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To the Graduate Council:

I am submitting herewith a dissertation written by Sandra Regina Machleit entitled "Working memory and writing : a comparison of two types of dynamic assessment of working memory and the relationship to writing ability of heterogeneously grouped seventh grade students." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

Katherine Greenberg, Major Professor

We have read this dissertation and recommend its acceptance:

Dianne Whitaker, Donald Dickinson, Michael Johnson

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Associate Vice Chancellor
and Dean of the Graduate School

Working Memory and Writing:

A Comparison of Two Types of Dynamic Assessment of Working Memory and the Relationship to Writing Ability of Heterogeneously Grouped Seventh Grade Students

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville

Sandra Regina Machleit

December 1999

DEDICATION

This dissertation is dedicated to my many family members and friends who have supported and encouraged me throughout my academic career. I especially dedicate this dissertation to the memory of my grandmother, Mamie Baucom, who instilled in me, the true meaning of hard work. I also dedicate this study to my mother, who taught me the meaning of generosity and to my brother, who taught me the meaning of courage.

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ABSTRACT

This study investigated the relationship of working memory under two types of dynamic assessment methods to the writing abilities of middle school-aged students. The Test of Written Language-Third Edition, Forms A and B (TOWL-3) was administered to heterogeneously grouped, seventh-grade students as pre-and post-test measures of writing. The Swanson's Cognitive Processing Test (S-CPT) was administered as an intervening measure of working memory using two types of dynamic assessment approaches, graduated prompting (GP) and mediated learning experience (MLE).

Working memory is defined as the mechanism by which individuals store and retrieve information needed to perform a particular task and is highly correlated with achievement. Moreover, working memory is hypothesized to underlie the writing process, specifically those processes related to text generation.

The results of this study indicate that there was no treatment effect of enhanced working memory with participants who were administered the S-CPT under either dynamic assessment approach, GP or MLE. However, there was a statistically significant treatment effect for transfer on writing achievement. Students who were administered the S-CPT under MLE assessment attained significantly higher post-writing scores than students who were administered the S-CPT under GP conditions. Calculation of effect size indicated a medium magnitude of effectiveness of the intervention for post-writing scores. Additional results of this study indicated that pre-writing scores were the best predictors of post-writing scores, followed by gain semantic working memory, and MLE treatment. This study has implications for both psychologists and educators who work with students in multi-ability heterogeneously grouped classes.

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CHAPTER I

INTRODUCTION

Purpose

The primary objective of this study was to investigate how working memory is related to the writing abilities of regular and special education students in the 7th grade. The Test of Written Language-Third Edition, Forms A and B (TOWL-3), (Hammill & Larson, 1996) was administered as pre- and post-test measures of writing. The Swanson's Cognitive Processing Test (S-CPT) (Swanson, 1996) was administered as an intervening measure of working memory using two types of dynamic assessment approaches, graduated prompting (GP) and mediated learning experience (MLE). Dynamic assessment is characterized as incorporating a pre-test, intervention or teaching phase, and a post-test.

A second objective of this project was to examine how individuals respond to dynamic assessment techniques that attempt to teach strategies to expand working memory capacity and processing efficiency. A third objective was to investigate the predictive validity of working memory under static and dynamic conditions and to compare MLE with GP to determine which of these two dynamic assessment interventions provided a more stable change in working memory as measured by Maintenance scores. The assumption was that if working memory capacity and efficiency could be enhanced, then writing achievement would improve.

Rationale

The focus of traditional psychological assessment has been on finding a deficit in the student that can be theoretically remediated with placement in special education classes. Because a growing number of students with mild to moderate learning disabilities are being educated in regular education classes, there is a need to supplement traditional assessment with alternative measures designed to tap the abilities of those with special needs. Promoters of alternative assessment believe there may be better ways to predict future achievement and learning potential of students experiencing difficulty in schools.

Although controversial (Marston, 1996), the political and philosophical movement toward inclusion and away from traditional pull-out programs in both special education and remedial classrooms has prompted a need to redefine assessment practices of school psychologists. The school psychologist plays an important role in this endeavor, as the main purpose of assessment shifts from student placement to discerning the learning potential of students and improvement of instructional strategies.

School psychologists have typically used traditional intelligence measures such as the Wechsler Intelligence Scale for Children-Third Addition (Wechsler, 1991) and achievement measures, such as the Woodcock-Johnson Achievement Test-Revised (Woodcock, R. & Johnson, M., 1989) when evaluating students with suspected learning problems. These measures are static in that they assess the "products" of student knowledge and do not address the "processes" of learning. In contrast, dynamic assessment methods incorporate interventions within the testing environment that allow the examiner to identify impaired cognitive processes or inefficient strategies of the learner.

The advances made by cognitive science with regard to the relationship between information processing models and achievement suggest that the component of working memory is highly related to academic success. Information processing theory makes an attempt to understand how learners perceive, process, and retrieve information in order to perform complex tasks such as those involved in the writing process. Research in cognitive theory and learning over the past decades reflects an attempt to answer questions about the relationship between working memory and learning.

A number of studies have linked the construct of working memory to specific academic areas such as reading comprehension (Daneman & Carpenter, 1980; Daneman & Greene, 1986), mathematics (Swanson, Cooney, & Brock, 1993) and writing (Swanson & Beringer, 1996). More rigorous predictive validity studies are needed to further examine the relationships between working memory and writing achievement. Additionally, the modifiability of working memory during dynamic testing interactions and its' relationship to writing (text generation) needs to be empirically addressed.

During the past decade, writing as a part of the school curriculum has been increasingly emphasized (Newcomer & Barenbaum, 1991). This emphasis has prompted a substantial body of research investigating students' composition ability. A writing composition model that emphasizes the central role of working memory in the writing process has emerged. Hayes (1996) extended the original writing model proposed by Hayes and Flower (1980) to include working memory as having a central role in writing. The revised model draws heavily on Baddeley's (1986) general model of working memory. Within the new model, phonological memory, a visual/spatial sketch pad, and semantic memory are subcomponents of working memory. According to Daneman & Green (1986) the greater one's working memory capacity, the better one can select "lexical items" for use in a sentence.

Swanson and Bernigner (1996) found that individual differences in working memory capacity correlated significantly with writing measures related to text generation. Using the graduated prompt method of dynamic assessment, they did not find significant differences in correlations between processing efficiency in initial and gain (dynamic testing) conditions with writing measures. Limitations to their study include: (1) variation in age that may have confounded results and (2) all students were academically low functioning. Campione and Brown (1987) suggest that when working with lower functioning students, the intervention should focus on metacognitive processes to facilitate transfer of learned skills. Unlike the GP intervention, mediated learning techniques attempt to facilitate metacognitive change. In addition, Swanson and Bernigner's study did not incorporate Maintenance scores of working memory.

The components of working memory are important in explaining and in understanding individual differences and responses to cognitive demands. By measuring students' ability to improve their working memory capacity and processing efficiency under dynamic assessment conditions, we can hope to be able to better predict what kind of strategies students need to improve their writing skills. Moreover, the use of dynamic assessment procedures will help determine how much intervention particular students may need in order to improve their writing skills.

Statement of the Problem

The use of intelligence tests to measure current cognitive ability of school-aged children continues to dominate the field of school psychology. Although such measures are psychometrically sound and offer valid estimates of students' current level of cognitive functioning, they are inadequate in determining estimates of cognitive learning potential. Dynamic assessment not only may be used to estimate learning potential, but also to examine the areas in which a student's learning breaks down, thereby determining the intensity and type of instruction needed for the student to succeed. As the role of school psychologists changes from "gatekeeper" of special education to "developer" of appropriate educational interventions, the application of dynamic assessment methods enriches the psychometric field. However, there is a need for research in the application of dynamic assessment measures to determine not only the students' cognitive abilities, but also, potential processing abilities and responsiveness to intervention.

There is also a need to study different approaches that can be used to predict future learning and to enhance the diagnosis and treatment of learning problems. Working memory has been established as a cognitive construct related to writing ability. What is unknown about the relationship of working memory to writing ability is whether the enhanced capacity and/or processing efficiency by which students use working memory under dynamic assessment conditions are better predictors of writing ability than static measures of working memory alone. Studying the processing potential of working memory capacity and efficiency under dynamic assessment procedures is warranted. Additionally, the modifiability of the process of working memory using a mediational approach to dynamic testing needs to be empirically addressed.

In this study, the graduated prompting (GP) approach to dynamic assessment was one in which the examiner gave "teaching hints" or "prompts" when a mistake was made by the examinee. The mediated learning experience (MLE) approach encouraged the examinee to use strategic approaches to overcome mistakes and to transfer strategies to learning outside the testing situation.

This study was unique in several ways. First, the study assessed writing ability with a pre- and post- standardized measure, thereby using pre-writing scores as a covariate. Second, the study compared the malleability of working memory under two types of dynamic assessment conditions. This study not only used graduated prompting but also used mediational type of dynamic assessment to compare the relationship of working memory to writing. Also, Maintenance working memory scores were used to discern the stability of change in working memory, after the interventions were removed.

Within the MLE intervention, examiners engaged in dialogue with students in which bridging principles (decontextualized rules) were used to assist students in transferring memory strategies from the testing situation to the learning environment in the classroom. Furthermore, both regular and special education students were taught writing in the classroom and by the same teacher. The importance of this study is that it gives school psychologists strategies for teaching to individual needs within the testing environment that can also be useful information for teachers.

Research Questions

The following research questions were addressed by this study:

I. What is the treatment effect of two types of dynamic assessment approaches, graduated prompting (GP) and mediated learning (MLE) on working memory as measured by the Maintenance score from the Swanson's Cognitive Processing Test (SCP-T)?

II. What is the treatment effect of two types of dynamic assessment, graduated prompting (GP) and mediated learning (MLE) on writing achievement as measured by the post-writing score from the Test of Written Language-Third Edition (TOWL-3)?

III. What is the relationship between Initial, Gain, and

Maintenance working memory scores as measured by the SCP-T under dynamic assessment conditions using GP and MLE approaches and post test writing achievement scores as measured by the Spontaneous Writing Composite scores from the TOWL-3

Results

Results of this study indicate that working memory, under static and dynamic testing, is positively correlated with writing achievement. Moreover, working memory under enhanced conditions with the MLE intervention was a better predictor of writing achievement than the GP intervention. There was no treatment effect of enhanced working memory with participants who were administered the S-CPT under either dynamic assessment approach, GP or MLE. However, there was a medium treatment effect for transfer on writing achievement with MLE. Both special and regular education students who were administered the S-CPT under MLE assessment attained statistically significant higher post-writing scores than students who were administered the S-CPT under GP conditions.

The specific focus of the MLE intervention was to assist the students in developing strategies for improving their working memory capacity as well as using working memory efficiently in writing tasks. On the other hand, the specific focus of the GP intervention was to assist the students in improving working memory as measured by the immediate tasks. Hence, the MLE intervention was more successful in facilitating meaningful associations between the working memory tasks and the writing tasks than was the GP intervention.

The results of the research suggests that students in the MLE group were better able to transfer strategies learned in the intervention than those students in the GP group. Hence, these students were better able to remember and internalize instructional strategies used in the assessment situation to the classroom to improve writing than those exposed to GP. This study has implications for both psychologists and teachers who work with multi-grouped ability students.

