block in both the model and the copy) . . . . . and the red and white is on

the side with the red half on the right and the left half on the left (point to the block in both the model and the copy).

5. Good, I did a good job on the first block.

1. What do I do next?

2. I have to choose the next block? I'll do the one next to it. Now, the red is on top and the red and white block is in the back (point to the block). The red and white block has the red on the right (point to the block) and the white on the left (point to the block).

3. Okay, now I have to place the blocks . . . . .okay, put the block down to the left of the first block . . . . . .turn the block so that the red is on top . . . .good . . . . .now . . . . .now turn the block so that the red and white block in the back has the red on the right and the white on the left.

4. Are there any errors? The red is on top like in the model (point to block in both model and copy). . . .Good . . . . .the mixed side is on the back (point to both model and copy) with the red on the right and the white on the left (point to the sides of the block in both the copy and the model) . . . . . . .Okay.

5. So far, so good.

(Two of the five blocks have been placed so far. The trainer continues to demonstrate the placement of all five of the blocks using the same method).

2. <u>The subject gestures and self-instructs aloud while performing the task:</u>

The same generalization task is used in this exercise. Each subject takes a turn to gesture and self-instruct aloud.

3. The subjects self-instructs silently without gesturing while performing the task:

The same generalization task is again used in this exercise. The subjects silently self-instruct while performing the task at their respective desks.

Session 5:

The five steps involved in self-instruction/component attentional skills are again reviewed by the trainer. At this point, the five steps are not written on the blackboard. The subjects are asked to remember them. The first exercise of this session involves the seventh Block Design of the WISC-R. The subjects are asked to self-instruct silently without gesturing while performing this task at their seats.

> Now, we are going to do another task that many of you probably do everyday in your classrooms. We are going to write with paper and pencil (At this point, paper and pencils will be distributed). We are going to copy a phrase that I am going to write on the blackboard. (The phrase, I AM LEARNING SOMETHING NEW, will now be written on the blackboard). This says, "I am learning something new". Now, we are going to learn to copy these letters using the same method we used before. For many of you, this is very familiar and you will have no problem copying the phrase. But, we are going to

see if we can improve our work and make it more like what's written on the blackboard. I will first demonstrate.

1. <u>Modeling: The trainer self-instructs while performing the task:</u>

1. Okay, what do I have to do? (Look at the model)

2. I have to copy this phrase, I AM LEARNING SOMETHING NEW, by starting with the letter on the left. That letter is I. The letter is a straight line with a little line crossing on the top and on the bottom (point to the letter, I and outline it with finger).

3. Now, I will copy the letter, I. First, I have to place my pencil on the left side of the paper . . . . ..the pencil should be at the top of the line margin . . . . . . and draw down in a straight line to the bottom of the line margin. . . . . now I have to place my pencil a little to the left of the letter on the top line margin. . . . . . and draw across in a short straight line . . . . . . okay, now I'll do the same thing on the bottom . . . . . .place the pencil a little to the left of the letter on the top line margin . . . .and draw across in a straight line . . . . . .Good.

4. Check for errors. Okay, the letter looks like the model . . . . . there is a straight up-and-down line and two short straight lines on the top and bottom. (While self-instructing, outline the letter with finger in both the model and the copy).

5. Good job.

1. What do I have to do next? (Look at model).

2. I have to copy the next letter. . . .that's the A of the next word. There's first a space before the letter. Then I have to start at the top of the line margin and draw a straight line down with a slant to the left. Then I have to do the same thing of the right. Then I connect the two slanted lines with a straight line across. (Point to the letter, A, and outline it with finger).

3. Now, I have to write the letter A. First, make sure there is a space before it . . . . . .make sure the space is big enough . . . . go to the top of the line margin . . . . . . okay, draw a straight line down with a slant to the left . . . . . go all the way down to the line margin and place the pencil . . . . . . now draw a straight line down with a slant to the right. . . go all the way down to the bottom of the line margin.

