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DEVELOPMENTAL CHANGES IN SELF-REGULATED LEARNING DURING A MULTI-TRIAL SORT-RECALL TASK

by

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A dissertation submitted to the Graduate Faculty in Educational Psychology in partial fulfillment of the requirements of the degree of Doctor of Philosophy, The City University of New York

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Abstract

DEVELOPMENTAL CHANGES IN SELF-REGULATED LEARNING DURING A MULTI-TRIAL SORT-RECALL TASK

by

Sebastian Bonner

Advisor: Professor Barry J. Zimmerman

A strategy model of student self-regulated learning (Zimmerman, 1986, 1989a, 1989b, 1990; Zimmerman & Martinez-Pons 1986, 1988, 1990) delineates the specific processes that contribute to student achievement. In this model, self-regulated learning processes are cyclically determined within three phases: forethought, performance/ volitional control, and self-reflection (Zimmerman, in press). Important forethought self-regulative processes include self-efficacy, goal setting, and strategic planning. Key performance/volitional control self-regulatory processes include self-observation and strategy use. A significant self-reflective phase process is self-reaction.

A procedure was created to investigate the early emergence of self-regulated learning processes in a cross-sectional study of 2nd, 5th, and 8th graders engaged in a sort-recall task. In this procedure, participants sorted picture cards into groups, arrayed them on a table, turned them face down, and tried to recall their location in order to match them with a duplicate set of picture cards. Participants were offered three increasingly difficult recall exercises, beginning with 10 cards, then 20, then 40 and were permitted to proceed sequentially through to the most difficult exercise, or to stop at easier levels.

Using this procedure, measures were taken of variables within the three phases proposed in Zimmerman's (in press) strategy model of student self-regulated learning. Determinants in the forethought phase were assessed with measures of learning and performance self-efficacy, learning and performance goal setting, and strategic planning. Performance/volitional control phase determinants included task strategy use and self-observation. Self-reflective phase determinants were assessed with a measure of self-reaction.

Multivariate analysis of variance of the measures of self-regulated learning processes showed statistically significant main effects for grade on all variables. Post-hoc analyses all measures were significantly different among all three grades, except for non-significant differences between the 2nd and 5th graders on sorting, study behavior, self-testing, strategy adjustment, and self-reaction. Path analyses revealed simple connections among 2nd graders' self-regulated learning processes, more complex connections in the case of 5th graders, and markedly integrative connections in the case of 8th graders, supporting the third hypothesis. Further analyses explored which variables predicted persistence to increasing difficulty levels.

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CHAPTER I

LITERATURE REVIEW

Introduction

Recent research has identified the important role that self-regulated learning processes play in student learning and achievement (Zimmerman, 1986). Self-regulation refers to self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals (Zimmerman, in press). A strategy model of student self-regulated learning (Zimmerman, 1986, 1989a, 1990; Zimmerman & Martinez-Pons 1986, 1988, 1990) has been developed that delineates the specific processes that contribute to student achievement. In this model (Zimmerman, in press), self-regulated learning processes are cyclically determined within three phases: forethought, performance/volitional control, and self-reflection.

An important process in self-regulative forethought is self-efficacy, a person's perception of his or her capability to learn or perform specific tasks at specific levels of mastery (Bandura, 1986). More generally, self-efficacy can be thought of as personal beliefs about one's ability to learn or perform effectively. Self-efficacy has been shown to be one of the best predictors of intrinsic motivation (Zimmerman, 1985, 1995b) and academic achievement (Schunk, 1984). Self-efficacy is a self-motivational belief underlying two other self-regulative processes within the forethought phase, goal setting and strategic planning. Goal setting refers to decisions about specific outcomes of learning or performance. Strategic planning involves purposive personal processes and actions directed at acquiring or displaying skill (Zimmerman, 1989). Highly self-

regulated people make cyclical adjustments in their strategic planning as they reconceptualize task demands in repeated iterations of a familiar learning effort.

Key performance/volitional control self-regulatory processes include strategy use and self-observation. Strategy use relates to efforts to reduce learning or performance demands to their essential parts and organize them meaningfully. The effectiveness of a wide range of cognitive strategies has been documented (e.g., Pressley, Woloshyn, & Associates, 1995). Self-observation involves personal efforts to perceive and record one's actions and their outcomes (Zimmerman, 1989b).

A significant self-reflective phase process is self-reaction. Self-reaction in the form of satisfaction or dissatisfaction, and their associated affect regarding performance, is important because people pursue courses of action that result in satisfaction, and avoid those that produce dissatisfaction (Zimmerman, in press).

The Zimmerman strategy model of self-regulated student learning assumes that students are active managers of their own learning rather than passive participants within structured learning environments (Zimmerman, 1989a). In this model, students are assumed to be metacognitively, motivationally and behaviorally active participants in their own learning processes (Zimmerman, 1986). Students are similarly conceptualized as primary agents in their own learning by several researchers including Schunk (1986), Corno (1986), and McCombs (1986).

Surprisingly little research has been conducted on the early emergence of self-regulated learning processes among young children. And although children as young as 9 years old have been used as participants in research on some aspects of self-

regulated learning (e.g., Schunk & Rice, 1992; Schunk & Hanson, 1989), research programs focusing specifically on how students' self-regulated learning processes develop are rare (Dufresne & Kobasigawa, 1988, 1989; Kobasigawa & Metcalf-Haggert, 1993).

In contrast, several research programs have explored the development of children's metacognitive knowledge and skill (Hasselhorn, 1992; Best & Ornstein, 1986; Best, 1993; Bjorklund & Buchanan, 1989; Schneider & Bjorklund, 1992; Gaultney, Schneider and Bjorklund, 1992; Bjorklund, et al., 1994). According to self-regulation theory, metacognitive factors constitute one of many aspects of learning. Zimmerman's (1989b, 1990) strategy model of student self-regulated learning includes self-efficacy, goal setting and planning, along with metacognitive processes, as personal determinants of self-regulated learning, and also includes behavioral and environmental determinants.

An investigation into the development of children's self-regulated learning processes, therefore, must incorporate other personal variables beyond metacognition, as well as behavioral and environmental variables, but could be informed by the findings of the research conducted within the limits of a metacognitive framework (Zimmerman, 1995a). What follows is a review of the findings on children's development of metacognitive knowledge and skills.

Developmental Changes in the Use of Memory Strategies

Lovett and Flavell (1990) conducted three studies on developmental changes in knowledge about mental processes using first graders, third graders and university students as participants. These studies investigated the development of children's understanding of the difference between strategies required for remembering (e.g., rehearsing) and strategies that aid comprehension (e.g., looking up a word in a dictionary). The procedure involved presenting participants with lists of words that were to be memorized (without demanding that their meaning be understood) and other lists that were to be understood (but not necessarily remembered).

This research was based on evidence that first graders (children aged 6-7) sometimes use rehearsal to achieve memorization, and by third grade (age 8-9) they are aware that categorization can facilitate memorization. However, at second grade (age 7-8), children rarely consider looking up an unfamiliar word in a dictionary to determine its meaning, relying more often on inappropriate strategies such as sounding out the word.

In line with these indications, Lovett and Flavell (1990) found that first graders rarely showed any clear understanding of the comprehension-memory distinction. And although third graders evinced an understanding that different studying methods are needed to achieve memorization versus comprehension, they were unable to recognize that different task features call for different strategic approaches. Third graders failed to discern that task features such as list length require students to use memorization strategies, and tasks such as item categorization require comprehension strategies.

By sixth grade, students instructed in specific memory strategies show improvements in memory retention and strategic transfer to related tasks (Fatal & Kaniel, 1992). However, sixth graders do not spontaneously apply mnemonic techniques across tasks, nor do they spontaneously retain items in memory over time. Improvements in their strategic skills and their memory achievement are greater when they are instructed in processes that Fatal and Kaniel (1992) classify as cognitive self-regulation, namely planning, monitoring and evaluation.

The studies by Lovett and Flavell (1990) and Fatal and Kaniel (1992) imply that between the third and the sixth grade, children's basic conceptualizations of their cognitive processes develop into skills needed to control their memory functions.

Item Typicality

Best (1993) provides details on how children's memory control skills develop. She specifically trained a group of third graders to use a memory strategy and merely induced another group of third graders to use organizational strategies by exposing them to categorizable materials. The latter treatment was based on indications that younger children spontaneously categorize materials for later retrieval within contexts supportive of such behavior, such as when the materials to be memorized consist of highly typical exemplars of the categories.

The group that received strategy training did not perform as well on organization and recall as did the group that was induced to use organizational strategies through prior exposure to high typicality categorizable materials. The latter group generalized their strategic sorting behavior to atypical materials. This result

supports Lovett and Flavell's (1990) finding that third graders are not amenable to strategy training.

Hasselhorn (1992) also found that the deliberate use of a categorization strategy by second and fourth graders increases with age and with item typicality. Within a 2 x 2 design (second or fourth graders x category typicality or atypicality), strategic activation of category knowledge was only possible by fourth graders presented with high typicality items.

Best and Ornstein's (1986) study on the effect of category typicality on children's use of categorization strategies included third and sixth grade students as participants. The third graders were trained to sort and recall high typicality items and were then asked to demonstrate their learning on low typicality items. They displayed greater organization in sorting, and recalled more low typicality items than did third graders who had been initially exposed to low typicality items. Clearly, for the third graders, low typicality items did not provide good exemplars for sort and recall training. The sixth graders' performance with low typicality items, on the other hand, did not depend on whether they had been initially exposed to high or low typicality items.

Similarly, when third, fourth, fifth, and seventh graders were trained to use organizational strategies, age differences emerged in the acquisition and use of the strategic classification skills (Bjorklund & Buchanan, 1989). The findings implied that as children grow older, they utilize more than simple category knowledge to improve their memory functioning. The seventh graders evinced greater recall and use of more

sophisticated clustering strategies in sort-recall tasks than the fourth graders. These age differences were more pronounced when the category lists contained typical items than when they contained atypical items. This finding implies that category knowledge is a prerequisite for more sophisticated approaches to memory tasks.

Best (1993) further found that it takes different types of materials to induce third graders and sixth graders to use memory strategies. Whereas exposure to taxonomically related materials facilitated third graders' recall and retention, sixth graders' performance was facilitated by functional materials (e.g., the ingredients of a cake, receptacles and what they can contain). The sixth graders' recall of atypical, functionally related material was higher than their recall of atypical, taxonomically related materials. The author suggested that exposure to functionally related items may induce older children to search for functional or thematic relations that may be appropriate to category atypical materials, an elaboration process that aids memory.

Similarly, on a multi-trial sort-recall task (Gaultney, Schneider and Bjorklund, 1992), fifth graders with category expertise were found to use more sophisticated strategies as they progressed through the trials. Their strategies progressed from taxonomic relationships (e.g., parts of the uniform) to items' functional relationships (e.g., shortstop, mitt, ball). This data supports Best's (1993) finding that exposure to functionally related material evokes categorization strategies among sixth graders, whereas categorical material evokes these strategies among third graders.

IQ and Item Typicality

Bjorklund, Schneider, and their colleagues have investigated the role that intelligence plays in younger children's memory performance. In one study (Bjorklund, et al., 1994), the investigators classified third and fourth graders into high- or low-IQ groups (based on WISC-R subtests), varied the typicality of the items their participants were instructed to memorize, trained the participants to use organizational strategies, and then tested them using sort-recall tasks.

Both the high- and low-IQ groups benefited from training (recalling significantly more than non-trained control groups). The high-IQ group that was trained using a category typical list outperformed the low-IQ groups, as well as another high-IQ group that was trained with a category atypical list, on measures of level of recall, sorting, and clustering. The high-IQ children continued to use the categorization strategies one week following the initial training and testing, whereas the low-IQ children did not.

The researchers concluded that high-IQ third and fourth graders enjoy an advantage when they need to remember atypical items, when they need to apply the memory strategy to new information, or when they need to remember the material over substantial delays.

IQ and Expertise

The relative effects of IQ or category expertise have also been investigated (Schneider & Bjorklund, 1992). In a study conducted in Germany using an expert-novice paradigm, second and fourth graders were tested on their interest in soccer,

soccer knowledge, intelligence, and declarative metacognitive knowledge. The children were presented with lists of soccer-related items and non-soccer-related items to sort and recall.

The results indicated that category expertise did not lead to reversal of developmental trends in memory functioning: Second grade soccer experts did not outperform fourth grade soccer novices on the sort-recall task. However, expertise was found to compensate for low-IQ: within each grade, although high-IQ soccer experts performed better than low-IQ soccer experts, low-IQ experts' performance was equal to that of high-IQ novices on the sort-recall task.

Among the fourth graders, expertise was also found to influence the use of categorization strategies. Both experts and novices spontaneously sorted the items into categories such as player type, kind of move, equipment and field location. However, only the experts showed a correspondence between their sorting behavior and their recall. In other words, the fourth grade experts who used organizational strategies during study were more likely to apply the same organizational strategies at recall, compared with fourth grade novices.

Gaultney, Schneider and Bjorklund (1992) replicated the Schneider and Bjorklund (1992) study in the United States, using second and fourth graders' baseball expertise in place of soccer expertise. Unlike the German study, the differences in use of categorization strategies between the experts and the novices did not quite achieve significance ($p < .07$). Therefore, the investigators carried out a second study using fifth grade children. With these participants, the results replicated the German study

in that the experts showed more strategy use than the novices, and their strategy use was reflected in greater recall.

To summarize the results of the two studies comparing the effects of expertise and IQ in Germany and the United States (Schneider & Bjorklund, 1992; Gaultney, Schneider & Bjorklund, 1992), between the second and the fifth grade, domain expertise plays a role in increases in students' strategic memory behavior. At each grade level, IQ is related to recall. Around the fourth or fifth grade, domain expertise compensates for differences in IQ in strategic memory functioning.

Summary: Development of Strategic Memory Functioning

The studies reviewed so far reveal several trends in the early development of students' memory functioning. First graders sometimes use rehearsal to achieve memorization, but even by second grade, they rarely exhibit strategies to enhance comprehension. By the third grade, they are aware that categorization can facilitate memorization, and that different studying methods are needed to achieve memorization versus comprehension, but they are unable to recognize that different task features indicate the need for different strategic approaches (Lovett & Flavell, 1990).

Third graders, furthermore, are not amenable to strategy training, but they may spontaneously categorize highly typical, taxonomically related materials in the service of later retrieval, and they generalize this strategic behavior to less typical items (Best, 1993). High-IQ third graders perform better than low-IQ third graders on atypical items, both on immediate and delayed recall (Bjorklund, et al., 1994). Among

German students, expertise compensates for IQ in that low-IQ experts perform as well as high-IQ novices in their domain of expertise (Schneider & Bjorklund, 1992).

Fourth graders' categorization behavior is also stronger if they are initially exposed to high typicality items (Best, 1993; Hasselhorn, 1992), and high-IQ students perform better than low-IQ students on atypical items (Bjorklund, et al., 1994). Among German students, superior expertise compensates for inferior IQ (Schneider & Bjorklund, 1992).

Among American students, fifth graders with category expertise use strategies based on functional relationships among items, rather than taxonomic relationships, and their expertise compensates for differences in IQ (Gaultney, Schneider & Bjorklund, 1992).

By sixth grade, functionally related materials are more likely to elicit strategic behaviors than taxonomically related materials (Best, 1993), and item typicality no longer has an effect on students' initiation and use of strategies to enhance memory (Best & Ornstein, 1986). Furthermore, if sixth graders are instructed in specific memory strategies, they show improvements in memory retention and strategic transfer to related tasks. These improvements are greater when they are instructed in such self-regulatory processes as planning, monitoring and evaluation (Fatal & Kaniel, 1992). And by seventh grade, students use sophisticated clustering strategies to enhance memory (Bjorklund & Buchanan, 1989).

Empirical studies of the development of other self-regulated learning processes besides metacognitive knowledge and skill are rare. The following is a review of the findings from these few studies.

Developmental Changes in Self-Regulated Learning Processes

Self-efficacy: Although research on the early development of self-regulated learning processes is scant, extant studies using participants in early elementary school present intriguing findings. For example, Wang and RiCharde (1987) found that self-efficacy perceptions reported by fourth graders correlated significantly with their performance on a paired-associates memory task, and improvements in self-efficacy generalized to non-related tasks. In contrast, although second graders' self-efficacy perceptions improved from pretest to posttest on the task, their improvement was not systematically related to measures of their performance. Rather, increases in their self-efficacy measures were interpreted as a function of increased familiarity with the task.

An indication of the conditions under which self-efficacy perceptions of second graders appear to be more reflective of performance comes from a training study by Schunk (1982). He reported that with explicit attributional feedback concerning their effort, 7-year-olds who were remediatively taught subtraction skills reported self-efficacy perceptions that significantly correlated with their performance.

Kobasigawa and his colleagues have conducted a program of three developmental studies that explored goal-setting processes, strategy use, self-monitoring, and self-evaluation, as well as the effects on these self-regulated learning processes of externally provided feedback (Dufresne & Kobasigawa, 1988, 1989;

Kobasigawa & Metcalf-Haggert, 1993). It is important to note, however, that the effects of self-efficacy were not measured in any of these studies, and that the measures of self-evaluation were not followed by any measures of self-reaction. And although in their second study Dufresne & Kobasigawa (1989) measured the goals against which the self-evaluations were formed, they did not analyze the results clearly enough to help explicate the relations between these two processes. Bearing in mind that the purpose of this research program was to explore the development of cognitive control over time management behaviors, the findings nevertheless offer intriguing preliminary indications of how some self-regulated learning processes develop.