CHAPTER II

LITERATURE REVIEW

History of Intelligence Testing

Since the beginning of compulsory education in the United States, there has been ongoing discussion and debate regarding the usefulness of the traditional standardized IQ tests to predict academic success of students in schools. In the early 1900's, the number of students participating in public education rose dramatically both in the United States and in Europe. The influx of students coming from backgrounds different from the educated elite, caused a rise in the failure rate of students. The high failure rate, as much as 50% of the student population, precipitated a call to establish which students would profit from instruction. Intelligence testing was one way for political and educational leaders to determine how to best distribute resources to students who supposedly were going to benefit from the educational process (Thorndike, 1997).

As early as 1904, Alfred Binet became involved with a group of concerned parents and educators in France who were interested in discriminating between two groups of students who had difficulty learning in school. Students who could learn the material, yet would not, were termed "malicious", while students who could not learn were called "stupid" (Thorndike, 1997). Binet's assumption was that intelligence tests could give objective information, which was apart from teachers' subjective notions, as to why some students were unable to profit from instruction at the same rate as the majority of students. A further assumption was that these tests could either corroborate or refute teachers' opinions of students' abilities.

School psychologists have historically performed a major role in administering and interpreting individual intelligence and achievement tests for students in schools. A recent survey (Wilson & Reschly, 1996) suggests that school psychologists continue to spend over half of their time in psychological assessment activities. Intelligence tests are frequently used to provide predictive information about academic performance, even though estimated correlations of approximately .50 have been reported between intellect and academic achievement (Jenson, 1980; Reschly & Grimes, 1995; Sattler; 1992).

Ironically, the criticisms with regard to intelligence testing and academic achievement that emerged in the early years of this century continue to resonate in contemporary literature (Reschly & Wilson, 1990). Among those criticisms is that intelligence tests are too simplistic and do not address the total picture of how humans process information and learn. As noted by Thorndike (1997) these criticisms are irrelevant to a certain degree in that developers of intelligence tests have never claimed that such tests explain the totality of human learning. Rather, the tests make an attempt to predict future academic and vocational successes. The challenge lies in developing and testing diagnostic procedures that lead to better instruction for diverse populations of students.

The political decision to use standardized assessment measures for the purpose of categorizing and labeling students into various ability groups is driven by the limitation of monetary resources appropriated to education. However, as educators, our main purpose is not necessarily to get the most from limited financial resources. The purpose of the educational system is to provide appropriate instruction so that all students have the opportunity to reach their fullest potential.

<u>Predictive Validity and Discrepancy Models</u>

Issues of test validity were addressed by the Joint Technical Standards for Educational and Psychological Testing (AERA, APA, NCME, 1985). They concluded that the concept of "validity" was the most important consideration when determining the usefulness of an instrument. According to Sattler (1992) predictive validity refers to the relationship between test scores and achievement on an applicable criterion. A time interval between the test and the performance on the criterion must be established.

Predictive validity is typically established by obtaining a coefficient by correlating cognitive ability to achievement in a content area. Predictive achievement methods that take regression effects into account are typically more psychometrically sound than other discrepancy models (Reynolds & Kaiser, 1990) and are traditionally used by school psychologists when determining specific learning disabilities within student performance. Recent efforts to determine the relationship of certain cognitive constructs (processes) presumed to underlie achievement have renewed interest in the predictive utility of the manipulation of cognitive processes and achievement (Reschly, 1997).

Historically, advocates of traditional standardized measures of intellectual ability have adhered to the following assumptions: (a) subtests draw upon certain cognitive processes related to intelligence; (b) the tasks represent the attributes that require intellectual behavior; and (c) the ability of individuals to successfully perform tasks is relatively stable (England, 1997). Recently, there has been an ongoing debate regarding the usefulness of the traditional standardized IQ test as a component in the assessment of children with regard to predicting future academic success (Reynolds & Kaiser, 1990). Moreover, some of these measures are noted to be outdated as they lack a theoretical base and are not derived from current scientific advances in cognitive science. The over-dependence on static IQ measures serve to "widen the gap" between intelligence testing and cognitive science.

Traditional standardized assessment measures typically assess the "products" of student output and consider the amount of "discrepancy" between ability and achievement; whereas, "process assessment" is aimed at measuring the underlying cognitive structures hypothesized to contribute to understanding the reason(s) "why" the discrepancy exists (Haywood, Brown, & Wingenfeld, 1990). Dynamic assessment procedures attempt to address this issue.

Dynamic Assessment Rationale

Dynamic assessment is contrasted with standardized or static tests in that the former focuses on the processes of learning while the latter focuses on the product of learning (Lidz, 1991). Dynamic assessment begins where static assessment ends and narrows the gap between intelligence testing and cognitive science. Most researchers do not claim that dynamic assessment of processes should replace traditional assessment of products. On the contrary, they speculate that dynamic assessment provides useful information that is not readily available from static tests (Budoff, 1968; 1974). Consequently, where traditional assessment focuses primarily on the products of effort and thought, dynamic assessment can provide information about

(a) cognitive processes utilized in problem-solving, (b) responsiveness to interventions, and (c) appropriate teaching strategies and activities for individuals as well as groups of students. Research in the area of cognitive processes and learning theory suggest that the time has come for school psychologists to supplement and extend assessment practices to include alternative instruments and approaches that measure abilities and processes untapped by traditional assessment measures.

Dynamic Assessment Approaches

Dynamic assessment is a term used to denote a model of psychoeducational assessment procedures and does not refer to specific tests or instruments (Haywood, Brown & Wingenfeld, 1990; Lidz, 1991). The term "dynamic" is used for several reasons. First, this assessment procedure is characterized by the attempts to discover learning or cognitive processes employed by an individual in attempting specific tasks. It is also dynamic because active teaching or mediating is done by the examiner in an attempt to discover what an individual is capable of learning. This is in contrast to the traditional assessment of intelligence that assess what the person knows. With dynamic assessment approaches, the interaction between the examiner and the examinee is important as the focus on learner metacognitive processes and responsiveness to intervention and/or mediation yields specific information about the learner's approaches to solving problems.

Another defining characteristic of dynamic assessment is the test format of pretesting-intervention-posttesting, whereas traditional assessment has only the static pre-test phase. In dynamic assessment a static pre-test is administered to establish how the individual performs without help. Next, interventions are carried out to help facilitate change in the individual. A static post-test is then given in order to determine what, if any changes took place in the person's processing as a result of the intervention. Rather than only assessing the examinee's current level of functioning as determined by the pre-testing phase, dynamic assessment assesses the examinee's learning potential as determined by the difference in performance between the pre-and post-testing phase after the intervention. Hence the results offer information about the characteristics of the learner as well as information about effective/ineffective treatments.

Theoretical Background of Dynamic Assessment

The roots of dynamic assessment procedures can be traced to Vygotsky (1978) and Feuerstein (1979). Vygotsky's concept of the zone of proximal development, ZPD, which is described as "...the distance between actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (pp. 85-86). Thus the zone of *actual* development characterizes the learner's independent level of performance, while the zone of *proximal* development is characterized by the learner's potential performance. Feuerstein's (1979) conceptualization of mediated learning experience (MLE) describes the distinctive components of the social interactions involved in creating a ZPD. Interactions defined as mediation of intentionality/ reciprocity, meaning, and transcendence are the most important components within an MLE (Lidz, 1997).

With dynamic assessment the purpose is to develop and investigate a ZPD, and in doing so successfully identify the ability of students to utilize certain cognitive processes required to complete the task. Contrasted with traditional intelligence testing which establishes a "ceiling" effect and ceases testing, dynamic assessment seeks to investigate the ceiling as the learner's potential for further learning.

Models of Dynamic Assessment

A review of the literature suggests that there are two distinct models of dynamic assessment: mediational/learning potential assessment and graduated prompting (Laughon, 1990). Dynamic assessment procedures differ in the types of tasks involved as well as in the nature of the interventions

(Lidz, 1997). A variety of skills are evaluated in dynamic assessment procedures and range from domain-general to domain-specific content. Examples of two distinctive approaches with respect to both content and intervention are those of Feuerstein (1979) and Campione and Brown (1987).

Mediational Assessment

Feuerstein's (1979) approach to dynamic assessment is supported by a theory of cognitive functioning in which a lack of sufficient high quality mediated learning experiences, (MLE), results in cognitive deficiencies (Jitendra & Kameenue, 1993; Lidz, 1987, 1991; Greenberg, 1999). Mediated learning is described by Feuerstein as ..."the interactional processes between the developing human organism and an experienced, intentioned adult who, by interposing himself between the child and the external sources of stimulation, 'mediates' the world to the child by framing, selecting, focusing, and feeding back environmental experiences in such a way to produce in him appropriate learning sets and habits." (p.71). The Learning Propensity Assessment Device, (LPAD), is a nonstandardized assessment device that attempts to identify student's impaired cognitive functioning in basic learning skills. Assessment procedures are linked to mediational interventions designed to assess not only the nature and extent of cognitive deficiencies, but also the degree and type of mediated learning needed to help the child profit from direct learning experiences.

Feuerstein's approach involves tasks that are domain-general rather than domain-specific, emphasizing the mediation of cognitive processes within nonstandardized clinical settings. Tasks are similar to those that tap "fluid abilities" rather than "crystallized abilities." Fluid ability is characterized by one's use of procedural knowledge, sequential reasoning and problem-solving strategies. Crystallized ability is lexical knowledge or general information that is derived from the culture by the individual (Horn & Cattell, 1966; Horn, 1994).

Feuerstein chooses non-academic tasks that are assumed to be less threatening to students who have a history of academic failure. Intervention techniques are derived in response to observations of the learner within the mediated learning experience. These interventions are based on a need for a strategic approach as well as an awareness of the basic tenets of a particular task solution. Furthermore, the mediation of intentionality and reciprocity, meaning, and transcendence are important components within the intervention. Mediation of intentionality and reciprocity involve focusing attention on specific elements as well as the goal and purpose of a task as the "mediator" strives to influence the success of the child, while the child is responsive to the "mediator." Mediation of meaning involves attributing value and emphasizing the affective significance of the task content. Transcendence involves creating connections between the present task and previous or future experiences (Lidz, 1991).

Greenberg (1999) also describes the four essential qualities of effective mediators within a "high quality" mediated learning experience (pg. 65). *Reciprocity* is described as "the dance" between the learner and the mediator that helps to create an atmosphere of acceptance, trust and understanding. *Intent* is described as focusing attention on important aspects of the learning task. Establishing *Meaning* is the process by which the learning experience or task becomes personally relevant to the learner. Finally, *Transcendence* is the act of "going beyond" the immediate learning experience and making a "decontextualized connection" between a principle or idea within previous or future situations.

MLE interventions differ from GP interventions most clearly in their clinical approach and child-centered focus on domain-general tasks, and inclusion of affective and motivational factors as well as cognitive processing factors. MLE interventions are dependent upon the responses of the student and requires significant inference from the examiner. Qualitative observations of improvement in the use of cognitive strategies on the part of the learner form the basis of improvement measures. GP interventions are more quantitative and task focused (Lidz, 1997).