Now, go to the left slanted line and draw a straight line across to the right slanted line. . . . .good.

4. Now, are there any errors? Okay, the letter looks like the model. . . . . .There are two lines that slant away from each other and connect at the top. The two slanted lines are connected by a straight line. (While self-instructing, outline the letter in both the model and the copy).

5. Good job.

(The rest of the sentence will be completed in the above manner).

2. <u>The subject gestures and self-instructs aloud while performing the task:</u>

The same sentence is used as above ie. I AM LEARNING SOMETHING NEW. Each subject takes a turn to gesture and self-instruct aloud.

3. <u>The subject silently self-instructs without gesturing while performing the task:</u>

The same sentence is used as above. Subjects silently perform the task while seated at their desks.

<u>Session 6:</u>

The five steps of self-instruction/component attentional skills are again verbally reviewed by the trainer. Again, the steps are not written on the blackboard and the subjects are asked to remember them. The first exercise involves the eighth Block Design from the WISC-R. The subjects are all given materials and asked to silently self-instruct without gesturing while performing the task at their desks.

The second exercise of the session involves the ninth Block Design of the WISC-R. This Block Design is different than those Block Designs previously practiced in that it involves the reproduction of 9 blocks as opposed to just 4 blocks.

> So far, we have been copying blocks that involve four blocks. Today, we will be practicing the copying of nine blocks. The same method will, of course, still apply.

1. Modeling: The trainer gestures and self-instructs will performing the task.

2. The trainer gestures and self-instructs while the subject performs the task.

3. The subject gestures and self-instructs aloud while performing the task.

4. The subject whispers self-instructions without gesturing while performing the task.

5. The subject silently self-instructs without gesturing while performing the task.

Session 7:

The five steps involved in self-instruction/component attentional skills are again reviewed. The steps are not put up on the blackboard. The first exercise in this session is the tenth Block Design from the WISC-R. Materials are distributed to all subjects in the group. This Block Design again involves nine blocks.

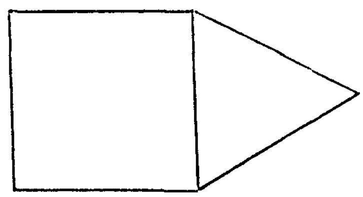
1. The subject whispers the self-instructions without gesturing while performing the task: The trainer goes around the room listening to the self-instructions. Direction is provided so as not to abbreviate the self-instructions.

The second exercise involves the eleventh Block Design from the WISC-R. The same materials are used for this exercise.

1. The subject silently self-instructs without gesturing while performing the task: The trainer emphasizes the importance of practicing the method outside of the group. Examples are given of possible applications in the classroom.

Session 8:

The five steps involved in self-instruction/component attentional skills are again reviewed during this session. A new generalization exercise is introduced. The exercise involves the construction of a simple design with pencils. Six pencils are used to construct the following simple design:



1. Modeling: the trainer gestures and says the self-instructions while performing the task:

   1. What is it I have to do? (Look at the model).
   2. I have to copy the design with pencils? I'll first start with the pencil on the bottom. That pencil is laid straight across. (Point to the pencil on the bottom and outline its direction with finger).

3. Okay, now I have to place the pencil. Okay, I'll pick up the pencil and place it so that it is laying straight across.
4. Are there any errors? Well, the pencil is laid across just like in the model. (While self-instructing, point to and outline the pencil in both the model and the copy).
5. So far, so good.

1. What do I have to do next? (Look at the model).
2. I have to decide where to go from here. I'll do the pencil on the right that is connected to the bottom pencil. That pencil is laid straight up-and-down with the bottom end of the pencil touching the bottom pencil. (Point to the pencil and outline its direction with finger).
3. Okay, now to place the pencil. I'll pick up the pencil and lay it down so that it's straight.....and lying up-and-down ..... and connected with the bottom pencil.
4. Are there any errors. Well, the pencil is laid straight up-and-down like in the model. (While self-instructing, point to and outline the pencil in both the model and the copy).
5. Good job.