Strategy use: In the first two studies, Dufresne and Kobasigawa (1988, 1989) presented children with a paired associates memory task contrasting related (dog-cat) and unrelated pairs (book-frog). Using a procedure in which the participants could choose how long to study the materials, the researchers took a measure that may be thought of as an operationalization of strategy use. This measure was "differential allocation," the difference between the amount of time participants studied the easier or the harder materials.

In their first study, whose participants included first, third and fifth graders, Dufresne and Kobasigawa (1988) found that fifth graders allocated significantly more time to studying the harder pairs than to studying the easier pairs, but that first and third graders did not display this differential.

In a modification of their original procedure, Dufresne and Kobasigawa (1989) then investigated whether younger children failed to allocate study time differentially

to hard and easy materials because they were unaware of the difference in difficulty. They divided their participants into two groups, and prompted one group to note the difference between the harder and easier materials by having them sort the two sets of materials into hard and easy piles.

The researchers found that prompting children to note the relative ease or difficulty of the materials did not lead to significant differences between the prompt group and the control group in terms of either self-evaluation (measured as differential allocation of time between hard and easy items) or recall scores.

Kobasigawa and Metcalf-Haggert (1993) altered the procedure used in the earlier studies (Dufresne & Kobasigawa, 1988, 1989) and included only first and third graders as participants. They further highlighted the difference between hard and easy items by switching from a procedure in which participants were asked to pair related or unrelated familiar items, to a procedure in which children were asked to memorize the names of concrete objects represented in line drawings. The participants were challenged to pair familiar pictures with their familiar names, and unfamiliar pictures with their unfamiliar names. The easy objects included frog, drum and butterfly, and the hard objects included anvil, obelisk and platypus. None of the participants could initially name the hard objects.

With this clearer difference between the easy and the hard items, both first and third graders studied the harder items significantly longer than the easier ones. This finding accords somewhat with Best's (1993) finding that young children

spontaneously approach memory tasks strategically when the tasks are fashioned to unambiguously suggest such strategies.

Feedback: From a social cognitive approach, self-regulated learning processes are theorized to be evoked in consonance with enactive feedback from behavioral efforts (Zimmerman, 1990). Dufresne and Kobasigawa (1989) injected a social cognitive dimension into their research program by providing feedback on recall accuracy after the first trial. Introducing a feedback variable permitted the researchers to investigate whether strategic allocation of study time would improve with task experience.

The researchers found that giving feedback after the first trial significantly correlated with improved self-evaluation by the fifth and seventh graders, as evinced by significant differences between their time spent studying hard versus easy pairs between the second and the first trial. Feedback did not lead to significant changes in strategic allocation of time among the first or third graders.

Self-evaluation: Dufresne and Kobasigawa (1988) also measured "sufficient allocation" of time, i.e., whether the overall amount of time students used to study was sufficient for perfect recall. This measure may be thought to reflect self-evaluative processes in that the behavior involves judgments of adequacy in terms of some standards or criteria.

Children in all grades (first, third, and fifth) failed to study the hard pairs sufficiently, as reflected in their recall scores (which averaged approximately 40% correct). In fact, only the fifth graders allocated an amount of study time that

somewhat approximated the true amount of time they needed to learn the material (as determined by comparing the amount of time they studied during a self-terminated condition to the amount of time they studied during a practice trial in which they were required to achieve perfect recall).

Having established that self-evaluation of learning sufficiency is imperfectly developed among fifth graders, Dufresne and Kobasigawa included seventh graders in their second study (Dufresne & Kobasigawa, 1989). However, they found that 50% of the seventh graders also failed to study enough to achieve perfect mastery.

Unfortunately, self-efficacy measures were not included in any of these studies. According to Zimmerman's (1990) model, self-efficacy perceptions, along with goal-setting and self-monitoring, guide students to self-evaluate their progress and decide whether they have studied sufficiently. It would have been interesting to learn whether overestimations of their self-efficacy for performing in the upcoming test led these students to prematurely terminate their studying efforts.

Self-monitoring: The researchers also measured self-monitoring processes in their second study (Dufresne & Kobasigawa, 1989). They scored self-testing behaviors from the videotaped sessions based on whether the participants covered the response item before they looked at it for at least one pair of the items in the booklets (which contained 5-7 pairs, depending on the grade level), or first looked at an item and then covered it. They also scored other behaviors, such as cumulative rehearsal, or looking away from the booklet and trying to name items from memory, but they acknowledged that these behaviors were indistinguishable from ordinary study

behaviors. Self-testing was rarely observed. Only 20% of the fifth and seventh graders spontaneously self-monitored, compared with none of the first or third graders.

In a later study that included only first and third graders (Kobasigawa & Metcalf-Haggert, 1993), the researchers attempted to achieve better measures of self-monitoring by presenting the names of the drawings on recorded magnetic tape that participants could only hear by running the picture card through a Bell and Howell Language Master machine. The researchers coded the videotaped study behaviors to differentiate between ordinary study behaviors and self-monitoring behaviors. Studying was scored as "ordinary study behaviors" when the participants mechanically put the cards through the Language Master machine one at a time to hear the names, with or without examining the pictures either before or after using the machine. Self-testing was scored when, for at least one item, participants tried to name a card in anticipation of running it through the machine. About one-fifth of the first graders and one-half of the third graders displayed the self-testing behavior. However, the development of self-monitoring skills is apparently still incipient at third grade, in that one-fourth of the children who used self-testing in the first of this two-trial procedure discontinued self-testing in the second trial.

Dufresne and Kobasigawa (1989) also measured self-monitoring after prompting participants with a battery of six questions related to memory functioning and to the use of self-testing. They introduced this self-monitoring prompt prior to initiating a third trial. They found that their self-monitoring prompts doubled the number of children in fifth and seventh grades who self-monitored. Improvements in

self-monitoring may have been related to the increase in the numbers of students in seventh grade who achieved perfect recall (from 31% prior to the self-monitoring prompt to 50% after the prompt), but the researchers did not directly measure the relationship between self-monitoring and recall scores.

Goal-setting: In the second study (Dufresne & Kobasigawa, 1989) the researchers introduced goal-setting as a new measure in an effort to explain their participants' failure to accurately self-evaluate the sufficiency of their studying efforts. They measured goal-setting by asking the participants to predict how many of the pairs they would recall correctly after they finished studying. In so doing, they attempted to assess whether the participants' failure to study enough to achieve perfect recall reflected inaccurate self-evaluations or accurate self-evaluations based on individually set mastery goals.

The participants also failed to achieve perfect recall when prompted to set goals (Dufresne and Kobasigawa, 1989). The researchers did not analyze their goal-setting measure in relation to the scores actually achieved, so it is hard to interpret what role goal- setting played.

Summary: Development of Self-Regulated Learning Processes

Strategy use: First and third graders do not spontaneously allocate significantly more time to studying harder items than easier items (Dufresne & Kobasigawa, 1988). However, when the difference in difficulty between the two sets is made vividly clear, they allocate their time significantly more to the harder items (Kobasigawa & Metcalf-Haggert, 1993). In contrast, fifth graders strategically allocate

significantly more time to studying harder items than easier items, even when no special effort is made to heighten the difference in difficulty (Dufresne & Kobasigawa, 1988).

Feedback: Fifth and seventh graders' strategic allocation of time improves with feedback. Feedback did not lead to significant changes in self-evaluation among the first or third graders (Dufresne & Kobasigawa, 1989).

Self-evaluation: Neither first, third nor fifth graders study sufficiently to achieve perfect recall. Fifth graders, however, allocate an amount of study time that somewhat approximates the true amount of time they needed to learn the material. Only half of the seventh graders sampled studied enough to achieve perfect mastery (Dufresne & Kobasigawa, 1989).

Self-monitoring: Self-testing is a rare phenomenon. Only 20% of the fifth and seventh graders spontaneously self-monitored, compared with no first or third graders. If self-monitoring is prompted, the effect is to double the number of fifth and seventh graders who self-test (Dufresne & Kobasigawa, 1989). When the material is presented in a manner whereby students must actively seek the information to be learned, 20% of first graders and 50% of third graders display self-testing behavior. However, one-fourth of the children who used self-testing in the first trial discontinued self-testing in the second trial.

Self-efficacy: Second graders' self-efficacy perceptions improve with experience on a learning task, but are not systematically related to measures of their performance; self-efficacy appears to be related to increased familiarity with the task

(Wang & RiCharde, 1987). However, when they are given explicit attributional feedback concerning their effort, second graders' self-efficacy perceptions correlate significantly with their performance (Schunk, 1982). Fourth graders' self-efficacy perceptions significantly correlate with their performance on a learning task, and improvements in self-efficacy generalize to non-related tasks (Wang & RiCharde, 1987).

A number of intriguing questions are raised by these findings.

- Do self-efficacy perceptions of young children predict their actual performance on learning exercises?
- Do self-efficacy perceptions of young children correlate with their goal-setting or self-reactions?
- How do self-regulated learning processes integrate as children develop?
- How are goal-setting and self-efficacy related to fifth and seventh graders' failure to study enough to achieve perfect recall?

Addressing these questions required a procedure that allowed measurement of more self-regulated learning processes than the variables included in the Kobasigawa research program (Dufresne & Kobasigawa, 1988, 1989; Kobasigawa & Metcalf-Haggert, 1993). This procedure is described in the following chapter.

CHAPTER II

DESCRIPTION OF THE STUDY

Objectives

This study was a cross-sectional investigation of the development of self-regulated learning processes among 2nd, 5th, and 8th graders engaged in a multi-trial sort-recall task. Several self-regulated learning processes were measured in this study including learning self-efficacy, learning goal, study strategy, self-testing, strategy adjustment, performance self-efficacy, performance goal, and self-reaction, as well as students' verbal intelligence and their memory performance.

The procedure used in this study was designed to explore how self-regulated learning processes emerge in young children and how these processes develop as children approach adolescence. This procedure was informed by the metacognitive research cited in the previous chapter. However, this procedure was not intended to demonstrate memory competence at sequentially increased difficulty levels of the recall task. In fact, the experimenter clearly modeled strategic learning processes (i.e., sorting, studying, and self-testing) that would help participants improve their recall. With all elements of the task known to each age group, observed differences in self-regulated learning processes among the different grade levels were meant to reflect choices, not implicit knowledge.

This procedure emerged from a social cognitive perspective on self-regulation that views students as active managers of their own learning rather than passive participants within structured learning environments (Zimmerman, 1989a). As will be

more fully elaborated below, memory studies conducted within a metacognitive paradigm preclude participants from exercising the choices required to investigate the effects of learning processes that reflect personal agency.

Gaultney, Schneider and Bjorklund (1992) acknowledged that their less than robust findings (i.e., marginal difference in strategic performance among fourth graders, and a gradual emergence of categorization behavior during successive trials among fifth graders) may have been related to their measures. The researchers suggest that "the mechanisms for the cognitive advantage of 'expert' children are many, and future research must delineate these mechanisms and examine ways in which educators can best make use of what children already know to facilitate future learning" (Gaultney, Schneider & Bjorklund, 1992, p.255-256).

Self-regulation theorists would argue that the mechanisms responsible for expert children's cognitive advantage involve other processes in addition to mental mechanisms, and that research procedures to investigate these processes must necessarily allow participants to actively manage their own learning. Gaultney, Schneider and Bjorklund (1992) preset the difficulty level of materials to be processed, hampering an investigation into individual choices in goal-setting or persistence. Similarly, sorting and studying time was fixed at two minutes for each participant and the participants were not permitted to test their mastery as they were learning.

In the metacognitive research reviewed in Chapter 1, participants' choices were restricted in order to ensure experimental control of the cognitive variables under investigation. Lovett and Flavell (1990) imposed a specific memorization strategy

(rehearsal) by having their participants listen to cassette tapes in which the word lists were repeated three times. Best (1990) and Best and Ornstein (1986) restricted the spatial layout that their participants could use to sort their picture cards by providing a cardboard sorting board with fixed rectangles in which the cards were to be arrayed. Hasselhorn (1992) permitted his participants three minutes to sort picture cards, then one minute to study the cards. Before the participants' recall was tested, the experimenter imposed a 30-second interference task. Restrictions such as these preclude the measurement of such forethought self-regulative processes as self-efficacy, goal setting, and strategic planning, or such performance/volitional control self-regulatory processes as self-observation and strategy use or, for that matter, and self-reaction, a self-reflective phase process.

Choice has been described as the sine-qua-non of self-regulation research (Zimmerman, 1994, 1995b). The procedure for this study was designed to allow the participants to use their own choice of categorization strategies, to array the materials in any spatial layout, to set their own difficulty levels and their own goals, to self-monitor and self-evaluate the adequacy of their learning, and to self-react by selecting at which difficulty level to terminate.

The importance of allowing choices is supported by evidence that children adopt a wide variety of approaches when engaged in memory tasks. In an investigation of recall strategies used by kindergartners, first graders and third graders, retrospective verbal reports and observations of overt behavior indicated developmental changes in how often participants rehearsed, in how accurately they executed each

strategy, and in the type of rehearsal that they used most frequently (McGilly & Siegler, 1989). In their recall efforts, most children used multiple approaches. Furthermore, changes in strategy choices were adaptive in the sense that participants rehearsed more often when failure to rehearse on the previous trial had led to incorrect recall. For these reasons, many choices were afforded participants in the present study.

Description of the Model

This study was based on Zimmerman's strategy model of student self-regulated learning (Zimmerman, 1986, 1989a, 1989b, 1990, in press; Zimmerman & Martinez-Pons 1986, 1988, 1990). This model describes how students prepare for learning challenges, how they evaluate their preparation efforts in light of their achieved mastery, and how they incorporate their evaluations to prepare for further learning challenges of a similar nature. A critical assumption of this model is that students achieve learning as the outcome of a series of self-regulated processes in three cyclical phases -- forethought, performance/volitional control, and self-reflection -- and that learning is incrementally achieved through successive iterations incorporating these self-regulatory processes. The self-regulated learning processes described in Zimmerman's (in press) model are presented in Figure 1.

Since this model attempts to portray how students approach typical learning situations, it may be helpful to first describe such an approach in some detail. A typical example may be drawn from the way a student might prepare for weekly vocabulary tests (Zimmerman, Bonner, & Kovach, 1996). This description would

have similar features if it were applied to student preparation in other academic areas as well, such as math and the sciences, language arts, social studies, foreign languages, etc. (The selections of gender for this hypothetical example were based on coin flips.)

After the teacher presents her students with a list of words to define, the student's engagement in studying efforts would be guided by his confidence in his ability to prepare and perform well on the test. The student would form some goal expectations of the grade he would want to achieve, and would plan to use some combination of study strategies to prepare. (The preceding were examples of forethought processes.) For instance, he might engage in some studying efforts at home, such as writing all the words and their definitions on index cards. The student may test himself to see which words he already can define. Then he might try some method to memorize the definitions of the remaining words, working on a few words at a time until he achieves some degree of competence. During his study, he may switch tactics occasionally if he encounters some obstacle or otherwise feels that his approach may be improved. (These were examples of performance/volitional control processes.) At some point, he would stop studying. After taking the test, the feedback from his score would influence his perception about how well he would perform on the following week's test, and may influence him to alter him studying approach for the next test. (This is an example of a self-reflective processes.)

The self-regulated learning processes that underlie learning are illustrated in such a scenario. When students are presented with a learning task, the difficulty level is often preset by the teacher, but the students themselves formulate goals regarding

the mastery they want to achieve. They set their goals based on their self-efficacy perceptions drawn from previous achievement on similar tasks. They structure the components of the task to increase their ease of learning, and monitor the effectiveness of their learning efforts by self-testing. Students self-evaluate the effectiveness of their learning efforts based on their self-monitoring. Their self-evaluations are based on both their self-efficacy for achieving specific levels of mastery and the goals they have set. Their self-efficacy perceptions strongly influence their degree of motivation. After their mastery is tested, they self-react in various ways: they may sense satisfaction or dissatisfaction with their efforts, their self-efficacy perceptions may alter, or they may set new goals for future learning efforts.

Features of the Procedure

The procedure created to study the development of self-regulated learning processes within this learning model employs materials similar to those used in paired-associate memory tasks, pictures representing concrete objects. However, the challenge embedded in the procedure developed for this study was not to recall the names of linked pairs of objects, but rather to match pictures laid out face down on a table with a duplicate set of pictures presented in random order.

This variation on a familiar procedure was designed to allow students to group the learning materials any way they want in the interests of later recall, rather than to present the materials already grouped in some fashion. Developmental changes in participants' grouping strategies are of interest, as are changes in their self-monitoring behavior, which was measured by counting how many pictures they turned face up to

check the progress of their learning efforts. Participants were offered the opportunity to continue the exercise at increasingly difficult levels. Participants' goal-setting and self-efficacy perceptions were measured at several points during the exercise.

Through this procedure, a broad range of the processes involved in students' self-regulated learning was investigated. These self-regulated learning processes will now be described in detail.