Graduated Prompting Assessment

While Feuerstein chooses dynamic assessment approaches that are domain-general, Campione and Brown (1987) utilize an approach that is domain-specific. That is the "intervention" is task-related. Their approach involves providing the learner with a series of pre-established graduated prompts following the transaction of an error. This more standardized approach to dynamic assessment is quantified by the number of prompts the child requires to master the task and is based on task analysis error rather than on any specific cognitive deficiency of the child.

The graduated prompting assessment approach as demonstrated by Campione & Brown (1987) is based on western interpretation of Vygotsky's (1978) theory and the notion of the existence of zones of actual and proximal development. As Vygotsky noted, much of learning takes place within the context of meaningful social interactions. When learning new or difficult information, Vygotsky hypothesized that the learner requires assistance from the teacher or significant other until the new information or skill is internalized. Graduated prompting is more concerned with the quantitative measures, i.e. number of prompts needed to achieve a correct response, than with qualitative descriptions of how the learner processes information in order to gain knowledge.

Within the zone of proximal development, the learner is unable to utilize new information without social support and guidance from another person. Once the learner internalizes the intellectual activity, learning occurs and the learner moves to the zone of actual development, which is characterized by matured "mental functions" (Vygotsky, 1978, p.85) in the developmental cycle whereby the information and/or skill becomes internalized. At this level, the learner no longer requires assistance from outside social forces for a particular task and is ready to advance to the next learning level.

Graduated prompting dynamic assessment procedures utilize the zone of proximal development to better understand children's ability or readiness to learn and/or benefit from instruction. A major feature of the graduated prompting method of dynamic assessment is that assessment of the proximal zone is continuous and is concerned with learning potential as well as transfer in both domain-general and domain-specific areas. The quantitative measure of the amount of assistance needed serves also as a measure of transfer efficiency (Jitendra & Kameenue, 1993). Thus the dependent measure of interest is "how much aid" is needed to bring about a specified amount of learning rather than "how much improvement" is brought about through intervention. In other words, graduated prompting procedures are generally "task" rather than "child" oriented.

Generally, tasks selected for graduated prompting procedures are similar to those in the Learning Potential Assessment Device (LPAD) in that they involve inductive reasoning problems, progressive matrices problems, and series completion problems. These types of tasks are assumed to be related to academic tasks and are amenable to selected prompting sequences (Campione, 1989; Campione & Brown, 1987). Graduated prompting procedures provide pre-determined teaching prompts that are sequenced from general to specific.

However, unlike Feuerstein's (1979) more clinical mediated learning experience, the prompting procedure is standardized in order to produce quantitative data. Hence, the examiner is not required to make high level inferences as required by Feuerstein's clinical approach. Rather, the graduations of prompts and probes move from general to specific and yield a measurement of the amount of assistance needed to solve a problem. The procedure has been extended to include domain-specific skills within curriculum-based assessments (Lidz, 1991; Campione & Brown, 1987).

The Swanson-Cognitive Processing Test (S-CPT) utilizes graduated prompting procedures in assessing and measuring certain cognitive processes such as episodic and semantic memory (Swanson, 1996). Information with temporal and sequential contexts, for example, the time and sequence of a story, involve episodic memory. Semantic memory is related to understanding, integrating and using written or spoken language.

Cognitive Processes in Writing

As the curriculum in schools has increased its emphasis on the teaching of writing skills, there has been an increase in research investigating students' writing ability and an increase in studies of methods of teaching writing. Perhaps the first and most influential work pertaining to the writing process from a cognitive perspective was that of Hayes & Flower (1980). Hayes & Flower proposed a model based on "think-aloud" protocols from novice and expert adult writers.

The Hayes and Flower's (1980) model of cognitive processes in writing includes the processes of planning, translating, and reviewing. These processes are proposed to operate in the writer's long-term memory and in the "task environment" of the writing act. The researchers suggest that these processes operate in an interactive simultaneous fashion rather than in a sequential manner. Hayes (1996) has extended the original writing model to include working memory as having a central role in writing. Within the new model, phonological memory, a visual/spatial sketch pad, and semantic memory are subcomponents of working memory.

Meichenbaum (1980) studied the metacognitive processes of children as they undertake a task. His research involved the monitoring of the "self-talk" students used while working on a particular task. Based on his work, other researchers have studied the relationship between metacognitive processes (planning) and text-structures. The development of several writing programs based on cognitive theory is founded on these works.

In planning, expert writers use knowledge of text-structure, of composition goals and of content to direct the planning process, whereas younger and less skilled writers use a "knowledge telling" process in which memory is searched for content only. Less skilled writers fail to utilize a "knowledge-transforming" processes in which relevant content is incorporated into text, and therefore insert irrelevant content that is unrelated to the goals of composition (Scardamalia & Bereiter, 1987).

Other researchers have modified the model from the perspective of the developing writer and applied it to learning disabled writers (Berninger, Abbott, Whitaker, Sylvester, & Nolan, 1995). These researchers found that problems of children with writing problems are diverse as are their responses to instruction. In addition, the researchers found that noncognitive or nonintellectual variables such as motivation and affect contribute to student's writing ability and treatment effects.

Early research on writing focused primarily on the syntactic and mechanical components of writing fluency. These studies, often treated written language as an extension of spoken language. The work of Britton, Burgess, Martin, McLeod, & Rosen (1975) shifted the focus to the type of writing that students produced based on class assignments, personal experiences, and a developed "sense of audience." Britton and colleagues identified specific categories of student's writing that included: expressive writing, expository writing, and poetic or story writing. This work provided the direction for research pertaining to disabled and low-achieving writers. Other work in the specific area of expository writing involving typical students served to guide research on low-achieving writers.

Expository writing is the ability to "explain" or provide information/knowledge about a particular subject. Knowledge of text-structure is an important component in expository writing. Specific text-structures include: comparison/contrast; description; sequence, and enumeration (Englert, Stewart, & Hiebert, 1988).

Berninger, Mizokawa & Bragg (1991) recommended use of a theory-based assessment protocol that evaluated neuropsychological, linguistic, and cognitive components that contribute to students' writing ability. Certain constraints on writing ability were found at various developmental levels. Neuropsychological constraints were most likely to contribute to writing difficulties of children in primary grades. Linguistic constraints were found to inhibit writing in students in grades 4-6, (Whitaker, Berninger, Johnson, & Swanson, 1994) while cognitive constraints were found to be the primary contributors of writing difficulties of students in grades seven and above (Berninger & Whitaker, 1993).

One group of studies by Newcomer & Barenbaum (1991), focused on the story compositions of learning disabled students and analyzed mechanical, vocabulary, and syntactic/fluency components. These studies found that the gap between learning disabled writers and typical writers seemed to widen with age. Moreover, learning disabled writers experienced significant problems related to the planning processes.

Other researchers (Thomas, Englert & Gregg, 1989) investigated aspects of expository writing in learning disabled and nondisabled students that included: syntactic maturity, fluency and mechanics; cohesion and text structures. Researchers speculated that the significant problems of learning disabled writers when compared to typical and low-achieving students can be partially contributed to the lack of actual instruction and practice of writing in special education classrooms. In fact, the lack of a comprehensive writing curriculum as well as the insufficient amount of time that students engage in actual writing within regular education classrooms contributes to writing deficiencies in all groups of students. They concluded that teachers should spend more time teaching writing. In addition, they called for studies to further identify and assess the modifiability of cognitive processes that underlie and contribute to the writing ability of all students.

Working Memory and Writing

Information processing theory makes an attempt to understand how learners perceive, process, and retrieve information in order to perform complex tasks such as those involved in the writing process. One of the critical components of information processing theory is the construct of working memory. Working memory is defined as a set of mechanisms, constrained by the capacity of a person's brain functioning, that work together simultaneously to both store information and to perform strategic cognitive processing (Baddeley & Hitch, 1974; Baddeley, 1986; Just & Carpenter, 1992).

Structurally, working memory has been described as consisting of a central executive processor together with two specialized memory components: a "phonological loop," which stores phonologically coded information, and a visual-spatial "sketchpad," which stores visually or spatially coded information (Baddeley, 1986). Baddeley, Lewis, and Vallar (1984) described the phonological loop as an inner voice that continually repeats information to be retained (e.g., telephone numbers) while the "sketchpad" is described as a mapping of visual representations.

Tulving (1986) identified additional criteria for distinguishing between "episodic" and "semantic" memory. Semantic memory refers to storing information about concepts and words, with a focus on rules and/or classifications. On the other hand, episodic memory refers to storing information about serial events and experiences, with a focus on situations and/or events.

The executive processor within the working memory system is hypothesized to operate in conjunction with the "phonological loop", that stores verbal information and the "visuo-spatial sketch pad" that stores visual information. There is emerging evidence that working memory capacity is the central mechanism related to how well individuals obtain and integrate new and old information (Engle, 1996).

Berninger, Cartwright, Yates, Swanson, & Abbott (1993) identified the specific components of translating, text generation and transcription within the writing process. As text is generated ideas are formed into units of language in verbal working memory. Transcription utilized skills needed to translate language representations in verbal working-memory into orthographic symbols as script. It has been postulated that the mechanical demands of transcription may place an overload on working memory and thus inhibit the composition quality of less skilled and learning disabled writers.

Although the relationships between short-term memory (a transient storage system) and long-term memory (a permanent storage system) and writing is well documented, (Hayes & Flower, 1980; McCutchen & Perfetti, 1982; Scardamalia & Bereiter, 1986) the relationship between working memory and writing is only beginning to be addressed (Swanson & Berninger, 1996). Thus far, the research supports several conclusions.

First, individual differences in working memory are more predictive of writing composition in middle-school children than for intermediate and primary school children. Measures of working memory in younger children do not contribute unique variance to writing fluency and quality (Berninger, Cartwright, Yates, Swanson, & Abbot, 1993; Berninger & Swanson, 1996). That is, knowing an elementary youngster's working memory capacity is not very useful in predicting their writing ability. In middle-school children, however, working memory contributes unique variance to three criterion measures that contribute to writing, i.e. advanced planning, translating, and revising (Bernigner, Whitaker, Feng, & Swanson, 1993; Beringer & Swanson, 1996). Consequently, the function of working memory in writing increases as writing ability and age increases.

Second, the notion that working memory contributes unique variance to writing in addition to that contributed by reading ability was replicated in three samples of intermediate-grade students with three measures of reading and writing (Swanson & Berninger, 1996). That is, reading ability alone does not fully explain writing ability. Finally, individual differences in working memory were found to be more related to text generation and text quality than to transcription (spelling), while short-term memory was more related to transcription (Swanson & Beringer, 1996).

Conclusion

School psychologists have typically used traditional measures of intellectual ability, coupled with achievement measures in order to diagnose learning problems of students. This diagnosis is often a precursor to determining whether or not a student is eligible for special education services.

The traditional "test and place" model of psychological service delivery has come under scrutiny as the movement toward "inclusive education" and "non-categorical disability" service delivery becomes widespread (Will,1986). Furthermore, the traditional assessment model yields "static" scores that measure the products of students' learning typically described as the current level of functioning. The dynamic assessment model makes an attempt to measure the modifiability of cognitive processes by which students learn new knowledge. In doing so school psychologists are better able to assess the potential of students' abilities, in addition to the current level of functioning.