(The trainer will complete the task in the same manner by placing the remaining four pencils).

1. <u>The subject whispers the self-instructions without gesturing while performing the task:</u> The same generalization task is used as above.

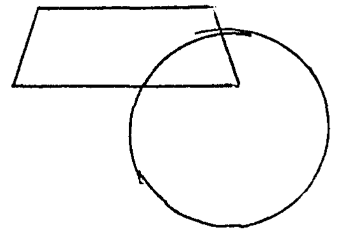
2. <u>The subject silently says the self-instructions without gesturing while performing the task:</u> The same generalization task is used as above.

The trainer attempts to engage group members in a general discussion of self-instruction/component attentional skills. Feedback regarding its usefulness is elicited. A review is provided of the definition of visuo-motor reproduction tasks and all group members are encouraged to apply these methods to within those parameters.

Script for component attentional skills training group:

Session 1:

The first session emphasizes the development of rapport between the trainer and the subjects in the group. The trainer introduces himself and asks that all members of the group introduce themselves. A discussion is initiated that focuses on the purposes of training. A trapezoid (ie. a quadrilateral having two parallel sides) with an intersecting circle is drawn on the blackboard.



The trainer says:

Who would have trouble copying these two forms on the blackboard. (Pause for responses.) Probably most of you would have some difficulty copying it. The goal of this group is to improve our copying skills. And when I say that, I mean all sorts of copying. In this group, we will practice different kinds of copying, not only copying a design like this one with paper and pencil but also copying a design with blocks, copying letters, copying a design made of pencils and other kinds of copying activities. You will see better what I mean later.

We will be learning to use a new approach to copying tasks. This new approach will hopefully help you to improve your copying skills. The approach is called component attentional skills training or what we will call "cast". (In order to simplify reference to the method, the component attentional skills approach will be known to the group as "cast"). The approach called "cast" will have us break down copying tasks into smaller parts. It should help us better plan and think about our task.

I'll be meeting with others of your classmates who will be learning other approaches to activities involving copying. All of you have been given tests that involve copying. You'll be given them again at the end of the training sessions to see how much you have improved. We'll be comparing this groups improvement using "cast" to the improvement of the other group using another type of approach. This will show us which approach is the most useful. Remember, it is important not to discuss the things you learn in this group with your classmates. That would confuse things and make it difficult to understand which way is more useful.

The first session presents an overview of component attentional skills training. The trainer briefly instructs the subjects on the importance of visual scanning and breaking the model down into component parts. The following steps are written on the blackboard and presented:

1) Look at the model.

2) Break the model down visually into components and choose one component part. Point to that component part.

3) Focus on duplicating it.

4.) Compare and point to the model and the copy to check for accuracy.

The steps are explained and reviewed twice during the first session.

Session 2:

The second session focuses on modeling and the active participation of subjects. The practice tasks used in this session will be the first, second, third and fourth Block Designs from the

WISC-R. All subjects practice each of the four Block Designs once. The procedure involves the following four steps:

1. Modeling: The trainer points to steps written on blackboard and gestures while performing the task:
While performing each step of the task, the trainer points to the steps written on the blackboard. Gestures are also used to indicate what the trainer is attending to in the task. The same gesturing is used as in the self-instruction/component attentional skills group.

2. The subject performs the task while the trainer points to the steps written on the blackboard and gestures: While performing the actual task, the subject is gesturally cued by the trainer.

3. The subject performs the task while pointing to the steps written on the blackboard and gesturing: While performing the actual task, the subject provides his/her own gestural cues.

4. The subject performs the task without pointing to the steps written on the blackboard or gesturing.

1. Modeling: The trainer performs the task while pointing to steps written on the blackboard and gesturing:

The trainer uses the first Block Design from the WISC-R in order to demonstrate the component attentional skills method.

1. The trainer will point to step 1 on the blackboard (Look at model) prior to studying the Block Design.
2. The trainer will continue to study the Block Design while pointing to step 2. (Point to the block).