Self-efficacy: Self-efficacy is a forethought process that influences planning and goal setting, and is itself influenced by learning performance (Zimmerman, in press). In this study, self-efficacy was measured twice during each trial. **Learning self-efficacy** was measured at the start of each trial, before the participant was asked to set the learning goal. **Performance self-efficacy** was measured following the completion of the learning phase.

Due to the important role of self-efficacy, a demonstration of the relationship between self-efficacy and outcomes was presented when self-efficacy was first introduced during the second practice trial. The experimenter asked the participant to rate his or her self-efficacy for spelling his or her name accurately, and then asked the participant to spell the name correctly. Then the experimenter asked the participant to rate his or her self-efficacy for spelling "obfuscation" (which is beyond the vocabulary of elementary school students) and then to spell the word. Participants were also offered spelling challenges about which they were expected to have intermediate self-efficacy perceptions.

Goal-setting: Goal-setting is a forethought process that determines the criteria against which students self-evaluate their learning efforts. In this study, after the two practice trials, participants were presented arrays representing difficulty levels of 10, 20, and 40 cards, and were directed to progress through increasing difficulty levels until they chose to stop. At each difficulty level, after measuring their learning self-efficacy, participants were asked to set **learning goals**, the number of pictures they were going to try to match correctly. Following their study efforts and the measurement of their performance self-efficacy, participants were asked to set **performance goals**, the number of pictures they were going to try to match correctly.

Strategic planning: Strategic planning is a forethought process, referring to purposive processes and actions that are directed at acquiring or displaying a skill (Zimmerman, 1989). Where self-regulated learning processes are fully developed, strategic planning is cyclically adjusted as learners reconceptualize task demands in repeated iterations of a familiar learning effort (Zimmerman, in press). Strategic planning was conceptualized in this research as **strategy adjustments**, and measured during the study phase by asking participants what they were doing differently at the current difficulty level.

Task strategies: Task strategies are performance/volitional control processes that help learners and performers focus on the task and optimize their efforts (Zimmerman, in press). In this study, the experimenter modeled a categorization strategy. Strategy use was measured by counting the **quantity of cards sorted**. In addition, a **studying behavior** variable was included by coding whether participants

named or touched the cards or exhibited any signs of rehearsing or forming mental images, such as looking away or closing their eyes.

Self-monitoring: Self-monitoring is a performance/volitional control process referring to a person's tracking of specific aspects of his or her own performance (Zimmerman, in press). In this study, the experimenter modeled self-testing behavior after studying the sorted cards, and measured self-monitoring by counting the **quantity of cards tested**. A developmental picture of the relationship between self-monitoring and other self-regulated learning behaviors has not been reported in the research literature. However, there is evidence of the situations that prompt students to self-monitor, and that evidence guides the methodology of this study.

Research indicates that self-monitoring is rarely observed in children until fifth grade (Dufresne & Kobasigawa, 1989; Kobasigawa & Metcalf-Haggert, 1993), but that with prompting some first and third graders do self-monitor their efforts as they are learning (Kobasigawa & Metcalf-Haggert, 1993). In order to encourage self-monitoring behavior, all participants were prompted to self-monitor during the second practice trial by encouraging them to self-test to see how well prepared they were to engage in the matching task. This prompt was positive as long as self-testing was exhibited ("I see that you're testing yourself. That will probably help you remember where the pictures are."). However, if there was no self-testing, the prompt was stated in negative terms ("I haven't seen you test yourself. If you test yourself, it will probably help you remember where the pictures are.").

Self-reaction: Self-reaction is conceptualized in Zimmerman's (in press) model as a self-reflection process that influences repeated engagement in learning. In this study, self-reaction was operationalized as a measure of satisfaction following each trial. It was measured after participants were given feedback on the results of their recall efforts.

In summary, this procedure permitted measurement of variables within the forethought, performance/volitional control, and self-reflective phases proposed in Zimmerman's (in press) strategy model of student self-regulated learning.

Research Questions

Several questions regarding the development of self-regulated learning processes were explored using this procedure.

- Do children's use of self-regulated learning processes increase in the course of development?
- Do all self-regulated learning processes develop at the same rate, or are there differences in children's increasing use of self-regulated learning processes in the course of development?
- In the course of development, do the self-regulated learning processes hypothesized in Zimmerman's (in press) model of student self-regulated learning show evidence of increasing integration? In other words, do individual processes predict increasingly more processes in the course of development?

- Which self-regulated learning processes predict persistence to increasing difficulty levels when participants are afforded choice in self-selecting their highest difficulty level?

Hypotheses

These research questions were addressed through the following hypotheses.

Hypothesis 1: There are developmental increases in self-regulated learning processes among 2nd, 5th, and 8th grade students.

Hypothesis 2: The pattern of increases among 2nd, 5th, and 8th grade students varies for specific self-regulated learning processes.

Hypothesis 3: Self-regulated learning processes exhibit increasing integration as predictors of recall in 2nd, 5th, and 8th grade students.

Design and Data Analysis

This study was cross-sectional in design, sampling three grade levels. The purpose of this study was to form a descriptive account of children's spontaneous development of a number of self-regulated learning processes. The analyses were based on participants' performance at their self-selected highest level of difficulty. The rationale for this decision was that self-regulated learning processes would be most apparent if students were working at the highest difficulty level in which they felt confident about their performance. If all participants had been required to perform at the 40-card most difficult level, all the 2nd graders and most of the 5th graders would have been performing at a level beyond which they would have personally chosen. On the other hand, had the analyses been conducted at an easier level, some

5th graders and nearly all the 8th graders would not have been experiencing an optimal degree of challenge. Learning self-efficacy, performance self-efficacy and self-reaction measures were adjusted to reflect participant's difficulty level. The measures were multiplied by 2 if the highest difficulty level was the 20-card second experimental level, and were multiplied by 4 if the highest difficulty level was the 40-card third experimental level. Multivariate analysis of variance was used to assess grade differences in the Quick Test and self-regulated learning measures. Post-hoc analyses of the results of the multivariate analysis of variance using the Tukey criteria were conducted to determine which grades' means differed. Finally, path analyses were conducted to assess the fit of the Quick Test and the self-regulated learning variables to the Zimmerman (in press) model of self-regulated learning.

CHAPTER III

METHOD

Participants

Participants were recruited from the 2nd, 5th, and 8th grades at a parochial school serving a predominantly African-American and Latino working-class community and at a multi-ethnic private school serving a mixed middle- and working-class community. Letters recommending participation in the study were distributed by the school principals to parents, along with consent forms. The consent form is attached as Appendix A.

Materials

Two identical sets of flashcards were used, measuring approximately 2½ x 3½ inches in size, with pictures on one face and blank on the reverse. These pictures were culled from commercially available flashcards designed to teach simple English vocabulary items. A single word appeared in print below each picture to identify the picture. One set of 10 pictures was assembled for the experimenter to model the sort-recall task. The pictures in this set included 4 colors (green, brown, grey, purple), 3 activities (swim, write, sleep), and 3 fruit (apple, peach, cherry). Two practice sets were assembled for the participants to familiarize themselves with the task. One practice set had five cards depicting 2 royalty (queen, king), 2 pets (cat, dog), and 1 miscellaneous picture (yellow). The other practice set consisted of 10 pictures including 4 people (girl, boy, woman, man), 4 colors (red, blue, black, white), and 2 small animals (fish, bird).

Three experimental sets were assembled, consisting of 10, 20, and 40 pictures. The 10-picture set included 4 vehicles (train, car, bus, plane), 3 utensils (spoon, knife, bowl), 2 large animals (elephant, zebra), and 1 miscellaneous picture (jacket). The 20-picture set included 8 activities (stand, play, walk, ride, drink, jump, run, sit), 6 body parts (nose, eye, mouth, head, ear, hand), 4 marine scenes (boat, ship, ferry, sea), and 2 elements (fire, water). The 40-picture set included 8 scenes from nature (sky, sun, moon, hill, grass, flower, leaf, tree), 7 pieces of furniture (telephone, table, chair, lamp, door, window, bed), 6 school materials (schoolbag, pen, ink, pencil, book, classroom), 6 foods (cake, banana, orange, egg, bread, milk), 5 toys (bicycle, gun, kite, ball, doll), 4 animals (cow, duck, pig, hen), 3 personal items (shirt, handkerchief, umbrella), and 1 miscellaneous picture (foot). Appendix B lists the order of the pictures in the presentation sets (the sets that the participants sorted and studied) and the matching sets (the sets that the participants had to match to the presentation sets).

In order to convey the increasing difficulty levels of the sort-recall task, three posters were created displaying sets of 10, 20 and 40 cards. The cards pasted on the posters were identical in size and shape to the flashcards, and matched the appearance of the cards turned face down.

Two sheets were created indicating 7-point scales. One sheet was used to guide participants' responses on the learning and performance self-efficacy questions, with 1 = not at all sure, 3 = a little sure, 5 = pretty sure, and 7 = completely sure. The other sheet was used to guide participants' responses on the self-reaction question, with 1 = not at all satisfied, 3 = a little satisfied, 5 = pretty satisfied, and

7 = completely satisfied. An alternative sheet was used with 2nd graders in which the word "satisfied" was replaced with the word "happy." Pilot testing had revealed that 2nd graders were unclear about the former term but not the latter. Appendix C shows the self-efficacy and self-reaction scales.

A tally sheet was created to record participants' responses on the following measures at each difficulty level: learning self-efficacy, learning goal setting, strategy adjustment, performance self-efficacy, performance goal setting, recall, and self-reaction.

A video camera was used to videotape participants' sorting, studying and self-testing behavior for later transcription and scoring. An audio tape recorder was used to record participants' responses to the strategy adjustment measure for subsequent transcription and scoring.

Five scoring sheets were prepared with grids for transcribing participants' videotaped sorting arrays at the two practice and three experimental levels. A 6 x 3 squares grid was prepared for the 5-picture first practice trial, a 7 x 4 squares grid was created for the 10-picture second practice trial and the 10-card first experimental trial, a 10 x 6 squares grid was created for the 20-picture second experimental trial, and a 10 x 8 squares grid was created for the 40-picture third experimental trial. An example of the grid for scoring the two practice trials is attached as Appendix D.

Measures

Measures of self-regulated learning processes and recall were taken using the following scales. A measure of verbal intelligence was also included to explore how

this important academic ability relates to children's use of self-regulated learning processes, and whether relations between verbal ability and self-regulated learning processes change as children develop. Figure 2 presents an overview of these measures and their relation to the cyclical phases hypothesized in Zimmerman's (in press) model of student self-regulated learning.

Quick Test: Participants' verbal intelligence was measured using the Quick Test (Ammons & Ammons, 1962), a quick screening instrument for measuring verbal-perceptual intelligence. The Quick Test is published in three forms comprised of 50 word items. Form 1 was used for the purposes of this research because the pictures appear to be more familiar to urban students than the pictures on the other forms, which favor rural scenes.

The Quick Test is administered in less than 2 minutes. The experimenter presents a sheet with four line drawings depicting couples dancing, a automobile racetrack accident, a traffic guard at work, and a waitress taking the order of a person seated at a table holding condiments and a drink. Each picture is labeled with a number. The experimenter reads a series of words, and the participant must identify which drawing is appropriate to the each word. Testing is ended when a participant gives incorrect answers or answers "don't know" six times in succession. Chronological age norms for numbers of correct answers are provided on the scoring sheet. The normed age corresponding to the last word prior to the failures was the participant's score.

Mean interform reliability for the Quick Test has been reported to range between .60 and .96 for the age groups relevant to the current research (Ammons & Ammons, 1962, p.126-128). From the standardization sample, 100 random cases between chronological age 2 and twelfth grade produced estimated standard errors of raw test scores of 2.45 for a single form. Validation of the Quick Test Form 2 has been established with correlations of .76 with the Short Form Wechsler Bellevue IQ Test, as well as .78 with the reading subscale, .61 with the spelling subscale, and .51 with the arithmetic subscale of the Wide Range Achievement Test (Whitney & Metzger, 1965).

Learning self-efficacy: At the start of each trial, participants were shown the poster depicting the appropriate difficulty level. Learning self-efficacy was measured by asking participants, "How sure are you that you can match all the pictures correctly?" Participants answered using the seven-point self-efficacy scale, in which 1 = not at all sure, 3 = a little sure, 5 = pretty sure, and 7 = completely sure.

Learning goal: At the start of each trial, participants' learning goals were measured with the question, "How many pictures are you going to try and match correctly?" Participants responded with a numerical quantity.

Sorting: Sorting was measured after transcription of the videotaped arrays by counting the number of cards included in meaningful categories. The process of scoring this measure will be more thoroughly presented in the Results chapter. Briefly described here, the grid transcriptions of participants' arrays of pictures were analyzed, meaningful categories were highlighted, and the total number of cards that constituted

these meaningful categories were counted. Participants were assigned scores equal to the quantity of cards included in meaningful categories at each difficulty level they attempted.

Studying behavior: Studying was measured on inspection of the videotapes. Participants' behavior after they arrayed the presentation set but before they turned any pictures face down was scored as 0 = participant makes no apparent motion besides visual inspection of the cards, 1 = participant touches or names the cards, or 2 = participant looks away from the cards or closes his or her eyes. It should be noted that the behavior scored as 2 (i.e., looking away or closing the eyes) was frequently but not always accompanied by behavior that could have been scored as 1 (i.e., touching or naming the cards), but no effort was made to distinguish these combinations.

Self-testing: Self-testing was measured by counting the number of cards turned face up for inspection once the participants had turned all or some of the cards face down.

Strategy adjustment: Strategy adjustment was measured by asking the question, "You're playing with new pictures this time. It's hard to learn new pictures. Are you doing anything differently this time?" Answers were recorded on audio tape, transcribed, and scored as 0 = participant failed to respond, answered "No," answered "I don't know," or repeated some element of the question, 1 = participant's answer included some reference to memorizing or remembering, or 2 = participant's answer included some reference to sorting or self-testing.

Performance self-efficacy: When the participant said he or she was ready to begin the recall test, performance self-efficacy was measured by asking the question, "Now that you have learned the pictures, how sure are you that you can match all the pictures correctly?" Participants answered using the seven-point self-efficacy scale, in which 1=not at all sure, 3 = a little sure, 5 = pretty sure, and 7 = completely sure.

Performance goal: Participants' performance goals were measured with the question, "How many pictures do you think you will be able to match correctly?" Participants responded with a numerical quantity.

Recall: The number of pictures accurately matched was recorded as the recall measure.

Self-reaction: Following the recall test, the experimenter tallied the recall score and reported it to the participant. Self-reaction was measured with the question, "How satisfied are you that you matched ___ pictures correctly?" Participants answered using the seven-point self-reaction scale, in which 1 = not at all satisfied, 3 = a little satisfied, 5 = pretty satisfied, and 7 = completely satisfied. In the case of the 2nd graders, the alternative scale replacing the word "satisfied" with the word "happy" was used.

Procedure

Parental consent was obtained for students to participate in the study. The research was conducted in a separate room in the schools, scheduled according to the teachers' convenience. Students spent approximately 45 minutes on the sort-recall

task, and their activities and responses to the interviewer's questions were videotaped for later scoring.

Participants were welcomed by the experimenter and told that they would be playing a matching game with pictures, and that they could spend as long or as short an amount of time as they wished engaging in the exercise. Demographic information was recorded, including gender, ethnicity, and birthdate, and an ID number was assigned.

The Quick Test was administered with the following introduction. "Before we start playing a matching game, I'm going to show you some pictures and say some words. When I say a word, point to which of the pictures best fits that word." The participant was given four vocabulary items normed as recognizable by children aged 2-4 years old (e.g., chewing, cow), followed by a vocabulary item (i.e., transom) normed as recognizable by youngsters aged 18. The introduction continued, "Some of these words are going to be hard. Just say, 'I don't know' when you get to one you don't know." Then, two more advanced vocabulary items (i.e., ingress, prehension) were presented to ensure participants' willingness to admit lack of recognition.

The Quick Test administration started with items approximately 10 words prior to those normed at the participant's chronological age, and continued until the participant made 6 successive errors. The number corresponding to the last word prior to the failures was recorded as the Quick Test score.

Then the experimenter introduced the sort-recall task by saying, "That was great, that got you used to looking at pictures and used to saying you don't know when

you don't know. Now that you're warmed up, you can play a game where you match pictures. First, let me show you how to play the game and then I'll let you practice. I'll use this set of pictures. When you play, you'll use different pictures."

The experimenter then used a demonstration set of 10 cards to model the basic elements of the exercise: sorting, studying, self-testing, and recalling. These elements were modeled so that all elements of the task were known to each age group and, as such, observed differences reflected choices not implicit knowledge. The experimenter first arrayed the presentation set with the pictures face-up saying, "I spread all the pictures on the table so I can see all of them." As he spatially rearranged the pictures into categories, he said, "Now I arrange the pictures into groups so I can remember where they are. Putting them in groups really helps. I look for pictures that seem to belong together. Here are some colors [putting together the pictures of green, brown, grey and purple], here are some activities that people do [putting together the pictures of swim, write and sleep], and here are some fruit [putting together the pictures of apple, peach and cherry]." The experimenter then said, "Now I study the pictures," following which he touched and named each picture. The experimenter then turned the pictures face down and said, "Now I test myself to make sure I know where the pictures are," following which he touched each picture, named it, and then turned it face up. The experimenter then took the matching set and said, "Now I try to find the pictures to match the ones that are in this second set." Finally, the experimenter matched the pictures from the matching set with the face-down pictures from the presentation set, and tallied the correct answer, which was always 10.