The advances made by cognitive science with regard to the relationship between information processing models of ability and achievement, suggest that the component of working memory appears to be highly related to academic success, especially in the higher grades. Initial research studies have suggested that the cognitive construct of working memory is a mechanism that is particularly related to writing ability.

CHAPTER III

METHODS AND PROCEDURES

Participants

The participants in the study consisted of 44 seventh grade students from a middle school in a mid-size southeastern city. The student body has a diverse, multicultural background. In this study, 20 of the students were female and 24 were male. Thirty-three students were regular education students, while 11 were identified as learning disabled. The mean age was 12-years-7-months and ranged from 11-years-6-months to 13-years-7-months. All students received instruction in heterogeneously grouped regular education "inclusion" classrooms. (Refer to Table I for demographic characteristics.)

Letters explaining the study were sent home with students. Both students and parents signed permission forms to indicate a willingness from the students and permission from parents to participate in the study.

Seventh grade students were selected for the study because at this grade level they are required to produce more writing than in previous grades and are expected to become proficient in their writing ability. The particular classes of students were selected because they were comprised of heterogeneously grouped regular and special education students who were participating in a school-level

TABLE I

Demographic Characteristics of Students

	GP GROUP (n=20)		MLE GROUP (n=24)		TOTAL SAMPLE (N=44)	
	n	%	n	%	n	%
Gender						
Female	10	50.0	10	41.7	20	46.0
Male	10	50.0	14	58.3	24	54.0
Education						
Regular	15	75.0	18	75.0	33	75.0
Special	5	25.0	6	25.0	11	25.0
Ethnicity						
Caucasian	18	90.0	21	87.5	39	88.6
Black	2	10.0	1	4.2	3	6.8
Asian	0	0.0	2	8.3	2	4.6

Note: Education refers to either regular or special education status.

"inclusion" pilot program funded by the state. All of the teachers in this particular team had actively participated in the pilot program and agreed to allow me access to students. Students of all ability levels were included in the study.

Instruments

Test of Written Language-Third Edition (TOWL-3)

The TOWL-3 (Hammill & Larsen, 1996) is a standardized instrument that has been used frequently in research on written language. The TOWL-3 has demonstrated high reliability and validity and has normalized scores with a mean of 100 and a standard deviation of 15. The examiner's manual reports internal consistency, test-retest with equivalent forms, and inter-rater reliability coefficients ranging from .80 to .90. The instrument is comprised of eight subtests in each of the two equivalent forms (A and B). This study used three subtests that are combined to produce a Spontaneous Writing Composite score. The Spontaneous Writing Composite measures students' ability to compose a writing sample, when given a picture stimulus, that expresses personal thoughts, feelings, and opinions. The Spontaneous Writing Composite measures students' ability to write functionally in everyday situations and requires that students integrate components of writing, for example, spelling, vocabulary, word usage, capitalization, punctuation, and syntax.

The subtests that comprise the Spontaneous Writing Composite are Contextual Conventions, Contextual Language, and Story Construction. The subtests are described below:

1. Contextual Conventions: Measures the ability to spell words properly and to apply the rules governing punctuation of sentences and capitalization of words in a spontaneously written composition.

2. Contextual Language: Measures the ability to use mature words that represent a variety of parts of speech; complex sentences comprised of introductory and concluding clauses, embedded phrases, and adjective sequences; and grammatical forms such as subject-verb agreements.

3. Story Construction: Measures the ability to write in a logical, organized fashion; to generate a specified theme or plot; to develop a character's personality; and to employ an interesting and engaging prose (Hammill & Larsen, 1996, pp. 5 & 6).

For this study, two independent trained raters calculated raw scores for each of the three subtests. Inter-rater reliabilities (agreements / total + disagreements) were calculated for separate subtests and combined subtests for both Form-A (pre) and Form-B (post) test measures. Inter-rater reliability for overall Form-A pre-test measures was r=.86 and r=.81 for Form-B post-test measures.

Swanson Cognitive Processing Test (S-CPT)

The S-CPT (Swanson, 1996) is comprised of eleven subtests and is based on an information-processing model that includes the component of working memory. An important feature of each of the subtests is that the examinee is required to store presented information in memory while actively "processing" additional information. The subtests were designed to tap episodic and semantic memory resources from visually and auditorially presented tasks. Seven studies evaluated the convergent, divergent, and criterion-related validity of the S-CPT. The results of the studies provide evidence that the instrument is a valid measure of working memory.

Another important feature of the S-CPT is that the battery can be administered using interactive or dynamic assessment procedures. Thus the battery proposes to measure different aspects of working memory as well as initial and potential processing ability. Since the S-CPT utilizes a test-teach-test procedure and yields three test scores: Initial, Gain, and Maintenance, a test-retest to determine reliability was not appropriate. Rather than determining a test-retest coefficient, an internal consistency coefficient was deemed to be more appropriate (Swanson, 1996). The Cronbach alpha procedure, with the effects of age partialed out, was used to determine reliability. The sum of scores across subtests for Initial, Gain, and Maintenance scores yielded a coefficient of $r = .96$.

Within each subtest, students' raw scores are obtained and converted into scaled scores. Scaled scores are calculated and converted into Component standard scores with a mean of 100 and a standard deviation of 15. The subtests factor into two component scores, Semantic and Episodic Memory. The subtests that comprise the Semantic Memory Component are Rhyming Words, Auditory Digit Sequence, and Semantic Association. The Visual Matrix, Mapping and Directions, and Story Retelling subtests comprise the Episodic Memory Component score.

For the purpose of this study the following six subtests were used and are described below:

1. Rhyming Words: Measures the ability to remember aurally presented rhyming words.

2. Visual Matrix: Measures the ability to remember visual sequences within a matrix.

3. Auditory Digit Sequence: Measures the ability to remember numerical information embedded in a short sentence.

4. Mapping and Direction: Measures the ability to remember a sequence of directions on a map that has no labels.

5. Story Retelling: Measures the ability to remember a series of episodes presented in a paragraph.

6. Semantic Association: Measures the ability to organize verbal information into abstract categories (Swanson, 1996, pp. 1-3).

Administration time for all six subtests ranged from approximately 45 to 99 minutes. Three doctoral graduate students in the Psychoeducational Studies Unit were trained to administer the S-CPT, a measure of working memory. Two were students in the school psychology Ph.D. program and one was a student in the educational psychology collaborative learning Ed.D. program. All students had previous exposure to various psychological testing procedures. Graduate students were trained over a six-weeks period for a total of 12 hours. All three students were trained in both methods of dynamic assessment.

Method

This study was a quasi-experimental repeated measures design. Two groups were to be comprised of approximately 30 seventh grade students each. Because of attrition factors, there were 20 participants in the GP group and 24 participants in the MLE group. First, students in large groups of approximately thirty, were administered a writing composition pre-test (Form A) from the TOWL-3. Students were read standardized directions from the TOWL-3 Administration Manual (1996).

> This exercise is designed to see how well you can write a story. Look at the picture before you. You are to write a story about that picture. Before you begin writing, take time to plan your story. A well-written story usually has a beginning, middle, and end. It also has characters that have names and perform certain actions. Use paragraphs to help organize your story. Correct punctuation and capitalization will make your story easier to read. After you have made a plan for your story, begin writing. Try to write as long a story as you can. If you need more paper, just let me know. You will have only 15 minutes to think about your story and to write it. Write the best story you can. Ready? Begin. When 15 minutes have elapsed, say STOP (pg. 22).

Students' writing composition scores were individually calculated. Raw scores from three subtests were obtained. Scaled scores from subtests were transformed into standard scores. To insure the equal distribution of students to treatment and control groups, writing composition scores were matched, according to writing ability as measured by the Form-A pre-test. Matched students were then randomly assigned to one of two treatment groups for the purpose of assessing the construct of working memory via two dynamic assessment methods.

Next, each student was individually administered six subtests of working memory from the (S-CPT). These subtests assess the information processing potential and capacity of working memory. During the administration of the S-CPT, students received three scores for each of the six subtests, Initial (static) scores, Gain (dynamic) scores, and Maintenance scores. The S-CPT was administered to each student in one setting. Initial scores reflect the students' ability to obtain information without assistance and are calculated by converting raw scores to standard scores. When the student misses an item, the examiner provided one of two interventions. The reader is referred to Appendices I and II for a full description of the dialogue/directions involved during the interventions.

Students in the GP group received a series of "hints" or "probes" designed to assist the student in recalling information. Students in the MLE group engaged in dialog with the examiner as described in the paragraph below. The highest number of items recalled with assistance was the Gain Score. Gain Scores reflect the students' highest level of processing ability with assistance provided as needed, according to GP or MLE procedures. After administering the six subtests for which Initial and Gain scores had been established, the examiner re-administered the highest item recalled on each of the subtests to obtain a Maintenance Score. Maintenance scores reflect the students' level of independent performance after assistance has been provided. If the student was able to remember the last item presented, the Maintenance Score was the same as the Gain Score. If the students did not remember the last item correctly recalled, the Maintenance Score was the same as the Initial Score. The tests were administered by trained graduate students.

One group of students' working memory was individually assessed by a mediational dynamic assessment (see Appendix II for MLE directions as used by the examiners). An important component of this assessment is to encourage students to engage in meta-strategic learning processes. The mediation phase consisted of three general instructional components for each of the six subtests of working memory. First, working memory and its relationship to writing was discussed. Next, students generated strategies for how they expected to improve their working memory. Finally, students were given the opportunity to generate examples of how and when they use working memory in everyday learning situations based on a decontextualized principle (see Appendix II).

The other group of students were individually assessed by a graduated prompting dynamic assessment (see Appendix I for GP directions used by the examiners). The probes were standardized and published in the administration manual of the SCP-T. An important component of graduated prompting assessment is that students receive standardized hints or probes based upon the point at which an incorrect response is made. The administration of probes is based on research (see Swanson, 1996) that shows that items missed at the beginning or end of a sequence are more likely remembered than items missed in the middle of a sequence. Probes are administered after an error response for the Initial score. Probes are matched to the type of error made by the student. Thus, if the participant forgot the last items in a series, the first probe was administered. The first probe included the last item in the series. If the participant forgot the first items in a series, then the second probe was administered. The second probe included the first item in the series. Finally, if the participant forgot the intermediate items, then the third probe was administered. The third probe included the middle items in the series. If the examinee did not benefit from the previous probes, the entire set was re-administered. (Refer to Appendix I for probing instructions.) There was not a focus on linking working memory to writing during the GP intervention.

The approximate testing time for individual assessment was 45 to 90 minutes. The testing sessions took place during the students' Language Arts class. Students were not penalized for time missed in class and were not required to make up missed assignments.

The final phase of assessment was the administration of the Form-B Story Writing subtest (TOWL-3) approximately four months after the initial evaluation. Students were administered this test in the Language Arts classes. All students were given group instructions in the classroom setting. Students were reminded to use the strategies that they learned during the working memory assessment in order to remember what they had learned about writing. The total testing time for the post-test in writing was approximately 20 minutes and followed standardized procedures used during the administration of Form-A.