3. The trainer will point to step 3 on the blackboard. (Focus on duplicating it). Then, the trainer will pick up a block and place it so that the red side is facing up.

4. The trainer will point to step 4 on the blackboard. (Compare model with copy to check for accuracy). The trainer will look at the model, point to the red block in the model, look at the duplicated red block and then point at the duplicated red block.

This will be repeated for the remaining three blocks of this Block Design item.

2. <u>The subject performs the task while the trainer points to the steps written on the blackboard and gestures:</u> The first Block Design from the WISC-R is used for this demonstration. The same gestural prompting is provided by the trainer as above while the subject performs the motor movements necessary to complete the Block Design. A volunteer is selected from the group to initiate the demonstration. The demonstration is repeated for all of the remaining members of the group.

3. <u>The subject performs the task while pointing to the steps on the blackboard and gesturing:</u>

The second Block Design from the WISC-R is used at this stage of training. The subjects perform the Block Design while self-prompting one at a time in a serial fashion. The subjects are asked to volunteer. Prior to beginning the self-prompting, each subject is reminded to point to the steps written on the blackboard.

4. <u>The subject performs the task without pointing to the steps written on the blackboard or gesturing:</u>

The third Block Design from the WISC-R is used for this exercise. The subjects each are given four red and white blocks and the appropriate stimulus card. The steps are again verbally reviewed by the trainer. They also remain on the blackboard.

5. The subject performs the task without pointing to the steps written on the blackboard or gesturing:

The fourth Block Design from the WISC-R is used for this exercise. The steps are again reviewed and will remain written on the blackboard. Subjects are urged to use all four steps.

Session 3:

Who remembers from the last time we met what the four steps of "cast" are.

The trainer will review the four steps. Following the verbal review, the four steps will be written on the blackboard.

1. Modeling: The trainer performs the task while pointing to the steps written on the blackboard and gesturing:

The fifth Block Design from the WISC-R is used as a demonstration.

2. The subject performs the task while pointing to the steps written on the blackboard and gesturing:

The fifth Block Design from the WISC-R is again used in this exercise. The subjects perform the task while pointing to the steps in a serial fashion in front of the rest of the group.

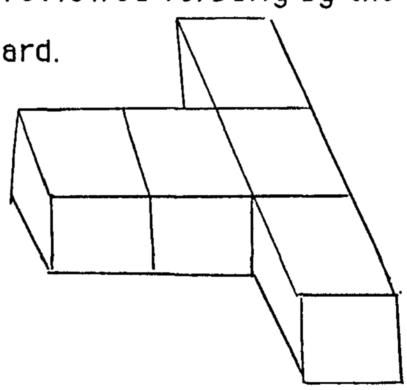
3. The subject performs the task without pointing to the steps written on the blackboard or gesturing:

The sixth Block Design from the WISC-R is used in this exercise. The subjects are each given a set of four red and white blocks and the appropriate stimulus card. The subjects perform this task at their seats simultaneously.

Session 4:

So far, we have been practicing by copying blocks from a piece of paper. But this approach can be used with all copying tasks. Today, we are going to again practice with blocks but instead of copying from a design on a piece of paper, we are going to copy a shape that I made out of blocks. When we copy it, we have to try and make it as much like the model as we can. That means, copying the sides as well as the tops of the model. Remember the four steps of "cast".

The four steps are reviewed verbally by the trainer and then written on the blackboard.