The experimenter then assisted the participant through two practice trials. In the first practice trial, the participant was given a presentation set of 5 cards. The experimenter's assistance during the first practice trial was limited to showing the participant that matched cards were not to be placed on top of the presentation array, but placed in a separate pile, and that cards incorrectly matched were to be turned back face down.

The second practice trial was preceded by an exercise to demonstrate the use of the self-efficacy rating scale. The experimenter presented the scale to the participant and said, "I want to ask you some questions about how sure you are. You need to use a number from 1 to 7 to answer these questions. Let me show you what these numbers mean. If you're not at all sure, you say 1. If you're a little sure, you say 3. If you're pretty sure, you say 5. And if you're completely sure, you say 7. Let's try it out to see if you understand how to use these numbers. How sure are you that you can spell your name? If you're completely sure, you say 7. How sure are you that you can spell the word cat? If you're completely sure, you say 7. How sure are you that you can spell the word science? If you're a little sure, you say 3 and if you're pretty sure, you say 5. How sure are you that you can spell the word mathematics? If you're a little sure, you say 3 and if you're pretty sure, you say 5. How sure are you that you can spell the word obfuscate? If you're not at all sure, you say 1. How sure are you that you can spell the word maudlin? If you're not at all sure, you say 1."

Following this exercise, the experimenter presented the participant with the poster illustrating the 10-card difficulty level, and said, "This is what 10 cards looks

like. How sure are you that you can match all 10 pictures correctly?" In the experimental trials, the participant's answer would be recorded as the **learning self-efficacy** measure. After recording the answer, the experimenter asked, "And how many pictures are you going to try to match correctly?" In the experimental trials, the participant's answer would be recorded as the **learning goal** measure.

The participant was then given the second practice trial presentation set, with the direction, "Here are the pictures. Spread them out and try to learn where you put them." As the participant was sorting or studying the cards, the experimenter said, "You're playing with new pictures this time. It's hard to learn new pictures. Are you doing anything differently this time?" In the experimental trials, the participant's answer would be recorded as the **strategy adjustment** measure.

Self-testing was prompted in the following manner. If the participant was observed reviewing the cards after they were turned face down, the experimenter said, "I see that you're testing yourself. That will probably help you remember where the pictures are." If the participant did not review the face-down cards, the participant said, "I haven't seen you test yourself. If you test yourself, it will probably help you remember where the pictures are."

When the participant indicated that he or she was ready to test his or her recall, the experimenter presented the self-efficacy scale and said, "How sure are you that you have learned the pictures well enough to match all the pictures correctly?" In the experimental trials, the participant's answer would be recorded as the **performance self-efficacy** measure. After recording the answer, the experimenter asked, "Now that

you have learned the pictures, how many pictures do you think you will be able to match correctly?" In the experimental trials, the participant's answer would be recorded as the **performance goal** measure.

Then the experimenter gave the participant the matching set, with the direction, "Now try to match the pictures from this set." After all the matches had been attempted, the experimenter tallied the score, and reported it to the participant. In the experimental trials, this score would be recorded as the **recall** measure. The experimenter then presented the self-reaction scale and asked, "How satisfied are you that you matched ___ of the pictures correctly?" The word "happy" was substituted for "satisfied" in the case of the 2nd graders. In the experimental trials, the participant's answer would be recorded as the **self-reaction** measure.

The experimenter then terminated the practice trials, and showed the 10-card difficulty poster, saying, "That was great. Now you're ready to play for real. I'll give you a different set of 10 pictures. That's the same number of pictures you just played with. This is what 10 cards looks like." The experimenter asked the participant if he or she wanted to continue. If so, the experimenter followed almost the same procedure as in the second practice trial. The difference in the experimental trials was that the exercise demonstrating self-efficacy was dropped and no prompts were offered to encourage studying or self-testing. In addition, the videotape records of the participant's **sorting, studying** and **self-testing** behaviors were later scored for analysis.

At the end of the 10-card first experimental trial and the 20-card second experimental trial, the experimenter showed the poster illustrating the appropriate next difficulty level, saying, "That was great. I also have a set of ___ pictures. This is what ___ cards looks like. It's twice as many as you just played with. Do you want to play again with ___ new pictures?" Testing was continued on participants who chose to proceed. Participants who chose to terminate their involvement were thanked for their participation, and offered a choice of one of three popular candy bars. Those students who continued through the final 40-card third experimental set were then thanked for their participation, and offered a choice of one of three popular candy bars.

CHAPTER IV

RESULTS

Reliability of Measures of Self-Regulated Learning Processes

The following measures were recorded directly from participants' responses: Quick Test, learning self-efficacy, learning goal, performance self-efficacy, performance goal, recall, and self-reaction. The remaining measures were scored from videotape and audiotape records, and interrater reliability was analyzed. Results of these analyses follows.

Sorting: From the videotape recordings, participants' final array of pictures were transcribed onto the grid scoring sheets by writing the names of the pictures in squares reflecting their spatial organization. Scoring began by drawing circles circumscribing groups of pictures that appeared to be sorted within meaningful categories. Sorting was measured as the number of cards that were included in meaningful categories. If the cards were arrayed in the order of the presentation set, sorting was scored as 0. Meaningful categories included the sets described under "Materials," above, as well as several variations.

The only scorable categories in the first experimental set included the 4 vehicles (train, car, bus, plane), the 3 utensils (spoon, knife, bowl), the 2 large animals (elephant, zebra), and the single miscellaneous picture (jacket). At this and the subsequent difficulty levels, miscellaneous pictures were counted as having been sorted if they were not included within any other categories, or if they were included within specific categories, as specified below. The scorable categories in the second

experimental set included the 8 activities (stand, play, walk, ride, drink, jump, run, sit), the 6 body parts (nose, eye, mouth, head, ear, hand), the 4 marine scenes (boat, ship, ferry, sea), and the 2 elements (fire, water). In addition, drink-water was scored as a combination, as was water included with the marine scenes, leaving fire standing alone.

The scorable categories for the third experimental array included the 8 scenes from nature (sky, sun, moon, hill, grass, flower, leaf, tree), the 7 pieces of furniture (telephone, table, chair, lamp, door, window, bed), the 6 school materials (schoolbag, pen, ink, pencil, book, classroom), the 6 foods (cake, banana, orange, egg, bread, milk), the 5 toys (bicycle, gun, kite, ball, doll), the 4 animals (cow, duck, pig, hen), 3 personal items (shirt, handkerchief, umbrella), and the single miscellaneous picture (foot). In addition the following combinations were accepted as categories, hen-egg and cow-milk.

The transcriptions on the scoring grid of the picture arrays of approximately half the participants at each of the difficulty levels were individually scored for category inclusion by the experimenter and a trained adult assistant, and their scores compared for interrater reliability. Sorting was scored as the number of cards included in meaningful categories. For the 10-card level, 29 participants of a total of 60 were scored, with 2 discrepancies between the scorers. The level of interscorer agreement was psychometrically reliable, Kappa = .84, $t = 6.22$, $p < .001$. For the 20-card level, 25 participants of a total of 51 were scored, with 2 discrepancies. The level of interscorer agreement was psychometrically reliable, Kappa = .88, $t = 8.21$, $p < .001$.

For the 40-card level, 12 participants of a total of 23 were scored, with 1 discrepancy. The level of interscorer agreement was psychometrically reliable, Kappa = .79, t = 6.14, $p < .001$. Discrepancies were discussed and resolved.

Studying: The videotapes of the studying behavior of approximately half the participants at each of the difficulty levels were individually scored by the experimenter and a trained adult assistant, and their scores compared for interrater reliability. Studying was scored as 0 = participant makes no apparent motion besides visual inspection of the cards, 1 = participant touches or names the cards, or 2 = participant looks away from the cards or closes his or her eyes. For the 10-card level, 29 participants of a total of 60 were scored, with 2 discrepancies between the scorers. The level of interscorer agreement was psychometrically reliable, Kappa = .90, t = 6.79, $p < .001$. For the 20-card level, 25 participants of a total of 51 were scored, with 2 discrepancies. The level of interscorer agreement was psychometrically reliable, Kappa = .85, t = 5.53, $p < .001$. For the 40-card level, 12 participants of a total of 23 were scored, with 2 discrepancies. The level of interscorer agreement was psychometrically reliable, Kappa = .71, t = 3.17, $p < .01$. Discrepancies were discussed and resolved.

Self-testing: The videotapes of the self-testing behavior of approximately half the participants at each of the difficulty levels were individually scored by the experimenter and a trained adult assistant, and their scores compared for interrater reliability. Self-testing was scored 0 = participant makes no apparent motion besides visual inspection of the cards, 1 = participant touches or names the cards, or

2 = participant looks away from the cards or closes his or her eyes. For the 10-card level, 29 participants of a total of 60 were scored, with 2 discrepancies between the scorers. The level of interscorer agreement was psychometrically reliable, Kappa = .88, t = 5.67, $p < .001$. For the 20-card level, 25 participants of a total of 51 were scored, with 2 discrepancies. The level of interscorer agreement was psychometrically reliable, Kappa = .87, t = 6.49, $p < .001$. For the 40-card level, 12 participants of a total of 23 were scored, with 2 discrepancies. The level of interscorer agreement was psychometrically reliable, Kappa = .73, t = 4.26, $p < .001$. Discrepancies were discussed and resolved.

Strategy adjustment: The audiotape recordings of the strategy adjustment responses of all the participants at each of the difficulty levels were transcribed into the Paradox database program, and sorted alphabetically on the responses to the question asked at the first experimental level. A new ID code was assigned to each response in order to ensure that the experimenter was blind to the participant, the participant's grade level, and whether the response to be scored was taken at the first, second or third difficulty level. A report was generated of all responses, which was individually scored by the experimenter and a trained adult assistant, and their scores compared for interrater reliability. Strategy adjustment was scored as 0 = participant failed to respond, answered "No," answered "I don't know," or repeated some element of the question, 1 = participant's answer included some reference to memorizing or remembering, or 2 = participant's answer included some reference to sorting or self-testing.

Examples of answers that were scored 0 are: "These are new pictures," "I'm doing the same thing," and "I have fun. This is fun. It's a game to remember." Examples of answers that were scored 1 are: "I memorize them by saying their names," and "I look at the pictures and use my memory," and "I use my memory. I have a good memory." Examples of answers that were scored 2 are: "I put them in order and memorize them," and "I turn all the cards face down. I put them in alphabetical order first but then I switched them around. They are in groups like furniture, food. Every set of cards has categories of pictures. I turn the cards over after I test what category I put them in to see if I'm right. I have to test all the categories until I get all of them right."

For the 10-card level, there were 3 discrepancies between the scorers. The level of interscorer agreement was psychometrically reliable, Kappa = .88, $\underline{t}$ = 6.89, $\underline{p}$ < .001. For the 20-card level, there with 2 discrepancies. The level of interscorer agreement was psychometrically reliable, Kappa = .91, $\underline{t}$ = 6.96, $\underline{p}$ < .001. For the 40-card level, there were 2 discrepancies. The level of interscorer agreement was psychometrically reliable, Kappa = .85, $\underline{t}$ = 4.97, $\underline{p}$ < .001. Discrepancies were discussed and resolved.

Recall: From the videotapes, the cards that participants turned over in a failed effort to match a picture were coded on the scoring grids with circles. Pictures eventually matched correctly were scored with a check, and pictures that were not matched correctly were scored with an x. An examination of the scoring grids for the 23 participants who completed the 40-picture third experimental trial, which included

the greatest frequency of incorrect attempts at matching, revealed that although the mean number of cards eventually matched correctly (mean = 3.13, SD = 3.17) was larger than the mean number of cards not matched correctly (mean = 2.96, SD = 3.12), there was no significant difference in accurate matching between cards that had been previously turned over and cards that had not been previously turned over (t = 2.40, n.s.). Therefore, the number of pictures accurately matched were recorded as the recall measure regardless of whether the correct matches had previously been turned over in an incorrect attempt at matching.

Participants - Demographic Analyses

Parents granted consent for 20 second graders, 22 fifth graders, and 23 eighth graders to participate in the study. All students who consented to participate were tested. However, the results of 1 fifth grade and 3 eighth grade students were excluded from the analyses because they had been left back. In addition, 1 second grade student's results were excluded because after she completed the two practice levels, she declined to complete the first experimental level. Recruitment was discontinued when a target of 20 participants at each grade level was reached.

The second graders' ages ranged from 7 years 5 months to 8 years 4 months, with a median age of 7 years and 8 months. The fifth graders' ages ranged from 10 years 5 months to 11 years 4 months, with a median age of 10 years 9 months. The eighth graders' ages ranged from 13 years 5 months to 14 years 4 months, with a median age of 13 years 10 months.

Two-thirds of the participants were drawn from a New York City parochial school, 93% of whose students were eligible for the school lunch program, which would classify them as lower SES. The remaining participants were recruited from a New York City private school whose mission is to provide a model for public education. This school's mission is pursued by enrollment policies that ensure a multi-ethnic student body, with a sliding tuition structure to avoid the stigma related to scholarships that may be felt by minority students in private schools. The school administration reports that two-thirds of their students pay less than the required tuition, and are supported by an endowment. The school's policy is to keep students' tuition support status confidential. Lunch is served free to all students. It is not possible to determine the SES of participants drawn from that school, but it may be assumed that they are middle or low SES.

The students from the private school represented 15% of the 2nd graders, 30% of the 5th graders, and 45% of the 8th graders, or 30% of the total sample. The ethnicity of all participants was predominantly African-American and Latino. As is evident from Table 1, the participants were almost equally balanced in terms of ethnicity and gender at each grade level.

The measures for each participant at his or her highest level of difficulty were used in the following analyses. Learning self-efficacy, performance self-efficacy and self-reaction measures were adjusted to reflect participant's difficulty level in the following manner. These measures were not adjusted if the highest difficulty level was the 10-card first experimental level. The measures were multiplied by 2 if the

highest difficulty level was the 20-card second experimental level. And the measures were multiplied by 4 if the highest difficulty level was the 40-card third experimental level.

The highest difficulty level attempted by participants at each grade level was as follows. All participants completed the 10-card first difficulty level. Of the second grade sample, 9 students stopped at the 10-card first difficulty level, and 11 continued to the 20-card second difficulty level. Of the fifth graders, 16 students stopped at the 20-card second difficulty level, and 4 students continued to the 40-card third difficulty level. Of the eighth graders, 1 student stopped at the 20-card second difficulty level, and 19 students continued to the 40-card third difficulty level. Table 2 presents the means and standard deviations on each measure at the highest difficulty level attempted by participants at each grade level.

The first statistical analysis tested whether there were any differences in measures of self-regulated study processes or recall due to participants' ethnicity or gender, or their school. Participants' measures on self-regulatory variables and recall at their highest level of difficulty were used in a multivariate 2 (gender) x 3 (ethnicity) x 2 (school) analysis of variance (MANOVA) using the general linear model. This procedure provides analyses of variance for multiple dependent variables by the three factor variables that divide the sample into groups. The analyses tested the null hypothesis about the effects of the factor variables on the means of the dependent variables. The dependent variables included in the analyses were Quick Test, learning self-efficacy, learning goal, quantity of cards sorted, study behavior, quantity of cards

self-tested, strategy adjustment, performance self-efficacy, performance goal, recall, and self-reaction. Wilks' Lambda, or the U statistic, was chosen as the multivariate test of significance. Lambda ranges between 0 and 1, with values close to 1 indicating the group means were not different. There were no significant main effects for gender (Lambda = .88, F(10,41) = .59, n.s.), ethnicity (Lambda = .83, F(20,82) = .39, n.s.), or school (Lambda = .80, F(10,41) = 1.01, n.s.). Similarly, no interaction effect achieved statistical significance: gender x ethnicity (Lambda = .73, F(20,82) = .71, n.s.), gender x school (Lambda = .74, F(10,41) = 1.47, n.s.), ethnicity x school (Lambda = .77, F(10,41) = 1.24, n.s.), gender x ethnicity x school (Lambda = .82, F(10,41) = .90, n.s.). Univariate analyses of variance revealed no significant between-subjects effects due to any of the three factors alone or in any combination. On the basis of these findings, the following analyses of developmental differences in measures of participants' self-regulated learning processes at their highest level of difficulty were conducted using the entire sample.

Developmental Differences in Self-Regulated Learning Processes.

The following analyses tested developmental differences in self-regulated learning processes. A one-way analysis of variance procedure (ANOVA) was used to ascertain the significance of differences among participants in the three grades on the following dependent measures: Quick Test, learning self-efficacy, learning goal, quantity of cards sorted, study behavior, quantity of cards self-tested, strategy

adjustment, performance self-efficacy, performance goal, recall, and self-reaction. Significant differences between the means at each grade level were found on all measures as reported in Table 3.

In addition to determining that significant differences exist among the means, post-hoc tests using Tukey's Honestly Significant Differences were conducted to determine which means differed. Tukey's test makes all pairwise comparisons between groups, and sets the experimental error rate at the error rate for the collection for all pairs of comparisons. The results revealing which group means differed are presented in Table 4.