Data Analysis

The treatment effect of two types of dynamic assessment, mediated learning verses graduated prompting, on working memory Maintenance scores was determined by utilizing analysis of covariance (ANCOVA) with Maintenance memory scores as the dependent variable and Initial memory scores as the covariate. The treatment effect of the intervention on writing was also determined by ANCOVA with post-writing scores as the dependent variable and pre-writing scores as the covariate. Multiple regression analysis was used in order to find the best predictors for post-writing scores.

The Initial score estimates mental processing ability and can be interpreted in the same manner as a "static" intelligence (IQ) score illustrating general processing abilities assumed to be shared across academic areas. The Gain score reveals the highest level of performance under dynamic assessment conditions reflecting processing potential. According to Swanson (1996), the Gain score reflects Vygotsky's (1978) "zone of proximal development." The Maintenance score measures the ability to profit from intervention, once the instructional support offered during the dynamic assessment period are removed.

The following statistical procedures were performed:

(1) The treatment effect of two types of dynamic assessment approaches, GP verses MLE, on working memory Maintenance scores was determined by using analysis of covariance (ANCOVA).

(2) The treatment effect of two types of dynamic assessment approaches, GP verses MLE, on post writing scores was determined by using analysis of covariance (ANCOVA) and effect sizes (ES).

(3) The predictive relationships between Initial, Gain, and Maintenance Episodic and Semantic working memory scores as measured by the S-CPT under GP and MLE approaches to dynamic

assessment was determined by multiple regression analysis using the Spontaneous Writing Composite post-test score as criterion.

CHAPTER IV

RESULTS

This study investigated the manipulation of working memory using two types of dynamic assessment methods and the relationship of working memory to writing achievement. Simple statistics reporting means and standard deviations of pre-and post-writing scores as well as composite and component scores of working memory by treatment group are presented in TABLES II and III. The education variable in TABLE III refers to whether or not the student was identified as a special education student.

Before conducting inferential statistics, the normality distribution for each variable was checked. With the alpha level set at .05, means for all variables were normal. In addition, interaction effects between independent variables were checked with ANCOVA to satisfy the equal slopes assumption. Interaction effects were not statistically significant.

TABLE II

Pre-test and Post-test Means for Writing Scores and Working Memory Variables by Treatment Group

	GP GROUP (n=20)			MLE GROUP (n=24)		
	PRE	POST		PRE	POST	
Writing						
Mean	101.50	108.30		102.60	116.40	
SD	21.64	18.43		22.30	20.08	
Working Memory Composite Scores						
	Initial	Gain	Maint.	Initial	Gain	Maint.
Mean	97.35	98.70	100.70	98.50	98.67	101.30
SD	7.86	11.13	11.49	9.59	8.62	8.70
Semantic Memory Component Scores						
	Initial	Gain	Maint.	Initial	Gain	Maint.
Mean	97.70	95.90	98.55	98.29	93.88	97.63
SD	8.66	9.37	10.43	10.54	10.85	11.69
Episodic Memory Component Scores						
	Initial	Gain	Maint.	Initial	Gain	Maint.
Mean	98.15	102.90	103.60	98.88	101.10	107.00
SD	10.02	14.69	12.52	9.65	8.67	8.91

TABLE III

Pre-test and Post-test Writing Scores
by Treatment Group and Education

Group	Education	Pre-Writing		Post-Writing	
		Mean	SD	Mean	SD
GP	Regular (n=15)	108.53	18.92	114.60	15.09
	Special (n=5)	80.20	14.75	89.20	14.57
MLE	Regular (n=18)	109.67	19.96	123.44	16.77
	Special (n=6)	81.33	14.49	95.33	13.69

Note: Education = Regular or Special Education Status

The first research question as to the treatment effect of the two types of dynamic assessment approaches, graduated prompting (GP) versus mediated learning (MLE) on working memory was determined by using analysis of covariance (ANCOVA) with Initial working memory scores as the covariate. An effect size was also calculated on the gain from Initial to Maintenance working memory scores. The adjusted means of Maintenance working memory and post-writing scores are shown in TABLES IV and V.

TABLE IV

Least Squares (Adjusted) Means for Working Memory Maintenance Scores by Treatment and Education

TREATMENT	EDUCATION	MAINTENANCE WORKING MEMORY Adjusted Means	Standard Error
GP (n=15)	Regular	102.20	1.94
GP (n=5)	Special	98.04	3.38
MLE (n=18)	Regular	101.50	1.83
MLE (n=6)	Special	99.14	3.24

Note: Education = Regular or Special Education Status

TABLE V

Least Squares (Adjusted) Means for Post Writing Scores by Treatment and Education

TREATMENT	EDUCATION Adjusted Means	POST WRITING	Standard Error
GP (n=15)	Regular	110.19	2.46
GP (n=5)	Special	104.10	4.51
MLE (n=18)	Regular	118.27	2.28
MLE (n=6)	Special	109.46	4.15

Note: Education = Regular or Special Education Status

To investigate the first research question, the Maintenance working memory score was the dependant variable and Initial working memory score was the covariate. The reader is referred to TABLE VI for results. Using adjusted mean scores for the dependent variable, Maintenance working memory, the ANCOVA analysis revealed no statistically significant differences between treatment groups for Maintenance working memory scores, as shown in Table V. Neither treatment nor education main effects were statistically significant. For the treatment, $F(1,40) = .01$, $p > .05$, and for education, $F(1,40) = 1.38$, $p > .05$. The interaction effect between treatment and education was not statistically significant. There were also no interaction effects between treatment group and Initial working memory or between education group and Initial working memory scores. The effect size of the standard mean difference of the Maintenance working memory scores between treatment groups was .07. This further indicates that there was no treatment effect for working memory Maintenance scores.

The second research question as to the treatment effect of the two types of dynamic assessment approaches, graduated prompting (GP) versus mediated learning (MLE) on post-writing was determined by using analysis of covariance (ANCOVA) with pre-writing scores as the covariate. Using

TABLE VI

Analysis of Covariance of Working Memory Maintenance Scores by Treatment Group and Education with Initial Working Memory Scores as the Covariate

SOURCE	MEAN SQUARE	DF	F Value
Treatment	0.37	1	0.01
Education	77.74	1	1.38
Trt x Edu	6.49	1	0.12
Initial Working Memory	1021.74	1	19.31***
$F(4,39)$ = 9.10***	R-Square = .48		

Note: Treatment = GP or MLE
Education = Regular or Special Education Status
Trt x Edu = Treatment x Education Interaction

*p < .05; **p < .01; ***p < .001

adjusted mean scores for post writing, the ANCOVA analysis revealed statistically significant differences between treatment groups for writing post-test scores as shown in shown in Table VII. Students in the MLE treatment group scored significantly higher post-writing scores than students in the GP treatment group, $F(1,40) = 4.25$, $p < .05$. The main effect for regular or special education placement was not statistically significant, $F(1,40) = 3.53$, $p > .05$. The interaction effect between treatment (GP or MLE) and

TABLE VII.

Analysis of Covariance of Post Writing Scores by Treatment Group and Education with Pre Writing Scores as the Covariate

SOURCE	MEAN SQUARE	DF	F Value
Treatment	368.81	1	4.25*
Education	306.62	1	3.53
Trt*Edu	15.03	1	0.17
Pre Writing	6366.20	1	73.28***
$F(4,39) = 37.61$***		R-Square = .79	

Note: *$p < .05$; **$p < .01$; ***$p < .001$
Education = Regular or Special Education Status

education (regular or special education status) was not statistically significant. The effect size of the standard mean difference of the post-writing scores between treatment groups was .65. This further indicates that there was a medium treatment effect for post-writing scores.

The third research question, to investigate the effectiveness of the independent variables in predicting post-writing scores, was answered using a multiple regression approach. The multiple regression model used for post-writing scores was as follows: Post-Writing = Treatment + Pre-Writing + Initial Semantic WM + Gain Semantic WM + Maintenance Semantic WM + Initial Episodic WM + Gain Episodic WM + Episodic Maintenance WM + Education. This model explained 84% of the variance for post-writing scores.

The beta weights provide an indication of the relative statistically significant contribution of the variables to the prediction of writing achievement as measured by post-writing scores. Students' pre-writing scores were the highest statistically significant predictors of writing achievement, followed by Gain Semantic working memory, Special Education placement and MLE treatment. Of the working memory components, the Semantic Gain scores followed by Initial Episodic scores were the statistically significant predictors of writing achievement. The MLE treatment was the better predictor for writing achievement for special education students. The reader is referred to TABLE VIII for specific results.

TABLE VIII

Regression Model with Post Writing Scores as the Dependent Variable
(N=44)

Independent Variable	*B*	*Beta*	*t*
Pre-Writing	6.78	<0.01	6.78***
Gain Semantic	0.78	<0.01	3.33***
Special Education	10.03	0.01	2.66**
MLE Treatment	6.69	0.02	2.44**
Initial Episodic	0.45	0.05	2.06*

$F(6,36) = 27.60$** *R-Squared* = .84

Adjusted R-Squared = .82

Note: *p <.05, **p <.01, ***p < .001

CHAPTER V

DISCUSSION

This study examined the information processing construct of working memory and writing ability of regular and special education students in the 7th grade. The sample of participants consisted of both regular and special education students who received writing instruction in an "inclusion" regular education classroom. Measures of students' working memory were assessed using two methods of dynamic assessment, GP and MLE.

The types of working memory scores that were used in this study represent various levels of functioning. For both groups, the Initial scores represent working memory as a "static" score that is similar to an IQ score. The Initial scores also may be thought of as representing Vygotsky's "zone of *actual* development" as determined by independent performance. The Gain scores represent the highest level of performance within a dynamic assessment intervention phase. They are a measure of the ability of the student to "overcome" processing inefficiencies thereby retrieving information that was not readily accessible during the initial test phase prior to intervention. In other words, the Gain scores represent the "zone of *proximal* development" as described by Vygotsky (1978) that is the "processing potential" of students. Maintenance scores reflect the ability to internalize support given during intervention and to sustain performance. Thus the Maintenance scores reflect the strength of the intervention in maintaining the Gain score after the intervention has been removed.

In light of the research questions, the following discussion will first compare these research results to previous research on dynamic assessment in general. Then, practical implications for the use of dynamic assessment approaches by school psychologists in the assessment of students will be addressed. Finally, limitations of this study and suggestions for future research will be offered.

Discussion of Treatment Effects

The first research question regarding the influence of GP and MLE approaches to the dynamic assessment of working memory was answered in the following ways. Results from this study indicated that on the average, students in both GP and MLE groups attained slightly higher overall working memory scores with the interventions as represented by Gain scores. However, the difference in the Gain scores was not statistically significant. Although statistically insignificant, Maintenance scores were also higher than the Initial and Gain scores. The increase in Maintenance scores reflects students' ability to internalize the interventions. According to the results of this study, both intervention approaches were equally effective in producing Maintenance scores that were higher than Initial and Gain scores.

Although there was no statistically significant difference between treatment groups for Maintenance working memory scores, the results do indicate a statistically significant difference between the two intervention approaches in the effect on writing achievement, in favor of the MLE intervention. Taken together, these findings support the previous research of Burns (1985) and Burns, Delclos, Bransford, & Sloan (1986) whose findings also suggested that both GP and MLE approaches were equally effective in improving performance on assessment tasks, and that mediational approaches were more effective on transfer tasks.