1. Modeling: The trainer performs the task while pointing at the steps written on the blackboard and gesturing:

1. The trainer will point to step 1 (Look at the model) prior to examining the model.

2. The trainer will continue to study the blocks while pointing to step 2. (Break down the model visually into parts and choose one component part. Point to that component). The trainer will point to the block on the upper right-hand of the T. He will point to all exposed sides of the block.
3. The trainer will point to step 3 on the blackboard. (Focus on duplicating it). Then, the trainer will pick up a block and place it so that the top is red, the front is white, the back is red and the right side is red and white with the red on the right and the white on the left.
4. The trainer will point to step 4 on the blackboard. (Compare and point to model and copy to check for accuracy). The trainer will look at the model, point to the block at the top right of the T in the model, look at the copy and point to the duplicated block. He will then point to the red top of the model and the red top of the duplicate. Trainer will continue by pointing to the white front of the model and then pointing to the white front of the copy. The trainer will also point to the red back of the model and then point to the red back of the copy. The red and white side will also be pointed out on both the model and the copy. The trainer will complete the block by pointing to the red half on the right side of block and the white half on the left side of the block in both the model and the copy.

This is repeated for each of the remaining blocks until the task is completed.

1. <u>The subject performs the task while pointing to the steps written on the blackboard and gesturing:</u>

The same generalization task is used in this exercise. Each subject takes a turn and performs the exercise.

3. <u>The subject performs the task without pointing to the steps written on the blackboard or gesturing:</u>

The generalization task is again used in this exercise. The subjects perform the task at their respective desks.

<u>Session 5:</u>

The four steps involved in component attentional skills training are again reviewed by the trainer. At this point, the four steps are not written on the blackboard. The subjects are asked to remember them. The first exercise of this session involves the seventh Block Design of the WISC-R. The subjects are asked to perform the task without pointing to the steps or gesturing.

> Now, we are going to do another task that many of you probably do everyday in your classrooms. We are going to write with paper and pencil. (At this point, paper and pencils will be distributed). We are going to copy a phrase that I am going to write on the blackboard. (The phrase, I AM LEARNING SOMETHING NEW, will be written on the blackboard). This says, "I am learning something new". Now, we are going to learn to copy these letters using the same method we used before. For many of you, this is very familiar and you will have no problem copying the phrase. But, we

are going to see if we can improve our work and make it look more like what's written on the board.

1. Modeling: The trainer performs the task while gesturing:

The trainer's desk will be next to the blackboard within reaching distance of the written phrase, I AM LEARNING SOMETHING NEW.

1. The trainer will examine the first word and then point to the I, in the phrase, I AM LEARNING SOMETHING NEW.
2. The trainer will point to the I, outlining it with his finger.
3. Then, the trainer will look at his sheet of paper and draw the .
4. The trainer will first outline the ¯ of the I with his finger on the model and then on the copy. He will proceed to outline the _ of the I with his finger on the model and the copy. Finally, he will outline the of the I with his finger on both the model and copy.

(The rest of the sentence will be completed in the above manner).

2. The subject performs the task while gesturing: The same sentence is used as above ie. I AM LEARNING SOMETHING NEW. Each subject takes a turn and performs the task.

3. The subject performs the task without gesturing: The same sentence is used as above. Subjects perform the task while seated at their desks.

Session 6:

The four steps of component attentional skills training are again verbally reviewed. Again, the steps are not written on the blackboard and the subjects are asked to remember them. The first exercise in this session involves the eighth Block Design from the WISC-R. The subjects are given the necessary materials and asked to perform the task at their desks.

The second exercise of this session involves the ninth Block Design from the WISC-R. This Block Design is different from those Block Designs previously practiced in that it involves the reproduction of nine blocks as opposed to just four blocks.

> So far, we have been copying blocks that involve four blocks. Today, we will be practicing the copying of nine blocks. The same method will, of course, still apply.

1. Modeling: The trainer performs the task while gesturing:
2. The subject performs the task while the trainer gestures:
3. The subject performs the task while gesturing:
4. The subject performs the task without gesturing:

Session 7:

The four steps of component attentional skills training are reviewed by the trainer. They are not, however, written on the blackboard. The first exercise of this session is the tenth Block Design of the WISC-R. The necessary materials are distributed to the group. This Block Design again involves the reproduction of nine blocks.