Developmental Differences in Variables Predicting Recall and Self-Reaction.

The next series of statistical analyses sought to determine which variables were related to participants' recall and self-reaction scores. The means and standard deviations on each measure at the highest difficulty level attempted by participants at each grade level was presented in Table 2. Table 5 presents the Pearson correlations among the Quick Test and self-regulated learning measures for 2nd graders working at their highest difficulty level.

The variables were entered in the sequence in which they were measured (Quick Test, learning self-efficacy, learning goal, sorting, study behavior, self-testing, strategy adjustment, performance self-efficacy, performance goal, recall, and self-reaction) in the EQS statistical program (Bentler, 1989), which provides a measure of goodness of fit to evaluate the models, Bentler's Comparative Fit Index (CFI). This index represents the increment in fit obtained by using the hypothesized model relative

to the fit of the null model (Stevens, 1996). The CFI is not affected by the sample size (Bentler & Bonnett, 1980), and ranges from 0.00 to 1.00, where 0.00 reflects a complete lack of fit and 1.00 indicates a perfect fit.

The path model for the 2nd graders appears in Figure 3. Learning self-efficacy, learning goal, sorting, studying and strategy adjustment dropped out of the model because they were not linked to the other measures. Therefore, the Quick Test and self-testing became the two exogenous variables in the model. The path coefficient between the Quick Test and studying was $\underline{P} = .37$, $\underline{p} < .05$. Studying predicted performance self-efficacy ($\underline{P} = .25$, $\underline{p} < .05$) as did self-testing ($\underline{P} = .45$, $\underline{p} < .05$). Performance self-efficacy predicted performance goal ($\underline{P} = .47$, $\underline{p} < .05$), which predicted recall ($\underline{P} = .81$, $\underline{p} < .05$), which predicted self-reaction ($\underline{P} = .81$, $\underline{p} < .05$). The Comparative Fit Index for the path model was .95, which represents a satisfactory fit (Bentler & Bonnett, 1980).

Table 6 presents the Pearson correlations among the Quick Test and self-regulated learning measures for 5th graders working at their highest difficulty level, and the path model for the 5th graders appears in Figure 4. Learning self-efficacy was the only exogenous variable in the model. The Quick Test, sorting and studying dropped out of the model. The path coefficient from learning self-efficacy to learning goal was $\underline{P} = .64$, $\underline{p} < .05$, and from learning self-efficacy to performance self-efficacy

was $\underline{P}$ = .61, $\underline{p}$ < .05. Learning goal predicted self-testing ($\underline{P}$ = .41, $\underline{p}$ < .05), which predicted strategy adjustment ($\underline{P}$ = .47, $\underline{p}$ < .05). Strategy adjustment did not subsequently predict any other variables. Performance self-efficacy, whose path coefficient from learning self-efficacy has already been detailed, in turn predicted performance goal ($\underline{P}$ = .71, $\underline{p}$ < .05), which predicted recall ($\underline{P}$ = .90, $\underline{p}$ < .05), which predicted self-reaction ($\underline{P}$ = .85, $\underline{p}$ < .05). The Comparative Fit Index for the path model was .84 which approaches a satisfactory fit (Bentler & Bonnett, 1980).

Table 7 presents the Pearson correlations among the Quick Test and self-regulated learning measures for 8th graders working at their highest difficulty level, and the path model for the 8th graders appears in Figure 5. The Quick Test was the only exogenous variable in the model. Studying and self-testing dropped out of the model. The path coefficient from the Quick Test to learning self-efficacy was $\underline{P}$ = .51, $\underline{p}$ < .05, from the Quick Test to recall was $\underline{P}$ = .19, $\underline{p}$ < .05, and from the Quick Test to learning goal was $\underline{P}$ = .23, $\underline{p}$ < .05. Learning self-efficacy predicted learning goal ($\underline{P}$ = .54, $\underline{p}$ < .05), sorting ($\underline{P}$ = .42, $\underline{p}$ < .05), and performance self-efficacy ($\underline{P}$ = .68, $\underline{p}$ < .05). Learning goal predicted sorting ($\underline{P}$ = .41, $\underline{p}$ < .05), which in turn predicted strategy adjustment ($\underline{P}$ = .53, $\underline{p}$ < .05). Strategy adjustment predicted performance self-efficacy ($\underline{P}$ = .11, $\underline{p}$ < .05) and performance goal ($\underline{P}$ = .29, $\underline{p}$ < .05). Performance self-efficacy also predicted performance goal ($\underline{P}$ = .75, $\underline{p}$ < .05), which predicted recall ($\underline{P}$ = .70, $\underline{p}$ < .05), which predicted self-reaction ($\underline{P}$ = .89, $\underline{p}$ < .05). The Comparative Fit Index for the path model was .85 which approaches a satisfactory fit (Bentler & Bonnett, 1980).

Variables Predicting Persistence

Two final analyses were conducted to determine which variables predicted participants' continuation to further difficulty levels. These analyses could not be conducted on the 8th grade sample because all but 1 student persisted to the 40-card highest difficulty level. It should be recalled that 9 of the 2nd graders stopped at the 10-card first difficulty level, and 11 of the 2nd graders continued to the 20-card second difficulty level. The variables of interest in the analyses to predict persistence were the four final measures taken prior to making the decision to continue: performance self-efficacy, performance goal, recall, and self-reaction. Tables 8 and 9 present the means and standard deviations on performance self-efficacy, performance goal, recall, and self-reaction for persisters and non-persisters by grade and difficulty level.

For the 2nd graders, the four final measures taken at the 10-card first difficulty level were analyzed to predict participants' choice of whether or not to proceed to the next difficulty level. Table 10 presents the Pearson correlations among predictors of persistence for 2nd graders on the 10-card difficulty level. Performance self-efficacy, performance goal, recall and self-reaction measures for 2nd graders taken at the 10-card first difficulty level were entered in the EQS statistical program (Bentler, 1989) with persistence (coded 0 for those to did not persist, and 1 for those who did) as the

final variable. Performance self-efficacy and performance goal dropped out of the model. The path coefficient between recall and self-reaction was $\underline{P} = .69$, $\underline{p} < .05$, and the path coefficient between self-reaction and persistence was $\underline{P} = .53$, $\underline{p} < .05$. The Comparative Fit Index for the path model was .99 which represents a satisfactory fit (Bentler & Bonnett, 1980). The path model for the 2nd graders appears in Figure 6.

It should also be recalled that 16 of the 5th graders stopped at the 20-card first difficulty level, and 4 of the 5th graders continued to the 40-card second difficulty level. For the 5th graders, the four final measures taken at the 20-card difficulty level were analyzed to predict participants' choice of whether or not to proceed to the next difficulty level. Table 11 presents the Pearson correlations among predictors of persistence for 5th graders on the 20-card difficulty level.

Similar results were obtained in the analysis of the 5th graders. Fifth graders' performance self-efficacy, performance goal, recall and self-reaction measures taken at the 20-card first difficulty level were entered in the EQS statistical program with persistence as the final variable. Performance self-efficacy and performance goal dropped out of the model. The path coefficient between recall and self-reaction was $\underline{P} = .62$, $\underline{p} < .05$, and the path coefficient between self-reaction and persistence was $\underline{P} = .51$, $\underline{p} < .05$. The Comparative Fit Index for the path model was .91, which represents a satisfactory fit (Bentler & Bonnett, 1980). The path model for the 5th graders appears in Figure 7.

No analysis could be conducted on the 8th grade sample because only 1 out of the 20 students persisted to the 40-card highest difficulty level.

CHAPTER V

DISCUSSION

Introduction

This study sought to describe how self-regulated learning processes emerge and develop among elementary school aged children. Self-regulation refers to self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals (Zimmerman, in press). A self-regulation research paradigm differs from experimenter controlled investigations in its permission of a wide latitude in learners' choice of their learning tasks and the learning processes used to attain them (Zimmerman, 1994). Critics of a self-regulation research design that allows choices of task difficulty level might contend that allowing students choice may preclude comparison at equivalent difficulty levels. However, there is research indicating that if students perceive tasks as beyond their efficacy level they do not perform at optimal levels of learning (Gaultney, Schneider & Bjorklund, 1992). Furthermore, such tasks would be avoided in naturalistic contexts where students can exercise choice (Zimmerman, in press), and thus do not provide an optimal index of transfer.

Whereas previous research into developmental trends in self-regulation (e.g., Zimmerman & Martinez-Pons, 1990) have used students' self-reports of their general approaches to study, this project was unique in that it took on-line measurements of children's self-regulated learning processes as they engaged in a learning effort. In this study, students were shown a complete array of processes and were then allowed

to decide whether to use them as they prepared for a sort-recall task. As such, this design sought to uncover the role of motivational processes such as perceived self-efficacy and self-reactions as well as metacognitive skills in learning and persistence.

The developmental analyses were based on participants' performance at their self-determined highest level of difficulty. The rationale for this decision was that self-regulated learning processes would be most evident if students were working at the optimal difficulty level at which they felt confident about their performance. Had all participants been required to perform at the 40-card highest difficulty level, all of the second graders and 16 of the fifth graders would have performed at a level more difficult than that which they would have personally chosen. On the other hand, had the analyses been conducted at the 20-card intermediate difficulty level, 4 of the fifth graders and 19 of the eighth graders may not have encountered an optimal degree of challenge. Permitting participants to self-determine their optimal level of difficulty provided revealing information regarding the processes that predict persistence.

Self-Regulated Learning Processes Related to Persistence

An inspection of Tables 8 and 9 provides descriptive support for the hypothesized role that self-regulated learning processes play in the determination of persistence. A narrative account of the interplay of performance self-efficacy, performance goal, recall and self-reaction at each of the grade levels follows (see Tables 8 and 9).

Second graders who terminated their performance at the 10-card level apparently were overly confident, after they had studied, that they could match all 10

cards correctly, reporting performance self-efficacy at a mean score of 6.67 (out of 7.00). Surprisingly, they then set performance goals at a mean of only 7.44 (out of 10.00), which was higher than they actually achieved as recall scores (mean = 6.67), resulting in the lowest self-reaction report in Table 9 (mean = 4.56, representing less than 5 = pretty happy). By contrast, those 2nd graders who continued to the 20-card level were more modest in their confidence that they could match all 10 cards correctly (mean = 5.55), but they set higher performance goals (mean = 9.09). Their recall scores (mean = 8.36), though less than their goal was considerably higher than the mean recall scores of 6.67 achieved by the students who terminated at the 10-card level, as was their self-reaction (mean = 6.45 vs. 4.56). At the 20-card level, these students' confidence was even more modest (mean = 5.18). Their performance goals were set at approximately the same percent as the students who had terminated at the 10-card level (14.91 out of 20, or 75%, compared with 7.44 out of 10, or 74%), though much lower than the 91% that they had set at the 10-card level, possibly reflecting the increased difficulty of the 20-card level. Their mean recall scores also may have reflected the difficulty of the 20-card level, falling to 11.82 (or 59%), compared with the 87% accuracy in recall scores (mean = 8.36) they achieved at the 10-card level, and even lower than the 67% accuracy in recall scores (mean = 6.67) that was achieved at the 10-card level by the 2nd graders who terminated their efforts at that level. The self-reaction ratings of the 2nd graders who persisted to the 20-card level were lower than their own self-reaction ratings at the 10-card level (mean = 5.91

vs. 6.54), but higher than the non-persisters' self-reaction ratings at the 10-card level (mean = 4.56).

The pattern of connections between performance self-efficacy and performance goal was inconsistent, suggesting that 2nd graders are not fully self-regulative. The students who terminated at the 10-card level reported a high performance self-efficacy (mean = 6.67), but set low performance goals (mean = 7.44). On the other hand, the students who continued to the 20-card level reported a lower performance self-efficacy than they had at the 10-card level (mean = 5.55), but set performance goals almost at the maximum mastery level (mean = 9.09 out of 10).

All the 5th and 8th graders advanced to the 20-card level, so their measures taken at the 10-card level are only instructive through comparisons between each other and with the 2nd graders at the 10-card level. The 5th and 8th graders' performance self-efficacy were almost equal (mean = 6.25 and 6.20, respectively). The performance goals of the persisters at this 10-card level increased by grade, from a mean of 9.09 by the 2nd grade persisters, to 9.20 by the 5th graders, to 9.55 by the 8th graders. Recall increased similarly, from a mean of 8.36 by the 2nd graders, to 8.90 by the 5th graders, to 9.75 by the 8th graders. However, self-reaction by the 5th graders was low (mean = 6.20) compared to that of the 2nd graders (mean = 6.45) and 8th graders (mean = 6.80). These differences, however, did not achieve statistical significance in a one-way analysis of variance comparing grade differences in self-reaction at the 10-card level among the 2nd, 5th, and 8th grade persisters ($F(2,48) = 1.77$, n.s.). An examination of the data revealed that the break in the grade increase

pattern in self-efficacy was caused by one 5th grader who scored a perfect recall, but rated his or her self-reaction at 3 ("not at all satisfied").

The pattern of differences at the 20-card difficulty level between the 16 fifth graders who terminated at that level and the 4 fifth graders who continued to the 40-card difficulty level was fairly consistent. On each variable in Tables 8 and 9, the non-persisters' measures were slightly lower than the persisters'. Comparing non-persisters and persisters, performance self-efficacy was rated at a mean of 5.19 versus 5.75, performance goal was set at a mean of 13.69 versus 20.00, recall scores achieved a mean of 15.19 versus 15.75, and self-reaction was rated at a mean of 5.13 versus 6.75.

At the 40-card level, however, there is some evidence that although the 5th graders persisted with great confidence, they may have overshot their capabilities. Their performance self-efficacy was rated uniformly at 5.00 ("pretty confident"). Their performance goals were reported at a mean of 36.25, or 91%, which is approximately as high as the entire 5th grade sample's performance goals at the 10-card difficulty level (mean = 9.20 out of 10). However, their recall scores achieved a mean of 28.75 (72%), and they reported self-reaction at a mean of 4.75, the second lowest self-reaction means reported in Table 9. It is questionable, however, whether the results of these 4 students can be generalized to any great extent.

Support for the Hypotheses

A multivariate analysis of variance (MANOVA) tested the first hypothesis, that there are developmental increases in self-regulated learning processes among 2nd, 5th,

and 8th grade students. The results of the analysis supported the first hypothesis. There were significant differences among the three grades on the Quick Test and all the self-regulated learning process measures (see Table 3).

A post-hoc Tukey test of the grade differences on these measures supported the second hypothesis, that the pattern of increases among 2nd, 5th, and 8th grade students varies for specific self-regulated learning processes. A perusal of Table 4 shows that the differences among all three grades were significant for the means of the Quick Test, learning self-efficacy, learning goal, performance self-efficacy, performance goal, and recall. On the following variables, there were significant differences in means between the 2nd and 8th graders, and the 5th and 8th graders, but not between the 2nd and 5th graders: quantity of cards sorted, study behavior, quantity of cards self-tested, strategy adjustment and self-reaction.

A possible explanation for the lack of difference between the 2nd and 5th graders on sorting, studying and self-testing is that school experiences that may contribute to the development of these study strategies do not normally occur until after 5th grade. Specifically, the amount of homework that teachers assign students up to 5th grade was reported recently as between 22 and 29 minutes (depending on student or parent reports), whereas students in the 6th grade and above received close to double that amount (Cooper, et al., 1998). Homework provides students with opportunities to develop self-regulated learning skills to a greater degree than is possible during classroom activities, which are mainly under the teacher's control.

The difference between the strategy adjustment scores of the 8th graders and the 2nd and 5th graders may reflect Zimmerman's (in press) hypothesis that only people with highly developed self-regulatory processes make strategic plans and cyclically adjust them during learning efforts. However, another possible explanation for the lack of difference on this variable between the 2nd and 5th graders may stem from the way the variable was measured. This possibility is discussed more fully under Shortcomings of the Study, below.

An explanation for the lack of differences in self-reaction may be gleaned from an examination of Table 9, which breaks down the means for self-reaction by grade, difficulty level, and persistence status. The self-reaction scores reported in Table 9 were not adjusted for difficulty level. Within a range of 1 - 7, with 1 = not at all happy (satisfied) and 7 = completely happy (satisfied), the 2nd graders who terminated their exercise at the 10-card difficulty level exhibited the lowest means on self-reaction of any cells in the Table 9, at 4.56 (lower than 5 = pretty satisfied). Those 2nd graders who continued on to the 20-card difficulty level displayed much greater satisfaction with their increased efforts, with a mean of 5.91 for self-reaction at their highest level of difficulty. In contrast, although 5th graders who terminated at the 20-card level displayed satisfaction levels above 5, those who terminated at the 40-card level may have overshot their optimal difficulty level. Those four 5th graders who terminated at the 40-card level rated their self-reaction at a mean of 4.75 (representing less than 5 = pretty satisfied). These results may have dampened the difference between the 2nd and 5th graders on the measure of self-reaction.