The second research question pertained to the treatment effect of two types of dynamic assessment approaches on working memory, GP and MLE, and transfer to writing achievement. An analysis of post-writing scores, indicated that students in the MLE group attained statistically significant higher writing achievement post-test scores over their pre-test scores than students in the GP group. According to Cohen (1988), a useful indicator of the magnitude of a result is best described by effect sizes. Arbitrary conventions for low, medium, and large effect sizes are .2, .5, and .8 respectively. The effect size between pre- and post-writing scores by treatment group was .65, indicating a medium effect result in favor of the MLE group.

The intent of the GP intervention was to focus solely on working memory tasks within the assessment situation, (Swanson, 1996) with the assumption that students may be able to independently transfer efficient memory strategies to writing. Students were asked to choose a strategy from a pictorial array that best described how he or she would remember the information. The reader is referred to Appendix I for a review of the specific prompting directions.

The intent of the MLE intervention was to focus on facilitating transfer of working memory strategies to writing and other activities. Conditions of transfer met by the MLE intervention included developing personal strategies and inner meaning for the memory tasks. Specific strategies were adapted from the Cognet Enrichment Network Education Model (COGNET) (Greenberg, 1999) and included: focusing the student's attention on the structure of the task, developing personal strategies for remembering elements in the task, generating a principle that connects working memory to an experience, then bridging the principle to a writing activity. The reader is referred to Appendix II for a review of the specific mediational components in the intervention. The research findings in this study are supported by COGNET evaluation studies that examined academic gains of COGNET students (Greenberg, Machleit, & Schlessmann-Frost, 1996). Students who attended schools using COGNET made higher academic gains overall than comparison groups on standardized achievement tests. Using the principles of MLE, COGNET students were able to internalize metacognitive strategies and transfer strategies to various academic tasks.

According to Das & Conway (1992), transfer of learning to a new situation occurs when general strategy training aims for "far" transfer by successfully applying principles to a distant learning situation. Students in the MLE group were better able to transfer efficient use of memory retrieval to writing tasks than were students in the GP group. This finding might well be due to the ability of the MLE group to internalize neurological memory coding and schemes (Lidz, 1991) learned in the intervention and to generalize them into their writing than were students in the GP group. As previously noted, the intent of the GP intervention was to facilitate the enhancement of working memory within the testing situation rather than to facilitate transfer to distant learning situations. Furthermore, the nonintellectual variables of motivation and affect were purposefully integrated into the MLE intervention and not into the GP intervention. Hence, this study provides a clear indication that the incorporation of an MLE intervention within the assessment situation provides a basis for linkage to instruction. In other words, when an MLE intervention is used in assessment, (focusing on intent, inner meaning, and bridging principles), and if the intervention is successful in modifying the students' performance, then those same strategies used in the assessment may also be useful strategies to improve instruction and learning in the classroom.

Discussion of Predictive Relationships

The third research question addressed the predictive relationships of Initial and Gain Episodic and Semantic working memory scores of regular and special education students to writing achievement. The results indicated that students' pre-writing scores were the best predictors of post-writing scores, followed by Gain semantic scores, special education placement, MLE treatment and Initial episodic scores.

According to Swanson (1996), individuals who score high in semantic memory are able to understand and synthesize the elements of verbal reasoning, categorical reasoning and vocabulary into spoken and written language. Individuals who score high on episodic memory tasks are better able to sequence information with temporal contexts.

The Semantic working memory Gain scores were statistically significant better predictors of writing achievement than were Semantic working memory Initial and Maintenance scores. Semantic Maintenance scores were better predictors than Semantic Initial scores. This finding is supported in the literature by other researchers (Lidz & Greenberg, 1996; Swanson, 1992; Tzuriel, 1996; 1993), whose findings suggest that "dynamic" post-test (Gain) scores are more highly correlated to and predictive of achievement in reading and math than are "static" pre-test (Initial) scores. Swanson (1995) also found that the S-CPT as a dynamic assessment measure was a better predictor of achievement in reading than were IQ scores from the WISC-R. The finding in this study, that semantic memory Gain scores were more robust in predicting writing than Initial memory scores, adds support for the use of dynamic assessment measures.

Finally, the Initial Episodic working memory scores were better predictors of writing than were Gain or Maintenance WM scores. Although students attained higher Gain and Maintenance Episodic memory scores, their writing scores did not improve to the same degree. This finding suggests that the interventions for episodic memory did not appear to mediate the links between episodic memory tasks and writing.

Practical Implications for the use of Dynamic Assessment by School Psychologists

The results of this study have practical implications to the professional practice of school psychologists. According to Flanagan & Genshaft (1997), the current debate with regard to educational reform revolves around several issues: (1) the efficacy of conventional educational practices to meet the diverse needs of the student population, (2) the usefulness of intelligence tests for diagnosing disabilities, and (3) the effectiveness of assessment practices in assisting in the development of appropriate instructional programming. This study and others have demonstrated the utility and validity of dynamic assessment methodologies to meet this challenge by showing that dynamic assessment offers information above and beyond that offered by traditional assessment.

Dynamic assessment approaches tap information processing and learning potential above and beyond that which is found in traditional static assessment. Conventional assessment practices have been criticized in that they discriminate between racial and ethnic groups (Kranzler, 1997; Helms, 1992). According to Nisbett, (1995) these differences are attributed to environmental factors rather than innate ability. Reform efforts in education have called for alternative approaches to assessment.

Dynamic assessment approaches have proven useful in the assessment of culturally diverse and disadvantaged populations (Tzuriel, 1993; Kaniel & Tzuriel, 1990). Using a mediated learning approach of dynamic assessment, the researchers found that minority adolescents in the experimental group showed higher abilities of learning and transfer than did the control group. Tzuriel & Klein (1987) found that disadvantaged preschool children showed higher gains than did disabled children.

Dynamic assessment has also demonstrated that cognitive processes are modifiable through direct intervention, and thus offers important information above and beyond static IQ tests in the diagnosing of disabilities. Berninger and Abbott (in press) contend that learning disabilities ought to be redefined on the basis of dynamic assessment. By incorporating dynamic assessment methods into their practice, school psychologists and teachers may have a better understanding of whether a student's learning problems result from a lack of teaching, from a lack of use of efficient strategies, or general cognitive impairment.

In addition, dynamic assessment approaches offer useable information in knowing how much of and what kind of intervention is needed to bring about independent learning. The manner in which the cognitive processes are modifiable is applicable to instructional practice. For example, if students exhibit poor planning skills, then the principles of planning may be taught as a general thinking skill (Greenberg, 1999) or as a specific thinking skill (Das & Conway, 1992). If a student exhibits poor memory skills, the instruction may include memory components using visual and/or auditory strategies such as concept mapping or verbal rehearsal in order to aid in recall (Ashman & Conway, 1997).

As previously discussed, static assessment reflects a testing situation in which there is either no systematic attempt or no attempt at all to determine whether an individual has difficulty accessing the correct response after an error has occurred. Dynamic assessment assesses whether problems in the retrieval of information are related to the availability and/or accessibility of information in memory. A major contribution of this study is that mediational instruction within the testing environment using the principles of MLE, i.e. intentionality/reciprocity, inner meaning and bridging for transfer improves student outcomes by enabling students to demonstrate internalized strategies from the testing situation to improved writing performance in the classroom.

This study further supports the Hays and Flower (1996) model of cognitive processing in writing which asserts that working memory is the central mechanism involved in the act of written composition. To reiterate, within the task environment and in the individual, all of the processes involved in writing have access to and carry out "nonautomatic" activities in working memory. Within their model, working memory is comprised of phonological memory, a visual/spatial sketchpad, and semantic memory. The present study further suggests that episodic memory is also a component in writing because of significant contributions in predicting writing achievement.

Finally, dynamic assessment using mediational approaches have been criticized because of the lack of standardization in the procedures as well as the extra time required in the administration of measures (Lidz, 1992). The results of this study demonstrated that a standardized dynamic assessment approach, graduated-prompting, was not as effective as a mediated learning approach in transferring improved cognitive functioning to academic skills in writing. Although the mediational approach was more time consuming, the effects of the intervention justified the greater costs in time.

Recommendations for Future Research

The primary focus of this study was to address the relationship between working memory under two types of dynamic assessment approaches and writing in seventh-grade students. The results of this study indicated the MLE intervention was more effective in facilitating the transfer of working memory strategies to writing tasks. The conditions of transfer included developing personal strategies and inner meaning for the memory tasks. A limitation of this study is that these results may not generalize to younger students. Seventh grade middle school aged students were the focus of this study because preliminary research indicated that working memory capacity does not contribute unique variance to writing in younger children (Berninger, et al., 1993; Berninger & Swanson, 1996).

A second, limitation of this study is that the number of participants in each group was small. Although, initial recruitment numbers were sufficient, because of attrition factors, the actual number of participants was lower than anticipated. A recommendation for future research is to "over recruit" participants in order to insure a larger sample size.

Finally, a recommendation for future researchers would be to replicate this study using a control group for working memory and writing measures in the research design. The control group would comprise students who were administered the pre-writing test, working memory subtests in a test-retest format without incorporating graduated prompting or mediated learning interventions, followed by a post-test in writing. The addition of the control group would strengthen the findings that the MLE intervention had a statistically significant impact on post-writing scores.

This study supported the revised Hayes & Flower writing model that includes a phonological component, a visual/spatial component, and a semantic component within working memory. Results of this study also found that episodic memory contributed to the Hayes & Flower (1996) writing model. The ability to process sequential information is considered to be an important component of the Episodic Composite score. On the other hand, the ability to integrate written language and information (simultaneous processing) is a component of the Semantic Composite score.

In this study, the Initial Episodic memory score was a better predictor of writing achievement than the Gain and Maintenance Episodic memory scores. Although episodic memory performance improved, the enhanced processing efficiency was not a better predictor of writing scores. There are at least two plausible explanations for this finding. First, it is possible that the interventions used for the episodic memory subtests were not a function of students' ability to sequence events in post-writing tasks. Another plausible explanation is that individual differences in episodic processing efficiency were not a function of writing achievement where as the general capacity of working memory as measured by the episodic subtests was related to writing achievement.

The next reasonable steps in forwarding the findings of this research are (1) to operationalize episodic memory as a variable in the Hayes & Flower (1996) writing model and (2) to refine the mediated learning intervention for episodic memory tasks in order to determine whether enhanced episodic memory is a function of improvement in the organization of writing tasks. In addition, the development of mediational approaches to examine other components in the Hayes & Flower model, for example, text reflection (planning) and motivation would serve to add to the current body of knowledge about writing.

The data provided in this study found that both groups of special and regular education students improved in writing ability when instructed in heterogeneous classrooms. However, students in the MLE group attained statistically higher writing scores than did students in the GP group. Further applied research is needed in classroom settings in order to replicate the positive findings in favor of instructional strategies that incorporate mediated learning experiences to improve academic achievement in a variety of subject areas.

Conclusions

The contemporary theories of mediated learning experience (Feuerstein, 1979) and the zone of proximal development (Vygotsky, 1978) are imbedded in the methodologies of dynamic assessment. Dynamic assessment approaches have met the challenge of contributing to the fields of school psychology and education by not only demonstrating effectiveness in identifying learning problems of students, but also in assisting those students to use strategies to alleviate particular learning problems. Some of these approaches, for example graduated prompting, are limited to the immediate task, incorporate standardized procedures, and are better suited for placement decisions. Other approaches, such as mediational approaches, are less standardized and are recommended for use in strategic transfer to academic tasks such as writing.