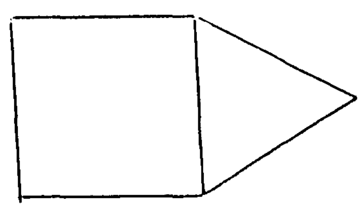
1. The subject performs the task without pointing to the relevant components:

The second exercise involves the eleventh Block Design from the WISC-R. The same materials are used for this exercise.

2. The subject performs the task without gesturing: The trainer emphasizes the importance of practicing the method outside the group. Examples are given of possible applications in the classroom.

Session 8:

The four steps are again reviewed. A new generalization exercise is introduced. The exercise involves the construction of a simple design with pencils. Six pencils are used to construct the following design:



1. Modeling: The trainer performs the task while gesturing:
2. The subject performs the task without gesturing: The same generalization task is used as above.
3. The subject performs the task without gesturing: The same generalization task is used as above.

The trainer attempts to engage the group members in a general discussion of component attentional skills training. Feedback regarding its usefulness is elicited. A review is provided of the definition of visuo-motor reproduction tasks and all group members are encouraged to apply these methods to within those parameters.

Table 1

Means and Standard Deviations for three pretests and posttests

	Pretests		Posttests		
Variables	M	SD	M	Adjusted M	SD
Group 1					
B.D. (WISC-R)	8.8	7.5	16.2	16.6	11.7
B.D. (LIPS)	2.2	1.3	3.5	3.3	1.3
DTVMI	11.1	9.0	12.4	12.6	9.8
Group 2					
B.D. (WISC-R)	9.1	9.7	11.2	10.8	9.4
B.D. (LIPS)	2.5	1.3	2.6	2.4	1.3
DTVMI	12.3	11.1	13.1	13.0	11.4

Note: Group 1 = Self-instruction/Component Attentional Skills Group. Group 2 = Component Attentional Skills Group. B.D. (WISC-R) = Block Design Subtest of the Wechsler Intelligence Scale for Children, Revised. B.D. (LIPS) = Block Designs from the Leiter International Performance Scale. DTVMI = Developmental Test of Visual-motor Integration.

Table 2

Correlation Coefficients for the three pretests, the three posttests and the Verbal IQ scores

	PreWiscr	PreLeiter	PreDtvmi	PostWiscr	PostLeiter	PostDtvmi	IQ
PreWiscr	1.00	.63**	.68**	.83**	.46**	.66**	.31
PreLeiter		1.00	.59**	.58**	.59**	.53**	.13
PreDtvmi			1.00	.62**	.31	.97**	.44**
PostWiscr				1.00	.45**	.66**	.31
PostLeiter					1.00	.31	.09
PostDtvmi						1.00	.42*
IQ							1.00

* $p < .05$ * $p < .01$
Prefix: Pre = Pretest Post = Posttest
Wiscr = Wechsler Intelligence Scale for Children, Revised. Leiter = Leiter International Performance Scale. Dtvmi = Developmental Test of Visual-motor Integration.

Table 3

Analysis of Covariance (Block Design, WISC-R)

HYPOTHESIS 1

Variation	Sum of Squares	df	Mean Square	F	signif. of F
Covariate	2697.02	1	2697.02	86.58	
Treatment	239.55	1	239.55	7.70	.009*
Residual	965.67	31	31.15		
Total	3902.23	33	118.25		

* $p < .01$

Table 4

Analysis of Covariance (Block Designs, LIPS)

HYPOTHESIS 2

Variation	Sum of Squares	df	Mean Squares	F	Signif. of F
Covariate	20.89	1	20.89	21.50	
Treatment	9.73	1	9.73	10.02	.003*
Residual	30.12	31	.97		
Total	60.73	33	1.84		

* $p < .01$

Table 5

Analysis of Covariance (DTVMI)

HYPOTHESIS 3

Covariate	Sum of Square	df	Mean Squares	F	Signif. of F
Covariate	3461.24	1	3461.24		
Treatment	2.17	1	2.17		.57
Residual	203.20	31	6.51		
Total	3666.62	33	111.11		

$p > .05$.

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