Support for the third hypothesis, that self-regulated learning processes exhibit increasing integration as predictors of recall in 2nd, 5th, and 8th grade students, was provided by path analyses of the Quick Test and the self-regulated learning variables. Considerable evidence was amassed that indicates that self-regulatory processes become increasingly integrative in the course of development. Figures 3, 4, and 5 reveal increased complexity and greater integration of self-regulated learning variables as children develop through the grade school years. Figure 3 illustrates the simple causal path linking the self-regulated learning processes of the 2nd graders. Their verbal intelligence (as measured by the Quick Test) was predictive of their study behavior ($\underline{P} = .37$, $\underline{p} < .05$). More specifically, students with a larger vocabulary tended to exhibit signs of rehearsing or forming mental images while studying for this task. The memorization behaviors displayed during this procedure would also be appropriate for preparing for vocabulary or spelling tests.

The number of cards tested predicted 2nd graders' performance self-efficacy ($\underline{P} = .45$, $\underline{p} < .05$, see Figure 3). However, there were no variables that predicted the quantity of cards sorted. In fact, sorting was not frequently exhibited among the 2nd graders. The mean number of cards sorted by 2nd grade students who terminated at the 10-card level was 1.00 (SD = 3.00), and the mean number of cards sorted by 2nd grade students who terminated at the 20-card level was 4.91 (SD = 8.46). The low incidence of sorting was expected from findings in metacognitive research. Second graders rarely exhibit strategies to enhance comprehension; by 3rd grade, they may be aware that categorization facilitates memorization, but they are unable to recognize

that different task features indicate the need for different strategic approaches (Lovett & Flavell, 1990).

An intriguing feature of the 2nd graders' path model is that neither leaning self-efficacy nor learning goals, both of which were measured before the participants actually engaged in the learning task, were predictive of recall and self-reaction. In contrast, the self-efficacy and goal variables measured after the studying experience were predictive of recall and self-reaction. Performance self-efficacy predicted performance goals ($\underline{P}$ = .47, $\underline{p}$ < .05, see Figure 3), which in turn predicted recall ($\underline{P}$ = .81, $\underline{p}$ < .05), which predicted self-reaction ($\underline{P}$ = .81, $\underline{p}$ < .05). This finding implies that forethought processes (i.e., self-efficacy and goal setting) are undeveloped in students at this grade level, but that they may be evoked during engagement in learning.

In contrast, inspection of Figure 4, showing the causal path linking the self-regulated learning processes of the 5th graders, reveals the presence of all three forethought variables (i.e., learning self-efficacy, learning goal, strategy adjustment). Although the presence of these variables evinces a greater complexity among the 5th graders' self-regulated learning processes, there are indications that their development is still incipient. In particular, strategy adjustment, a forethought measure, though influenced by the number of cards tested ($\underline{P}$ = .47, $\underline{p}$ < .05), was itself not causally linked with any other variables on the path to recall and self-reaction. As is evident from Table 2, strategy adjustment was rarely exhibited among 5th graders. In fact, 14 of the 5th graders scored 0 on this measure, and 6 scored 1. None of the 5th graders

included sorting or self-testing in their answers to the question, "Are you doing anything differently [now that you're playing with new pictures]?"

The 8th graders' causal path (Figure 5) shows a great deal of integration of self-regulated learning processes. The Quick Test measure of verbal intelligence predicted learning self-efficacy ($\underline{P}$ = .51, $\underline{p}$ < .05), learning goal ($\underline{P}$ = .42, $\underline{p}$ < .05), and recall ($\underline{P}$ = .19, $\underline{p}$ < .05). Learning self-efficacy predicted learning goal ($\underline{P}$ = .54, $\underline{p}$ < .05), sorting ($\underline{P}$ = .42, $\underline{p}$ < .05), and performance goal ($\underline{P}$ = .68, $\underline{p}$ < .05). Sorting was predicted by both learning self-efficacy ($\underline{P}$ = .42, $\underline{p}$ < .05) and learning goal ($\underline{P}$ = .41, $\underline{p}$ < .05). Strategy adjustment predicted performance self-efficacy ($\underline{P}$ = .53, $\underline{p}$ < .05) and performance goal ($\underline{P}$ = .29, $\underline{p}$ < .05). All the variables operationalizing Zimmerman's (in press) strategy model for student self-regulated learning remained in the 8th graders' path model, with the exception of studying and self-testing.

Support for the Theoretical Model

This procedure served as a rich source of data on the development of self-regulated learning processes that students engage in during a learning task. At the start of each trial, after participants were shown a poster conveying the difficulty level of the upcoming sort-recall task, they were asked to assessed their **learning self-efficacy**, a forethought process theorized to influence their planning and goal setting (Zimmerman, in press), with the question, "How sure are you that you can match all the pictures correctly?" The responses reported by students in the 5th and 8th grades influenced subsequent aspects of their learning behavior. The 8th graders reported responses that were linked causally both to learning goals ($\underline{P}$ = .54, $\underline{p}$ < .05, see Figure

5) and performance goals ($\underline{P}$ = .68, $\underline{p}$ < .05, see Figure 5), supporting the role that self-efficacy serves in learning as theorized by Zimmerman (in press). The 8th graders' learning self-efficacy ratings were also causally linked to the number of cards sorted ($\underline{P}$ = .42, $\underline{p}$ < .05, see Figure 5), a connection with task strategies that was discovered in addition to those proposed in the Zimmerman (in press) model. In the case of the 5th graders, path analyses also revealed that learning self-efficacy was causally linked to learning goal ($\underline{P}$ = .64, $\underline{p}$ < .05, see Figure 4), as well as to a later measure of self-efficacy, performance self-efficacy ($\underline{P}$ = .61, $\underline{p}$ <.05, see Figure 4).

After they rated their learning self-efficacy, participants were asked to set a **learning goal**, a forethought process that theoretically determines the criteria against which students self-evaluate their learning efforts (Zimmerman, in press), in answer to the question, "How many pictures are you going to try and match correctly?" In this study, both the 8th graders and 5th graders provided responses that were causally linked to their task strategies, in support of Zimmerman's (in press) model. The 8th graders' responses were linked to the number of cards sorted (($\underline{P}$ = .41, $\underline{p}$ .05, see Figure 5), and the 5th graders' responses were linked to the number of cards self-tested ($\underline{P}$ = .41, $\underline{p}$ < .05, see Figure 4).

Two measures of task strategies, a performance/volitional control process that helps learners focus on the task and optimize their efforts (Zimmerman, in press) were recorded in this procedure. Among the 8th graders, the **number of cards sorted** was predictive of strategy adjustments ($\underline{P}$ = .42, $\underline{p}$ < .05, see Figure 5). However, although the mean **studying behavior** scores of the 8th graders were significantly

different from those of the 2nd and 5th graders (see Table 4), this was a crude index that showed very little variability among students in the upper grades. Therefore, this variable did not contribute to the fit of the path analyses predicting recall and self-reaction at any grade level, and dropped out of the models.

After engaging in learning, participants were scored on their self-monitoring, a performance/volitional control process referring to a person's tracking of specific aspects of performance (Zimmerman, in press), by tallying the **quantity of cards tested**. This variable helped predict performance self-efficacy among the 2nd graders ($\underline{P}$ = .45, $\underline{p}$ < .05, see Figure 3). It predicted strategy adjustment among the 8th graders ($\underline{P}$ = .47, $\underline{p}$ < .05, see Figure 5).

During their engagement in learning and self-monitoring, participants were measured on their strategic planning, a forethought process referring to purposive processes and actions that are directed at acquiring a skill (Zimmerman, 1989). In this study, strategic planning was conceptualized as **strategy adjustment** and measured by asking participants what they were doing differently at the current difficulty level. Although strategy adjustment was not consistently predicted by a specific variable, its emergence as an important variable in self-regulated learning was evident. Strategy adjustment played no predictive role among 2nd graders' self-regulated learning processes (see Figure 3). Strategy adjustment was predicted by quantity of cards tested among the 5th graders ($\underline{P}$ = .47, $\underline{p}$ < .05, see Figure 4), but it did not predict any other self-regulated learning variables in the path model. However, among the 8th graders, strategy adjustment was predicted by quantity of cards sorted ($\underline{P}$ = .53,

$p < .05$), and it in turn predicted both performance self-efficacy ($\underline{P} = .11$, $p < .05$) and performance goal ($\underline{P} = .29$, $p < .05$).

Following their preparation, participants were again asked to rate their **performance self-efficacy**, to set **performance goals**, to test their **recall**, and to rate their **self-reaction**. These four variables were consistently strong predictors in paths describing self-regulated learning processes among participants at all three grades. Among the 2nd graders, performance self-efficacy predicted performance goals ($\underline{P} = .47$, $p < .05$, see Figure 3), which in turn predicted recall ($\underline{P} = .81$, $p < .05$), which predicted self-reaction ($\underline{P} = .81$, $p < .05$). Among the 5th graders, performance self-efficacy predicted performance goals ($\underline{P} = .71$, $p < .05$, see Figure 4), which in turn predicted recall ($\underline{P} = .90$, $p < .05$), which predicted self-reaction ($\underline{P} = .85$, $p < .05$). Among the 8th graders, performance self-efficacy predicted performance goals ($\underline{P} = .75$, $p < .05$, see Figure 5), which in turn predicted recall ($\underline{P} = .70$, $p < .05$), which predicted self-reaction ($\underline{P} = .88$, $p < .05$).

In addition, recall and self-reaction played a strong role in predicting persistence among the 2nd and 5th graders. Among the 2nd graders, recall predicted self-reaction ($\underline{P} = .69$, $p < .05$, see Figure 6), which in turn predicted persistence ($\underline{P} = .53$, $p < .05$). Among the 5th graders, recall predicted self-reaction ($\underline{P} = .62$, $p < .05$, see Figure 7), which in turn predicted persistence ($\underline{P} = .51$, $p < .05$).

These path analyses showing the variables that predict recall and self-reaction followed the sequence of forethought, performance/volitional control, and self-reflection as proposed by Zimmerman (in press). At each grade level, this ordering of

the measures of self-regulated learning processes produced a satisfactory fit of the model. These results may be interpreted as evidence that the decision to persist depends on performance/volitional control and self-reflective phase processes rather than forethought processes, in support of the Zimmerman (in press) model. In the case of the 2nd graders, although performance self-efficacy and performance goal correlated with persistence, -.42 and .36 respectively (see Table 10), they were not linked causally and dropped out of the model (see Figure 6). With the inclusion of performance goal, the path coefficient from performance goal to recall was $\underline{P} = .49$, $\underline{p} < .05$, but the Comparative Fit Index dropped to .74, a non-satisfactory fit. Among the 5th graders, although performance self-efficacy and performance goal correlated with persistence, .16 and .53 respectively (see Table 11), they were not linked causally and dropped out of the model (see Figure 7). With the inclusion of performance goal, the path coefficient from performance goal to recall was $\underline{P} = .42$, $\underline{p} < .05$, but the Comparative Fit Index dropped to .69, a non-satisfactory fit.

Limitations of the Study

This study was an effort to measure self-regulated learning processes during engagement on a learning task by students at three grade levels. As such, a procedure was required that would capture the interest of and present learning challenges to children whose ages ranged from approximately 7 and a-half to 14 and a-half years of age. The procedure in this study attempted to satisfy this requirement by presenting an engaging memory task at sequentially increasing difficulty levels. The benefit of this procedure was that all participants would proceed through the same sequence of

difficulty levels. However, since the nature of the variables of interest in this research required that participants exercise their own choice, another requirement of the procedure was that participants be allowed to terminate their involvement at their own self-determined difficulty level. A shortcoming of this procedure arose from students exercising their permission to choose their optimal difficulty level. Although a good balance was achieved between non-persisters and persisters at the 2nd grade level (n = 9 and 11, respectively), no such balance existed for the 5th graders (n = 16 and 4 for the non-persisters and persisters, respectively) or the 8th graders (n = 1 and 19 for the non-persisters and persisters, respectively).

The procedure used in this study provided an abundant source of data on self-regulated learning processes. However, another shortcoming of this research stemmed from the burden of gathering this type of data. Considerable time was required to test each participant, followed by time spent scoring the videotape and audiotape records. Unfortunately, the limited sample size clearly restricted the interpretation of the results. Inferential statistics on the data summarized in Tables 8 and 9 were limited to the analyses that predicted persistence among the 2nd and 5th graders. This was due to the limited number of participants reflected in each cell. It was hard to feel confident drawing conclusions regarding the differences in self-regulated learning processes between the 16 fifth graders who terminated at the 20-card difficulty level, and the 4 fifth graders who went on the 40-card difficulty level. It was impossible to draw any conclusions on the basis of the single 8th grader who terminated at the 20-card difficulty level.

Similarly, the limited sample size led to difficulty in interpreting some findings. For example, the mean self-reaction of the 5th graders at the 10-card difficulty level was slightly lower than the self-reaction of the 2nd and 8th graders at that level due to the influence of one fifth grader who scored a perfect 10 but rated his or her self-reaction at only 3.00 (out of 7.00).

An even greater shortcoming was that no description of the differences between the 8th grade persisters and non-persisters could be offered since only 1 student failed to continue to the 40-card difficulty level. The mean recall by the 19 eighth graders who completed the 40-card difficulty level was 31.89, precluding the suspicion that there may have been a ceiling effect. Nevertheless, a fourth difficulty level may distinguish persisters from non-persisters within the 8th grade. Pilot testing would have to determine the number of cards at the higher difficulty level. Continuing the pattern established in the present research of doubling the number of cards at each level would lead to an 80-card level. It is unlikely that sufficient numbers of 8th graders would rise to that challenge.

On a specific variable, the strategy adjustment question appeared to have been poorly phrased. As it was phrased in this study, there was no focus on the increasing difficulty level. The experimenter merely drew attention to the different composition of pictures at each level (i.e., "You're playing with new pictures this time. It's hard to learn new pictures. Are you doing anything differently this time?") This phrasing may have contributed to the very few instances of answers that included a reference to either sorting or self-testing and thus earned the highest score of 2. Only three

answers out of a total of 136 were scored as 2. This low frequency may, however, reflect the theoretical property of strategic planning, that it is cyclically adjusted only among people for whom self-regulated learning processes are fully developed (Zimmerman, in press). The interpretation of results relating to this variable may have been clearer if the question had clearly stated that the new level was more difficult, not merely that there are new pictures (i.e., "You're playing with twice as many pictures this time. It's hard to learn twice as many pictures. Are you doing anything differently this time?").

Directions for Future Research

Redressing the limitations suggested in the preceding section in a replication study is one avenue for future research. In addition, more research is needed to understand the roles of task strategies and self-monitoring in on-line engagement in self-regulated learning, and how these processes develop. Confusion still exists regarding task strategies. The studying behavior measure of task strategies played a causal role in predicting recall and self-reaction among the 2nd graders, predicting performance self-efficacy ($\underline{P}$ = .25, $\underline{p}$ < .05, see Figure 3). Neither measure of task strategies played any predictive role among 5th graders' self-regulated learning processes (see Figure 4). However, the quantity of cards sorted measure of task strategies played a causal role in predicting recall and self-reaction among the 8th graders, predicting strategy adjustment ($\underline{P}$ = .53, $\underline{p}$ < .05, see Figure 5).

Similarly, the development of self-monitoring is still unclear. Evidence gathered in this study suggests that self-monitoring is important to how 2nd and 5th

graders learn. Among 2nd graders, the quantity of cards tested predicted performance self-efficacy ($\underline{P}$ = .45, $\underline{p}$ < .05, see Figure 3), and among 5th graders the quantity of cards tested predicted performance strategy adjustment ($\underline{P}$ = .47, $\underline{p}$ < .05, see Figure 4). However, this variable failed to play any predictive role among 8th graders' self-regulated learning processes.

Finally, recent research (Zimmerman & Kitsantas, 1997) has revealed that when students were asked to attribute less than optimal performance, attributions that reflected strategy use were predictive of their self-efficacy. Developmental differences in student attributions during learning were not included in this study and could be investigated in the future.

Implications for Educational Practice

Metacognitive research strives to isolate executive control processes that govern cognition. Within the metacognitive tradition, participants' forethought and self-reflective processes are not measured, and their performance/volitional control processes are restricted.

Educators may infer from metacognitive research that mental mechanisms alone account for students' learning, and that they have little hope of teaching young students to use cognitive strategies. In particular, research in the metacognitive tradition (Best, 1993) has demonstrated that children in the third grade are not amenable to strategy instruction, but that they do spontaneously use memory strategies if they are presented with highly typical, taxonomically related materials. By sixth grade, item typicality no longer has an effect on students' initiation and use of memory

strategies (Best & Ornstein, 1986). Rather, strategic behaviors are more likely elicited by functionally related materials (Best, 1993).

Thus guided, teachers wishing to elicit strategic memory functioning may find themselves searching for typical exemplars within the course content, or exemplars linked through functional relationships. Given these constraints, how would a teacher help students with an assignment to memorize the names of the states in the union? What are "typical" names of states? Are there any functional relationships to be found within such a list of names?

The most important implication of the study presented here stems from its support of a view of students as active managers of their own learning rather than as passive participants within structured learning environments (Zimmerman, 1989a). In the Zimmerman (in press) model of student self-regulated learning, self-regulated learning processes are seen as more than mere adjuncts to cognitive processes; they are viewed as part of the very fabric of cognition.