The specific findings of this study indicated that both GP and MLE interventions were successful in promoting the processing efficiency of overall working memory as measured by the Composite Working Memory score. However, the mediated learning approach was more effective in promoting increases in writing achievement.

The results of this study indicate that by incorporating dynamic assessment procedures into their professional practice, school psychologists are able to do more than just evaluate students for placement decisions. The results from dynamic assessment findings, using mediated learning approaches, offer practical and useful knowledge for teachers regarding appropriate interventions to use with students who exhibit various learning problems.

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APPENDICES

APPENDIX I

Dynamic Assessment: Graduated Prompting

I. RYHMING WORDS

I'm going to say some words, then ask you a questions about the words, and then I would like you to say the words in order to me. For example, I would like you to remember "MAT-CAT," but first I would like you to answer a question about those words. Which word did I say, "cat" or "rat"?

That's right. "CAT" was the word I said. Now can you tell me all the words that I said in order?

Now lets try some other words.

1.	lip-slip	*slip* or jip
2.	run-/fun/-gun	sun or *fun*
3.	car-/star-bar-/far	jar or *star*
4.	shun-/bun-nun-pun-/dun	*nun* or pun
5.	nap-sap-/gap-rap-/cap-lap	*gap* or flap
6.	ear-dear-/sear-fear-gear-year-/ clear-near	*snear* or gear
7.	sack-crack-back-/ snack-black-shack-track-/ mack-jack-flack	*snack* or rack
8.	red-fed-bed-/ led-ned-jed-sled-shed-head-/ ped-fred-bled	fled or *fed*
9.	care-fare-share-dare-/ clare-bare-tare-mare-hare-lare-/ pare-ware-blare-flare	chair or *tare*

Probe Instructions:

Probe 1. The last word(s) in the sequence were_______. Now can you tell me all the words in order?

<u>(If set 1 was missed, skip probe 1 and move to probe 4)</u>

Probe 2. The first word(s) in the sequence is (are) ___________. Now can you tell men all the words in order?

Probe 3. The middle words in the sequence are _______. Now can you tell me all the words in order?

Probe 4. All the words in order are __________. Now can you tell me all the words in order?

II. VISUAL MATRIX

Instruction and Administration

I'm going to show you some pictures of boxes, and there will be dots in some of these boxes. I'm going to show these pictures to you for FIVE seconds and then I will cover up the pictures. You have a sheet of paper with boxes in front of you. I would like you to fill in where the dots are to go for each box. Before you begin filling in the dots, I will ask you a question.

SHOW THE MATRIX FOR FIVE SECONDS

Process Question Are there any dots in the first column? (The first column is defined as the first vertical section of the matrix on the examinee's left-hand side)

Draw the dots in the correct order.

Probe Instructions to Examiner

(The examiner needs to have available at least 4 Examinee Response forms for the probing and another for the maintenance condition.)

Probe Instructions to Examinee

If you missed placing some dotes in the right boxes, I think you can do it correctly if I provide you with some hints.

Probe 1. On the blank matrix, the examiner correctly draws in dots for the column(s) labeled E (end). Now can you draw where the rest of the dots go?

Probe 2. On a blank matrix the examiner draws in dots for the column(s) labeled B (beginning). Now can you draw where the rest of the dots go?

Probe 3. On a blank matrix, the examiner draws in the dots for the column(s) labeled M (middle). Now can you draw where the rest of the dots go?

Probe 4. This Picture Book matrix is shown for 2 seconds. Now can you fill in all of the dots?

III. AUDITORY DIGIT SEQUENCE

Instructions and Administration

I'm going to read you some sentences that have information I want you to remember. All the sentences have to do with remembering an address, but I would like you to pay attention to all the information in the sentence because I will ask you a question about the sentence. After I present this information, and before you recall it, I will ask you to choose a strategy.

(Show the Subtest Strategy Card)

Some of the ways that help you remember are:

1. Saying the numbers over to yourself. For example if I say "2-4-6-3 Bader Street," you world say it to yourself over and over again.

2. Or you might say some numbers together in pairs. For example, you might say "24 and 63."

3. Or you may just want to remember that the numbers go with a particular street and location. For example, if I say "2-4-6-3 Bader Street," you would remember that 2-4-6-3 and Bader Street go together.

4. Or you might think of other things that go with the numbers, for example, if I say "2-4-6-3," you might think "2-4-6-3, I have to go climb a tree."

ITEM SETS:

1. Imagine you are a taxi driver and you have to drive people around in a car. Suppose somebody wanted to have you drive them to the hospital located at 2-9 MAPLE STREET.

PROCESS QUESTION: *Now what was the name of the street?*

STRAGEGY QUESTION: *Now point to the picture that you think will help you remember the address.*

RECALL QUESTION: *Now tell me the numbers of the address of the hospital in order.*

2. Suppose somebody wanted to have you drive them to the library at 1-/4-/8 OAK STREET.

3. Suppose somebody wanted to have you drive them to the

supermarket at <u>8-/6-5-/1 ELM STREET.</u>

4. Now suppose somebody wanted to have you drive them to the mall at <u>9-/4-1-7-/3 CEDAR STREET.</u>

5. Now suppose somebody wanted you to have you drive them to the church at <u>6-3-/7-9-/1-5 ASPEN STREET.</u>

6. Now suppose somebody wanted to have you drive them to the park at <u>9-1-/3-5-7-/8-2 SYCAMORE STREET.</u>

7. Now suppose somebody wanted to have you drive them to the post office at <u>1-3-5-/9-6-8-4-/3-2-7 LOCUST STREET.</u>

8. Now suppose somebody wanted to have you drive them to the market at <u>7-8-3-/4-4-1-8-9-3-/5-7-4 PINE STREET.</u>

9. Now suppose somebody wanted to have you drive them to the University at <u>4-7-2-/8-1-3-6-2-1-9-3-/ 6-2-6 POPLAR STREET.</u>

<u>PROBE INSTRUCTIONS:</u>

1. The last numbers of the address for the ________ on ________ street are __________. Now can you tell me all of the numbers in order?

2. The first numbers of the address for the ______ on __________ street are ________. Now can you tell me all of the numbers in order?

3. The middle numbers for the ________ on ________ street are ____________. Now can you tell me all of the numbers in order?

4. The numbers in order for the _________ on ___________ street are ____________. Now can you tell me all of the numbers in order?

IV. MAPPING AND DIRECTIONS

Instructions and Administration

You can see on this map there are buildings and streets. There are also dots, lines, and arrows. The dots are stoplights and the lines and arrows are directions. I want you to imagine that you are driving a car and you are lost in the city. You asked for directions from people in the city and they drew you a map like this one. The amp will help you get out of the city. Sometimes the car will zig-zag on some streets and that's okay, as long as you follow the arrows.

Before you draw the directions and stoplights, I would like you to show me the way you are going to remember. I would like you to pick a picture that best matches how you plan to remember the directions and stoplights.

The ways of remembering as shown in these pictures are:

1. Begin by filling in the dots or stoplights first and then draw the lines.
2. Start with the design first and then fill in the dots.
3. Do parts of the city that you remember and then try to put together the rest.
4. Start from the place where they drive out of the city and then work backwards.

Here is the map to be remembered: Present the map for 5 SECONDS.

PROCESS QUESTION: Were there any stoplights in the first column?

STRATEGY QUESTION: Which one of these 4 pictures best shows how you are going to remember the map? Show the strategy sheet for 10 seconds.

Give the examinee a blank may and say: Please draw the lines and arrows (directions) and dots (street lights) as quickly as possible on this blank map. Be sure to connect all the dots with lines, and be sure to include the arrows (allow up to 30 seconds).

Repeat the above until the examinee makes an error, then present the probing questions.

PROBE INSTRUCTIONS

You missed placing some of the dots, arrows, and/or lines in the right place on your map. I think you can do it correctly if I give you some hints.

Probe 1. On a blank map, the examiner draws in the dots, lines and arrows for the column(s) labeled E and says, NOW CAN YOU TELL ME WHERE THE REST OF THE DOTS (STOPLIGHTS) GO AND CONNECT THEM?

Probe 2. On a blank map, the examiner draws in the dots, lines and arrows for the column 9s) labeled B, and says, NOW CAN YOU TELL ME WHERE THE REST OF THE DOTS GO AND CONNECT THEM?

Probe 3. On a blank map, the examiner draws in the dots, lines, and arrows for the column(s) labeled M, and says, NOW CAN YOU TELL ME WHERE THE REST OF THE DOTS GO AND CONNECT THEM?

Probe 4. The picture book is shown for 5 seconds. The examiner removes the model map and asks the examiner to draw the map correctly.

V. STORY RETELLING

Instructions and Administration

I'm going to read you a paragraph from a book. When I stop I would like you to repeat the events of the story in the order that I read them to you. I would like you to listen to everything I say because I will ask you a question about the story.

Read the story.

(1) On March 25, 1944, Sergeant Nicholas Alkemade of the Royal Air Force looked at his watch. (2) Just three hours earlier, he had been in a bomber that had caught fire while on a bombing raid over Berlin. (3) The captain of the bomber crew ordered all the crew to bail out, but the fire in the fuselage made it impossible for Alkemade to reach his parachute.

(4) He had to make a decision-either to die in the fire or jump out of the airplane. (5) He opened the plane's door and jumped 18,000 feet without a parachute. (6) The last thing he remembered he was looking at his feet and seeing stars. (7) Falling at 120 miles per hour, he landed in a fir forest interlaced with branches. (8) Eighteen inches of snow cushioned his final landing.

(9) He was found by a German patrol and taken prisoner. (10) Understandably, his story at first was disbelieved by German interrogators-but the story was true. (11) Alkemade suffered burns on his legs, face, and arms-all sustained before his over three-mile jump.

Process Question

Was the person who jumped out of the plane a man or a woman?

Now tell me the story, in order of the events, as if I have never heard it before.

Process Instructions

That was good story telling. You had left out some details or had them in the wrong order. I would like to read the sentence(s) you left out or mixed up. Now can you tell me the events of the story in order?

Probe 1. The sentences you mixed up or left out at the end of the story were (read sentences 9,10, and/or 11). Now can you tell me the events of the story in order?

Probe 2. The sentences you mixed up or left out at the beginning of the story were (read sentences 1, 2, and/or 3). Now can you tell me the events of the story in order?

Probe 3. The sentences you mixed up or left out in the middle of the story were (read sentences 4, 5, 6, 7, and/or 8). Now can you tell me the events of the story in order?

VI. SEMANTIC ASSOCIATION

<u>Instructions and Administration</u>

I am going to say some words. Some of the words go together. Don't tell me the words in the order I give them to you, but say the words that go together. For example, if I say the words, "car, baseball, truck, football' you would say 'car and truck" together and then you would say "baseball and football" together. This is because a car and truck are something you ride in, a form of transportation, and baseball and football are sports.

Now remember, when I give you the words mixed up, I want you to change the order of the words and say the words as they go together. I will ask you a question about the words and then you answer the questions and then say the words that go together.