This study demonstrates that students invoke more than metacognitive processes when they learn. For example, they engage forethought processes to prepare for learning challenges. The 5th grade students in this study exhibited relationships between forethought processes -- learning self-efficacy and learning goal -- measured before they engaged in study, as well as performance self-efficacy and performance goal measured after they had engaged in study (see Figure 4). The 8th graders displayed more complex relationships, where learning self-efficacy influenced both learning goal and performance goal, as well as a performance/volitional control

process, strategy use (i.e., cards sorted) (see Figure 5). Forethought processes were not evident among the 2nd graders; however, they demonstrated a relationship between performance self-efficacy and performance goal, which were measured after their studying efforts (see Figure 3).

As they are learning, students use performance/volitional control processes. Self-observation was elicited in this study even among 2nd graders simply by presenting a clear model of the behavior (see Figure 3). The 5th graders' forethought process of setting learning goals influenced their self-observation and strategy adjustment (see Figure 4), and by 8th grade, both forethought processes (learning self-efficacy and learning goal) influenced strategy use and strategy adjustment (see Figure 5). After receiving feedback on the results of their learning efforts, students' self-reflective processes influence their continued motivation. In the present study, recall predicted self-reaction, which predicted persistence to more difficult levels (see Figures 6 and 7).

The results of this study imply that educators have much more control over the development of student self-regulated learning than metacognitive research would suggest. They also imply practices that educators could utilize to promote the development of self-regulated learning processes. This study provides evidence that clear modeling of self-regulated learning processes can elicit similar processes among students as young as the 5th grade, and complex interactions among these processes among 8th graders. To develop students' self-regulated learning processes, teachers should find opportunities to model these processes.

Returning to the challenge posed earlier of how a teacher might help students memorize the names of the states in the union, the teacher could model self-efficacious beliefs (e.g., "I've memorized lots of lyrics to songs, I'm sure I can memorize the names of the states in the union"), goal-setting (e.g., "I'll memorize half the names today, and the other half tomorrow"), and strategic planning (e.g., "I'll memorize the names of the states in groups starting with the same letter; once I've learned those, I'll memorize them in alphabetical order within each group"). The preceding were examples of self-regulated learning processes involved in forethought. The teacher could find similar ways to model self-regulated learning processes involved in performance/volitional control and self-reflection.

Beyond simple modeling, teachers can encourage the development of self-regulated learning processes by organizing their presentations to permit students to set learning goals, to use strategies to learn, to self-monitor their learning progress, and to systematically adapt their efforts on the basis of learning outcomes. Because learning is incrementally achieved through successive iterations incorporating self-regulatory processes, an instructional technology aimed at promoting the development of self-regulated learning processes should involve several iterations of classroom and homework activities (Zimmerman, Bonner, & Kovach, 1996).

Educators should maintain consistency in the way they present course content materials, and should give frequent quizzes to inform students of the effectiveness of their learning strategies. With a consistent backdrop, and with frequent feedback, students can test alternative methods of learning to discover strategies appropriate to

different studying demands, and appropriate to the context of their lives, such as their time constraints and the educational resources they can afford.

Figure 1. Phase Structure and Subprocesses of Self-Regulation. Adapted from Zimmerman, B. J. (in press). Attaining self-regulation: A social cognitive perspective. To appear in M. Boekaerts, P. Pintrich, & M. Seidner (Eds.), Self-Regulation: Theory, Research, and Applications. Orlando, FL: Academic Press.

Forethought	Performance / Volitional Control	Self-reflection
Task Analysis	Self Control	Self-Reaction
Goal Setting	Task Strategies	Self-satisfaction
Strategic Planning	Self-observation	
Self-Motivation	Self-testing	
Self-efficacy		

PREPARATION FOR STUDY

CYCLICAL PHASE:	Forethought		
SELF-REGULATED LEARNING PROCESS:	Self-Efficacy	Goal Setting	Strategic Planning
OPERATIONALIZATION:	**Learning Self-Efficacy**	**Learning Goal**	**Strategy Adjustment**
WHEN MEASURED:	Before presenting the set to be studied	Directly after Learning Self-Efficacy	After presenting the set of cards for study
HOW MEASURED:	How sure are you that you can match all pictures correctly?	How many pictures are you going to try and match correctly?	You're playing with new pictures this time. It's hard to learn new pictures. Are you doing anything differently this time?
SCALE:	1 - 7	0 - # of cards in set	0 = participant failed to respond, answered "No," answered "I don't know," or repeated some element of the question 1 = participant's answer included some reference to memorizing or remembering 2 = participant's answer included some reference to sorting or self-testing

Figure 2. Overview of Measures

STUDY

CYCLICAL PHASE:	Performance/Volitional Control		
SELF-REGULATED LEARNING PROCESS:	Task Strategies		Self-Testing
OPERATIONALIZATIONS:	**# Cards Sorted**	**Study Behavior**	**# Cards Tested**
WHEN MEASURED:	After completion of array	After array, before any cards turned face-down	After cards turned face-down
HOW MEASURED:	Transcribed final array onto grids, counted number of cards included in meaningful categories	Inspection of videotape records: scored participants' hand and eye gestures, and verbalizations	Inspection of videotape records: counted number of cards turned face-up for inspection
SCALE:	0 - # of cards in set	0 = participant makes no apparent motion besides visual inspection of the cards 1 = participant touches or names the cards 2 = participant looks away from the cards or closes his or her eyes	0 - # of cards in set

Figure 2. Overview of Measures (continued)

PREPARATION FOR TESTING

CYCLICAL PHASE:	Forethought	
SELF-REGULATED LEARNING PROCESS:	Self-Efficacy	Goal Setting
OPERATIONALIZATION:	**Performance Self-Efficacy**	**Performance Goal**
WHEN MEASURED:	After cards are turned face-down and before testing.	Directly after Performance Self-Efficacy
HOW MEASURED:	Now that you have learned the pictures, how sure are you that you can match all the pictures correctly?	How many pictures do you think you will be able to match correctly?
SCALE:	1 - 7	0 - # of cards in set

Figure 2. Overview of Measures (continued)

TESTING (feedback)

Recall
After studying is completed
Tallied number of correct matches from videotapes
0 - # of cards in set

REACTION

CYCLICAL PHASE:	Self-Observation
SELF-REGULATED LEARNING PROCESS:	Self-Reaction
OPERATIONALIZATION:	**Self-Reaction**
WHEN MEASURED:	After giving feedback on correct number
HOW MEASURED:	How satisfied (happy) are you that you matched ___ pictures correctly?
SCALE:	1 - 7

Figure 2. Overview of Measures (continued)

Table 1. Total Participants in Each Grade, Classified by Ethnicity and School

GRADE	GENDER	ETHNICITY						Total Gender by School	
		Afr-Am.		White		Latino			
		Paro	Priv	Paro	Priv	Paro	Priv	Paro	Priv
2	Male	3	1	0	0	3	2	6	3
	Female	6	0	1	0	4	0	11	0
	Total Eth	10		1		9			
5	Male	3	1	2	0	3	1	8	2
	Female	2	3	0	0	4	1	6	4
	Total Eth	9		2		9			
8	Male	2	4	1	0	2	2	5	6
	Female	3	1	1	0	2	2	6	3
	Total Eth	10		2		8			

Table 2. Means and Standard Deviations on Quick Test and Self-Regulated Learning Measures at Highest Difficulty Level by Grade

Measure	2nd Grade		5th Grade		8th Grade	
	Mean	SD	Mean	SD	Mean	SD
Quick Test	7.65	1.18	10.40	1.10	12.80	1.54
Learning self-efficacy	8.05	3.22	13.00	4.79	21.20	4.87
Learning goal	11.40	5.82	21.05	10.61	33.25	6.79
Quantity of cards sorted	3.15	6.74	9.95	13.52	31.65	12.11
Study behavior	.60	.75	1.00	.56	1.50	.61
Quantity of cards self-tested	5.00	8.27	9.75	13.33	32.80	12.74
Strategy adjustment	0.00	.00	.30	.47	.75	.64
Performance self-efficacy	8.70	3.03	12.30	4.78	23.10	5.96
Performance goal	11.55	6.17	18.20	10.29	31.35	8.27
Recall	9.50	3.53	17.90	6.32	31.05	8.85
Self-reaction	8.55	4.24	12.00	5.35	22.30	7.32

Table 3. Multivariate Analysis of Variance of Quick Test and Self-Regulated Learning Measures at Highest Difficulty Level by Grade

		Sum of Squares	df	Mean Square	F	Sig.
Quick Test	Between Groups	265.63	2	132.82	80.07	.001
	Within Groups	94.55	57	1.66		
	Total	360.18	59			
Learning self-efficacy	Between Groups	1639.63	2	819.82	36.71	.001
	Within Groups	1272.95	57	22.33		
	Total	2912.58	59			
Learning goal	Between Groups	4795.90	2	2397.95	37.37	.001
	Within Groups	3657.50	57	64.17		
	Total	8453.40	59			
Quantity of cards sorted	Between Groups	8733.23	2	4366.62	34.32	.001
	Within Groups	7251.35	57	127.22		
	Total	15984.58	59			
Study behavior	Between Groups	7.23	2	3.62	8.35	.001
	Within Groups	24.70	57	.43		
	Total	31.93	59			
Quantity of cards self-tested	Between Groups	8844.70	2	4422.35	32.49	.001
	Within Groups	7758.95	57	136.12		
	Total	166603.65	59			
Strategy adjustment	Between Groups	6.70	2	3.35	17.44	.001
	Within Groups	10.95	57	.19		
	Total	17.65	59			
Performance self-efficacy	Between Groups	2132.80	2	1066.40	47.33	.001
	Within Groups	1284.20	57	22.53		
	Total	3417.00	59			
Performance goal	Between Groups	4507.63	2	2253.82	35.80	.001
	Within Groups	3588.30	57	62.95		
	Total	8095.93	59			
Recall	Between Groups	4565.03	2	2282.52	49.28	.001
	Within Groups	2639.95	57	46.32		
	Total	7204.98	59			
Self-reaction	Between Groups	2012.63	2	1006.32	29.21	.001
	Within Groups	1963.95	57	34.46		
	Total	3976.58	59			

Table 4. Post-hoc Analysis of Grade Differences in Quick Test and Self-Regulated Learning Measures at Highest Difficulty Level

Measure	2nd x 5th Grade	5th x 8th Grade	2nd x 8th Grade
Quick Test	$p < .001$	$p < .001$	$p < .001$
Learning self-efficacy	$p < .01$	$p < .001$	$p < .001$
Learning goal	$p < .001$	$p < .001$	$p < .001$
Quantity of cards sorted	n.s.	$p < .001$	$p < .001$
Study behavior	n.s.	$p < .05$	$p < .001$
Quantity of cards self-tested	n.s.	$p < .001$	$p < .001$
Strategy adjustment	n.s.	$p < .01$	$p < .001$
Performance self-efficacy	$.p < .06$	$p < .001$	$p < .001$
Performance goal	$.p < .05$	$p < .001$	$p < .001$
Recall	$p < .001$	$p < .001$	$p < .001$
Self-reaction	n.s.	$p < .001$	$p < .001$

Table 5. Pearson Correlations Among Quick Test and Self-Regulated Learning Measures for 2nd Graders at Highest Difficulty Level

		quick test	learn self-eff	learning goal	# cards sorted	study behav	# cards tested
quick test	Pearson Correlation	1.000					
	Sig. (2-tailed)	.					
learn self-eff	Pearson Correlation	-.092	1.000				
	Sig. (2-tailed)	.700	.				
learning goal	Pearson Correlation	-.124	.519	1.000			
	Sig. (2-tailed)	.602	.019	.			
# cards sorted	Pearson Correlation	-.257	.058	.215	1.000		
	Sig. (2-tailed)	.273	.809	.364	.		
study behav	Pearson Correlation	.366	-.056	-.058	.168	1.000	
	Sig. (2-tailed)	.112	.813	.809	.479	.	
# cards tested	Pearson Correlation	-.081	.188	.350	.345	-.169	1.000
	Sig. (2-tailed)	.735	.428	.130	.137	.477	.
perf self-eff	Pearson Correlation	-.163	.666	.390	.513	.129	.357
	Sig. (2-tailed)	.492	.001	.089	.021	.587	.122
perf goal	Pearson Correlation	-.232	.460	.819	.434	-.086	.418
	Sig. (2-tailed)	.325	.041	.000	.056	.718	.067
recall	Pearson Correlation	-.208	.586	.656	.474	-.099	.468
	Sig. (2-tailed)	.379	.007	.002	.035	.678	.037
self-reac	Pearson Correlation	-.159	.473	.478	.467	.040	.308
	Sig. (2-tailed)	.503	.035	.033	.038	.869	.187

Table 5. Pearson Correlations Among Quick Test and Self-Regulated Learning Measures for 2nd Graders at Highest Difficulty Level (continued)

		perf self-eff	perf goal	recall	self-reac
quick test	Pearson Correlation				
	Sig. (2-tailed)				
learn self-eff	Pearson Correlation				
	Sig. (2-tailed)				
learning goal	Pearson Correlation				
	Sig. (2-tailed)				
# cards sorted	Pearson Correlation				
	Sig. (2-tailed)				
study behav	Pearson Correlation				
	Sig. (2-tailed)				
# cards tested	Pearson Correlation				
	Sig. (2-tailed)				
perf self-eff	Pearson Correlation	1.000			
	Sig. (2-tailed)	.			
perf goal	Pearson Correlation	.460	1.000		
	Sig. (2-tailed)	.041	.		
recall	Pearson Correlation	.551	.803	1.000	
	Sig. (2-tailed)	.012	.000	.	
self-reac	Pearson Correlation	.641	.493	.804	1.000
	Sig. (2-tailed)	.002	.027	.000	.

Figure 3. Path Model of Variables Predicting 2nd Graders' Recall and Self-Reaction at Highest Difficulty Level

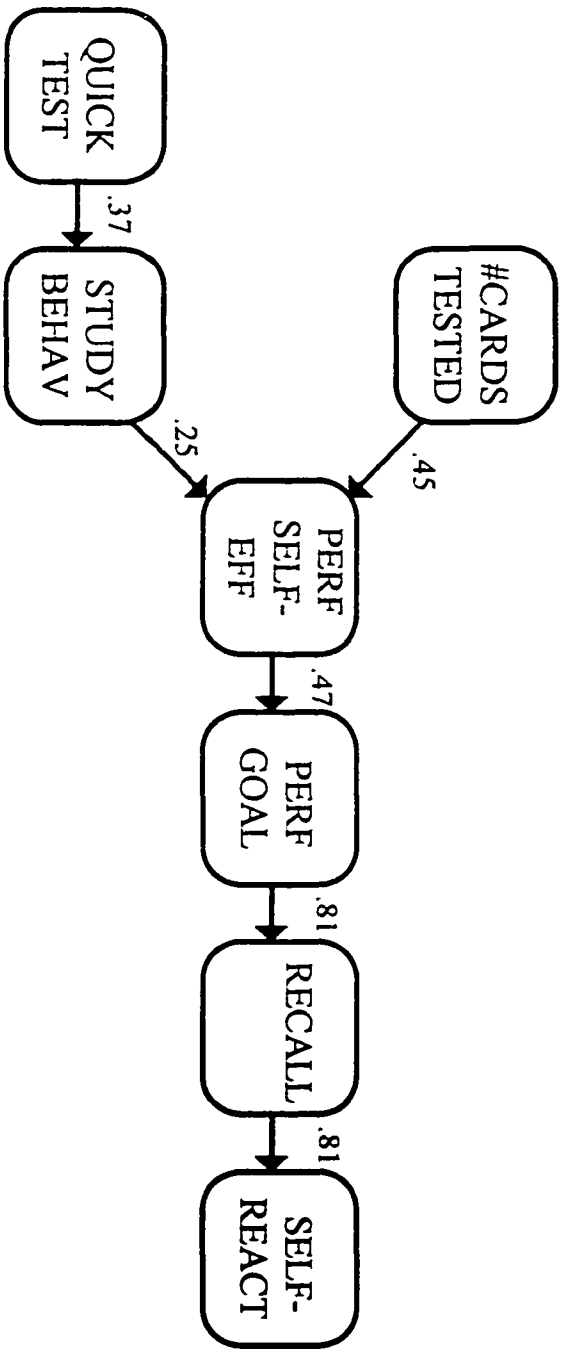


Table 6. Pearson Correlations Among Quick Test and Self-Regulated Learning Measures for 5th Graders at Highest Difficulty Level

		quick test	learn self-eff	learning goal	# cards sorted	study behav	# cards tested
quick test	Pearson Correlation	1.000					
	Sig. (2-tailed)	.					
learn self-eff	Pearson Correlation	-.060	1.000				
	Sig. (2-tailed)	.801	.				
learning goal	Pearson Correlation	.533	.641	1.000			
	Sig. (2-tailed)	.016	.002	.			
# cards sorted	Pearson Correlation	.240	.391	.636	1.000		
	Sig. (2-tailed)	.309	.088	.003	.		
study behav	Pearson Correlation	-.085	.508	.468	.319	1.000	
	Sig. (2-tailed)	.720	.022	.038	.171	.	
# cards tested	Pearson Correlation	.364	.309	.408	.660	.176	1.000
	Sig. (2-tailed)	.115	.185	.074	.002	.459	.
strategy adjust	Pearson Correlation	.368	-.234	.050	.143	-.199	.466
	Sig. (2-tailed)	.111	.321	.836	.547	.400	.038
perf self-eff	Pearson Correlation	-.004	.611	.670	.531	.353	.297
	Sig. (2-tailed)	.987	.004	.001	.016	.127	.204
perf goal	Pearson Correlation	.361	.683	.875	.648	.291	.494
	Sig. (2-tailed)	.117	.001	.000	.002	.213	.027
recall	Pearson Correlation	.325	.653	.814	.650	.355	.613
	Sig. (2-tailed)	.162	.002	.000	.002	.124	.004
self-reac	Pearson Correlation	.287	.550	.632	.303	.175	.477
	Sig. (2-tailed)	.219	.012	.003	.195	.460	.034

Table 6. Pearson Correlations Among Quick Test and Self-Regulated Learning Measures for 5th Graders at Highest Difficulty Level (continued)

		strategy adjust	perf self-eff	perf goal	recall	self-reac
quick test	Pearson Correlation					
	Sig. (2-tailed)					
learn self-eff	Pearson Correlation					
	Sig. (2-tailed)					
learning goal	Pearson Correlation					
	Sig. (2-tailed)					
# cards sorted	Pearson Correlation					
	Sig. (2-tailed)					
study behav	Pearson Correlation					
	Sig. (2-tailed)					
# cards tested	Pearson Correlation					
	Sig. (2-tailed)					
strategy adjust	Pearson Correlation	1.000				
	Sig. (2-tailed)	.				
perf self-eff	Pearson Correlation	.052	1.000			
	Sig. (2-tailed)	.829	.			
perf goal	Pearson Correlation	.052	.711	1.000		
	Sig. (2-tailed)	.827	.000	.		
recall	Pearson Correlation	.099	.635	.904	1.000	
	Sig. (2-tailed)	.678	.003	.000	.	
self-reac	Pearson Correlation	.167	.527	.782	.849	1.000
	Sig. (2-tailed)	.481	.017	.000	.000	.