ITEM SETS	PROCESS QUESTION
1. (vegetables and clothes) coat, carrots/ gloves, tomatoes	Which word, carrot or banana
2. (fruit and vehicles) pear, car, prune/bus, apple, truck	Which word, apple or peach
3. (tools and clothes) shirt, saw/pants, hammer/ belt, nails	Which word, level or saw
4. (sports, furniture, weapons) hockey, rifle, chair/ football, sword, table	Which word, sword or knife
5. (birds, colors, shapes) canary, black, triangle/ robin, orange, circle/ sparrow, pink, hexagon	Which word, red or orange

5. (transportation, chemicals, elements, animals)

airplane, hydrogen, gorilla/
ship, nitrogen, lion, bus, sodium, puma/
taxi, carbon, koala

Which word, ship or car

7. (American presidents, trees, occupations)

Fillmore, eucalyptus, chemist/
Madison, pine, zoologist, Garfield, ash,
Clerk, Adams, architect/
Buchanan, sycamore, machinist

Which word
Birch or ash

8. (authors-literature, musical instruments, tools, personalities)

Which word
Dickens or
Twain

Tolstoy, viola, bolts, depressed/
Dickens, flute, stapler, neurotic, Hemingway,
Homer, cello, sandpaper, paranoid

<u>Probe 1.</u> If the examinee omits a final word in any category, the examiner tells the examinee <u>all the category names and the final word</u> that appears in the list within each category. The examiner then asks the examinee to recall all the words by category.

<u>Probe 2.</u> If the examinee omits a beginning word in any category, the examiner tells the examinee <u>all the category names and the first word</u> that appears in the list within each category. The examiner then asks the examinee to recall the words by category.

<u>Probe 3.</u> If the examinee omits a beginning word in any category the examiner tells the examinee <u>all the category names and all the middle words</u> that appear in the list within each category. (If the set does not have middle words, the examiner proceeds to <u>probe 4</u>). The examiner then asks the examinee to recall the words by category.

<u>Probe 4.</u> The examiner presents all the words in their original order and asks the examinee to recall all the words that go together.

MAINTENANCE SCORES

After Initial and Gain Scores have been established for the six subtests, the examiner again presents the examinee with the highest numbered item that was successfully recalled with either the probing or mediation (Gain Score). This time, however, hints and/or mediation are not provided.

I. Rhyming Words

These words that I'm going to say for you now were presented earlier. I want to see if the words are now easier for you to remember.

Present the items, ask the process question, ask the examinee to recall the words in the correct order.

II. Visual Matrix

This matrix that I'm going to show you was presented earlier. I want to see if the matrix is now easier for you to remember.

Present the model matrix in the Picture Book, remove the model matrix, ask the process question, present a blank matrix, and ask the examinee to complete it correctly. Score as a gain score if correctly reproduced, if not score as an initial score.

III. Auditory Digit Sequence

The sentence I'm going to read to you was presented earlier. I want to see if the numbers in the sentence are easier for you to remember. Remember to choose your strategy.

a. Say the numbers to yourself.
b. Say the numbers in pairs.
c. Remember that numbers go with a particular street.
d. Think of other things that go with numbers.

The examiner then reads the sentence, asks the process question, and directs the examinee to recall the numbers.

IV. Mapping and Directions

This map that I'm going to show you was presented earlier. I want to see if the map is easier for you to remember this time. Remember to choose your strategy.

a. Start with the dots first.
b. Start with the design first.
c. Do the parts of the city you remember first and then try to figure out the rest.
d. Start from the most recent and work backwards.

Show the map for 5 seconds, ask the process question, present a blank Response Form, and ask the examinee to reproduce the correct directions.

V. Story Retelling

This story I'm going to read to you is the same one I read to you earlier. I want to see if the sentences in the story are now easier for you to remember. Read the story, ask the process question, and ask the examinee to recall the story.

VI. Semantic Association

The set of words that I'm going to read to you was presented earlier. I want to see if the set is now easier for you to remember. Present the set, ask the process question, ask the examinee to recall the words that go together.

Note: The instructions in Appendix I were from the Swanson's Cognitive Processing Test (SCP-T) Administration Manual (Swanson, 1996).

APPENDIX II

Dynamic Assessment: Mediational Assessment
General Directions

I'm going to present you with some information, and would like you to do the best you can to remember that information. Some of the information will be easy to remember and some will be difficult. Just do your best. This is probably a different kind of activity than you have done before. That's because I'm just as interested in the ways that you try to remember the information as I am in the number of items you are able to remember. While we work together today, I'm going to ask you to try to remember some new and different kinds of information. This information will help us find out how a special kind of memory called "working memory" is related to the way we go about writing.

Working memory is a "temporary storage area or a work space where information is held in our memory while we think about what we are going to do next and/or how we are going to use the information." We can apply this concept of working memory to writing if we think of our brain as a work space where we hold information in the form of ideas, plans, and/or rules about what we want to put down on paper or write. As we write we use specific operations, or procedures to accomplish our goal of generating (creating) text (manuscript) on paper. To simplify this process, we take our ideas and put them down on paper. Our ability to use working memory processes efficiently is related to how well we are able to put our thoughts on paper.

I'm interested in finding out if the strategies you learned to improve your working memory in the tasks help you to improve your writing.

Give me some examples of how you use working memory when you write.

BRIDGING: Tell me some other ways that we use working memory every day at school, at home, to solve problems?

GENERAL GUIDELINES FOR MEDIATION AFTER EACH SUBTEST

INTENT

1. Review the pre-test, pointing out correct responses as well as where mistakes were made.

2. Ask: What did you do to help you remember? What will you do this next time?

2. Discuss various strategies for remembering.

MEANING

Discuss why the efficient use of working memory is important in this activity.

PRINCIPLE

If I use working memory efficiently, then I will improve my________________skills.

TRANCSENDENCE

When do we use this skill at school, at home, when writing?

I. RHYMING WORDS GUIDELINES FOR MEDIATION

1. Review the pre-test orally, pointing out correct responses as well as where mistakes were made.

2. Ask: "What did you have to do in this task?

   "What did you do to help you remember?'

   Here are some strategies to help you remember:

   a. Listen for the same middle and ending sound
   b. Remember the same middle and ending letters
   c. Remember the first letter and ending sounds
   d. Auditory an/or visual rehearsal (say or see the words over and over)

3. Why is an efficient use of working memory important in this activity?

<u>Principle: If I use working memory efficiently, then I will remember what I have heard.</u>

4. Let's do the rhyming words tasks again. What strategy are you going to use to help remember?

   Use your strategy to help you do a better job at remembering the words.

Give the subtest again without probes to get GAIN SCORES.

II. VISUAL MATRIX MEDIATIONAL GUIDELINES

1. Review the pre-test, pointing out correct and incorrect responses.

2. Ask: "What did you do to help you remember?
   What will you do this time?

   Here are some strategies to help you remember.

Discuss systematic scanning and strategies for remembering the dot placements on the matrix.

a. grouping
b. visual imaging
c. verbal rehearsal
d. other ideas

3. How did you use your strategy to help you remember?

4. Why is efficient use of working memory important in this activity?

<u>Principle: If I use working memory efficiently, then I will improve my visual/spatial skills.</u>

5. When do we use this skill at home? At school? When we write?

6. What strategy will you use to help you remember the dots this time? Use what you learned to help you do a better job as we do this activity again.

Re-administer the VISUAL MATRIX subtest to get a GAIN SCORE.

III. AUDITORY DIGIT SEQUENCE GUIDELINES FOR MEDIATION

1. Review the pre-test. Point out correct and incorrect responses. Discuss and review the systematic strategies used for remembering the address-digit sequence shown on the strategy sheet.

    a. Say the numbers to yourself.
    b. Say numbers in pairs.
    c. Remember that numbers go with a particular street.
    d. Think of other things that go with the numbers.

2. How did you use your working memory to help you remember?

3. Why is efficient use of working memory important in this activity?

    Principle: If I use WORKING MEMORY efficiently then I will be able to accurately remember the correct order of things.

4. When do we use this skill at home? At school? When we write?

5. What strategy will you use this time to help you remember the addresses?

Re-administer the AUDITORY DIGIT SEQUENCE subtest to get a GAIN SCORE.

IV. MAPPING AND DIRECTIONS GUIDELINES FOR MEDIATION

1. Review the pre-test. Point out correct responses as well as where mistakes were made. Discuss and review the systematic strategies used for remembering the information.

    a. Start with the dots first
    b. Start with the design
    c. Do the parts of the city you remember first and then try to figure out the rest
    d. Start with the most recent and work backwards

2. Ask: How did you use your working memory to help you remember? Why is efficient use of working memory important in this activity?

<u>Principle: If I use working memory efficiently, then I will be able to make a better plan.</u>

3. When do we use this skill at home? At school? When we write?

4. What strategy will you use as you do this task again? Use what you learned to help you do a better job remembering the directions.

Re-administer the AUDITORY DIGIT SEQUENCE subtest to get a GAIN SCORE.

V. STORY RETELLING MEDIATIONAL GUIDELINES

1. Review the pre-test. Point out where correct responses as well as where mistakes were made.

2. Ask: What do we need to know so that we can do this better?

   Discuss systematic stragegies for remembering stories. For example, what happeed at the beginning, in the middle, and at the end of the story. Use visual imaging or verbal rehersal.

3. How did you use your working memory to help you remember?

4. Why is efficient use of working memory important in this activity?

   <u>Principle: If I use working memory efficiently, then I will be able to remember the correct order of events.</u>

5. When do we use this skill at home? At school? When we write?

6. What strategy will you use to help you to remember the events in the story?

The examinee is asked to tell the story again, in the correct order. The Gain Score is computed as the number of sentences recalled and is determined in the same manner as the Initial Score.

VI. SEMANTIC ASSOCIATION MEDIATIONAL GUIDELINES

1. Review the Initial (pre-test) scores, pointing out where correct responses as well as where mistakes were made.

2. Discuss strategies for remembering the words that go together.

   a. Think of words in a category.
   b. Think of ways in which words are alike.
   c. Think of a way to associate words.
   d. Think of the differences between words.

3. Ask: How did you use your working memory to help you remember?

4. Why is efficient use of working memory important in this activity?

   Principle: If I use WORKING MEMORY efficiently, then I will be able to selectively attend to what is important.

5. When do we use this skill at home? At school? When we write?

6. Let's talk about what we have learned.

   What strategy will you use? Let's use what we learned to help us do a better job of remembering as we do this activity again.

Re-administer the SEMANTIC ASSOCIATION subtest to obtain a GAIN SCORE.

MAINTENANCE SCORES

After Initial and Gain scores have been established for the six subtests, the examiner again presents the examinee with the highest item that was successfully recalled with either the probing or mediation (GAIN SCORE). This time, however, the hints and/or mediation are not provided.

VITA

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Ms. Machleit has been involved in various aspects of the educational systems in North Carolina and Tennessee. In North Carolina, she taught in a private school for dyslexic children. In Tennessee, she worked as a public school teacher in regular and special education classrooms. She also served as a lead support teacher for the Cognitive Enrichment Program (COGNET). She is presently employed as a school psychologist in a public school setting. She was awarded the Doctor of Philosophy in Education degree in December of 1999.