Figure 4. Path Model of Variables Predicting 5th Graders' Recall and Self-Reaction at Highest Difficulty Level

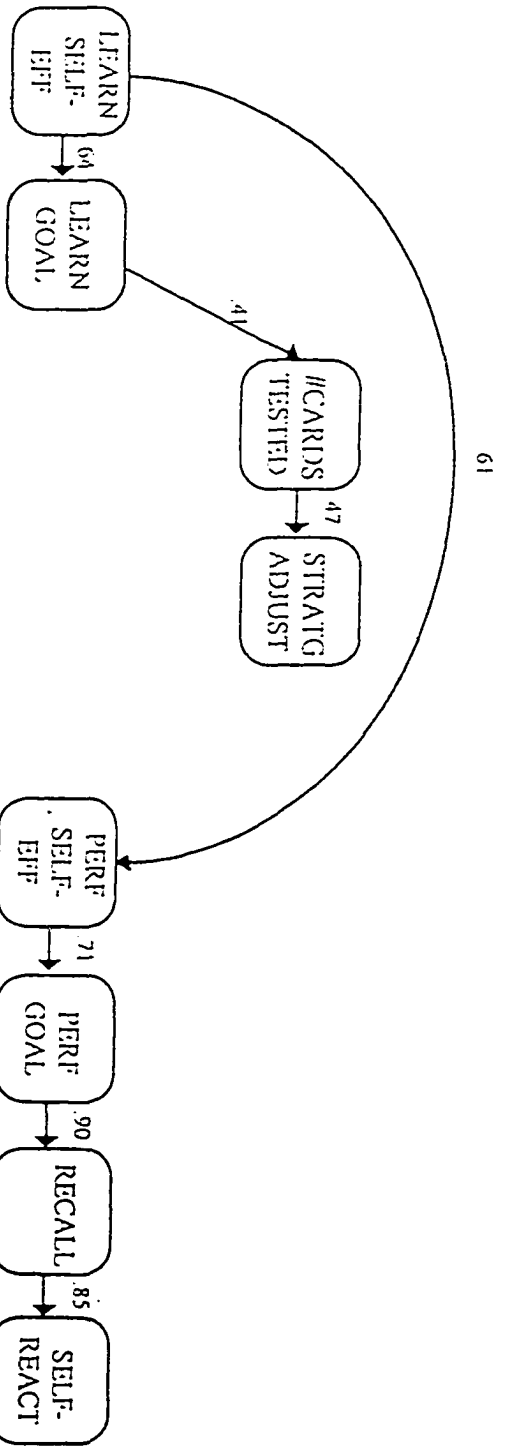


Table 7. Pearson Correlations Among Quick Test and Self-Regulated Learning Measures for 8th Graders at Highest Difficulty Level

		quick test	learn self-eff	learning goal	# cards sorted	study behav	# cards tested
quick test	Pearson Correlation	1.000					
	Sig. (2-tailed)	.					
learn self-eff	Pearson Correlation	.510	1.000				
	Sig. (2-tailed)	.022	.				
learning goal	Pearson Correlation	.553	.652	1.000			
	Sig. (2-tailed)	.011	.002	.			
# cards sorted	Pearson Correlation	.450	.778	.653	1.000		
	Sig. (2-tailed)	.047	.000	.002	.		
study behav	Pearson Correlation	.337	.427	.109	.455	1.000	
	Sig. (2-tailed)	.146	.060	.649	.044	.	
# cards tested	Pearson Correlation	.421	.621	.571	.512	.095	1.000
	Sig. (2-tailed)	.064	.003	.009	.021	.689	.
strategy adjust	Pearson Correlation	.374	.778	.367	.553	.339	.582
	Sig. (2-tailed)	.104	.000	.111	.011	.143	.007
perf self-eff	Pearson Correlation	.346	.735	.539	.727	.334	.625
	Sig. (2-tailed)	.136	.000	.014	.000	.150	.003
perf goal	Pearson Correlation	.307	.767	.457	.650	.330	.726
	Sig. (2-tailed)	.188	.000	.043	.002	.155	.000
recall	Pearson Correlation	.556	.779	.643	.847	.524	.781
	Sig. (2-tailed)	.011	.000	.002	.000	.018	.000
self-reac	Pearson Correlation	.528	.650	.430	.703	.367	.733
	Sig. (2-tailed)	.017	.002	.058	.001	.111	.000

Table 7. Pearson Correlations Among Quick Test and Self-Regulated Learning Measures for 8th Graders at Highest Difficulty Level (continued)

		strategy adjust	perf self-eff	perf goal	recall	self-reac
quick test	Pearson Correlation					
	Sig. (2-tailed)					
learn self-eff	Pearson Correlation					
	Sig. (2-tailed)					
learning goal	Pearson Correlation					
	Sig. (2-tailed)					
# cards sorted	Pearson Correlation					
	Sig. (2-tailed)					
study behav	Pearson Correlation					
	Sig. (2-tailed)					
# cards tested	Pearson Correlation					
	Sig. (2-tailed)					
strategy adjust	Pearson Correlation	1.000				
	Sig. (2-tailed)	.				
perf self-eff	Pearson Correlation	.795	1.000			
	Sig. (2-tailed)	.000	.			
perf goal	Pearson Correlation	.814	.888	1.000		
	Sig. (2-tailed)	.000	.000	.		
recall	Pearson Correlation	.691	.830	.766	1.000	
	Sig. (2-tailed)	.001	.000	.000	.	
self-reac	Pearson Correlation	.692	.701	.679	.892	1.000
	Sig. (2-tailed)	.001	.001	.001	.000	.

Figure 5. Path Model of Variables Predicting 8th Graders' Recall and Self-Reaction at Highest Difficulty Level

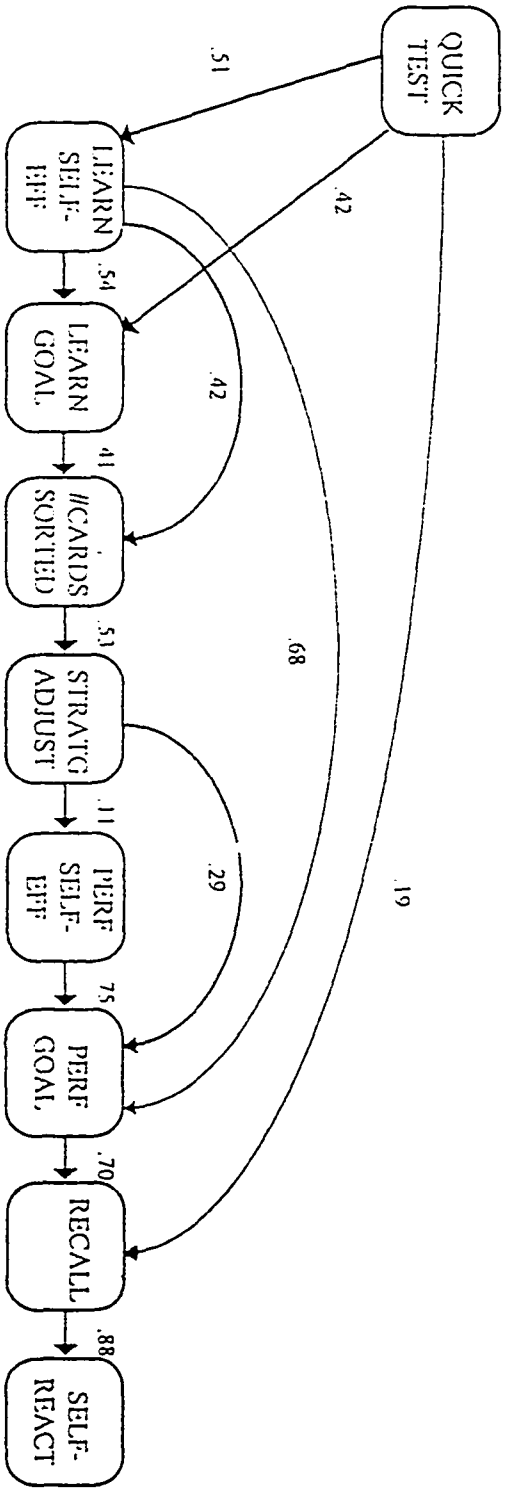


Table 8. Means and Standard Deviations on Performance Self-Efficacy and Performance Goal for Persisters and Non-persisters by Grade and Difficulty Level

SAMPLE SIZE

	10 cards		20 cards		40 cards
	Terminate	Continue	Terminate	Continue	Terminate
2nd Grade	n= 9	n= 11	n= 11		
5th Grade		n= 20	n= 16	n= 4	n= 4
8th Grade		n= 20	n= 1	n= 19	n= 19

PERFORMANCE SELF-EFFICACY

	10 cards		20 cards		40 cards
	Terminate	Continue	Terminate	Continue	Terminate
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
2nd Grade	6.67 (.71)	5.55 (1.57)	5.18 (1.60)		
5th Grade		6.25 (1.16)	5.19 (1.52)	5.75 (.96)	5.00 (.00)
8th Grade		6.20 (.95)	5.00 (.00)	6.16 (1.17)	S5.95 (1.31)

PERFORMANCE GOAL

	10 cards		20 cards		40 cards
	Terminate	Continue	Terminate	Continue	Terminate
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
2nd Grade	7.44 (3.21)	9.09 (1.04)	14.91 (6.04)		
5th Grade		9.20 (1.24)	13.69 (4.63)	20.00 (.00)	36.25 (4.50)
8th Grade		9.55 (1.23)	20.00 (.00)	16.47 (3.22)	31.95 (8.04)

Table 9. Means and Standard Deviations on Recall and Self-Reaction for Persisters and Non-persisters by Grade and Difficulty Level

SAMPLE SIZE

	10 cards		20 cards		40 cards
	Terminate	Continue	Terminate	Continue	Terminate
2nd Grade	n= 9	n= 11	n= 11		
5th Grade		n= 20	n= 16	n= 4	n= 4
8th Grade		n= 20	n= 1	n= 19	n= 19

RECALL

	10 cards		20 cards		40 cards
	Terminate	Continue	Terminate	Continue	Terminate
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
2nd Grade	6.67 (1.73)	8.36 (1.21)	11.82 (2.86)		
5th Grade		8.90 (1.52)	15.19 (2.69)	16.00 (2.16)	28.75 (4.57)
8th Grade		9.75 (.55)	15.00 (.00)	17.00 (2.69)	31.89 (8.23)

SELF-REACTION

	10 cards		20 cards		40 cards
	Terminate	Continue	Terminate	Continue	Terminate
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
2nd Grade	4.56 (2.13)	6.45 (.93)	5.91 (1.04)		
5th Grade		6.20 (1.32)	5.12 (1.26)	6.75 (.50)	4.75 (2.06)
8th Grade		6.80 (.62)	5.00 (.00)	6.16 (1.17)	5.63 (1.83)

Table 10. Pearson Correlations Among Predictors of Persistence for 2nd Graders on 10-Card Difficulty Level

		Performance Self-Efficacy	Performance Goal	Recall	Self-Reaction	Continue to 20 cards
Performance Self-Efficacy	Pearson Correlation	1.000				
	Sig. (2-tailed)	.				
Performance Goal	Pearson Correlation	.011	1.000			
	Sig. (2-tailed)	.964	.			
Recall	Pearson Correlation	-.154	.491	1.000		
	Sig. (2-tailed)	.518	.028	.		
Self-Reaction	Pearson Correlation	-.354	.010	.691	1.000	
	Sig. (2-tailed)	.125	.967	.001	.	
Continue to 20 cards	Pearson Correlation	-.422	.355	.520	.533	1.000
	Sig. (2-tailed)	.064	.125	.019	.015	.

Figure 6. Path Model of Variables Predicting Persistence Among 2nd Graders

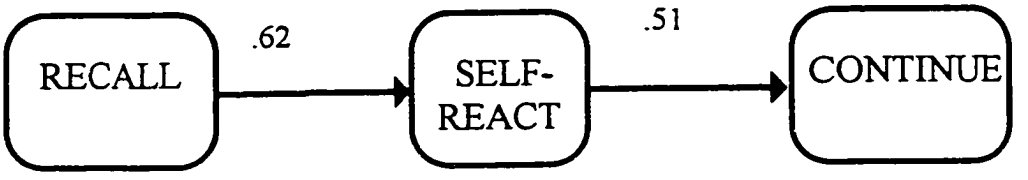
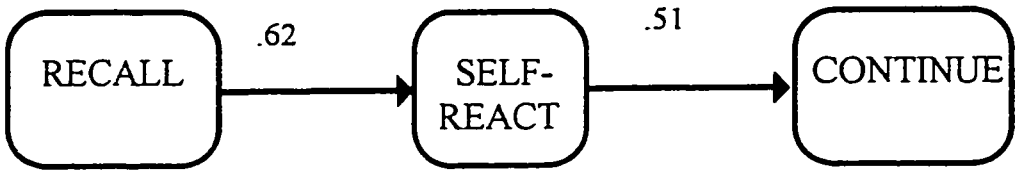


Table 11. Pearson Correlations Among Predictors of Persistence for 5th Graders on 20-Card Difficulty Level

		Performance Self-Efficacy	Performance Goal	Recall	Self-Reaction	Continue to 40 cards
Performance Self-Efficacy	Pearson Correlation	1.000				
	Sig. (2-tailed)	.				
Performance Goal	Pearson Correlation	-.028	1.000			
	Sig. (2-tailed)	.906	.			
Recall	Pearson Correlation	-.381	.419	1.000		
	Sig. (2-tailed)	.098	.066	.		
Self-Reaction	Pearson Correlation	.008	.604	.624	1.000	
	Sig. (2-tailed)	.972	.005	.003	.	
Continue to 40 cards	Pearson Correlation	.163	.533	.092	.506	1.000
	Sig. (2-tailed)	.493	.016	.700	.023	.

Figure 7. Path Model of Variables Predicting Persistence Among 5th Graders



Appendix A. Consent Form

THE GRADUATE SCHOOL AND UNIVERSITY CENTER
OF THE CITY UNIVERSITY OF NEW YORK
Ph.D. Program in Educational Psychology / Box 445
Graduate Center: 33 West 42 Street, New York, NY 10036-8099
212-642-2261

Parent or Guardian Consent Form

I agree to allow my child to participate in a study to be conducted by Sebastian Bonner, a doctoral student at the Graduate School and University Center of the City University of New York. The study is being conducted with the permission of the administration and faculty of my child's school, . I understand that my child will be asked to take a short vocabulary quiz and play a matching pictures game. My child will be videotaped during this study so that his/her performance can be analyzed later to help the researchers understand how self-regulation develops in children. My child's performance during the study will in no way affect his/her school grades.

I realize that participation in this study is voluntary and I understand that my child may withdraw from the study at any time without any penalty. All the information about my child will be kept confidential and his/her identity will not be revealed to any individual.

If I need to have additional information about this study, I am free to call 212- to talk with Mr. Bonner.

I understand that my child will not face discomfort or risk by participating in this study. I also understand that his/her participation in the study may help teachers and students to understand more about how self-regulation skills develop in children.

Signature of Parent/Guardian_____

If you are interested in receiving information regarding the results of the study, please place a check mark on the space below and give your address. A summary reflecting the overall results will be mailed to you. No individual names or scores will appear.

_____ Please send me the results of the study.

Address:_____

_____

Appendix B. Picture Order in Presentation and Matching Sets for Each Trial

Modeling
Presentation: swim green write apple brown sleep grey peach purple cherry
Matching: cherry brown apple green swim peach purple sleep grey write

Practice 1
Presentation: queen cat king yellow dog
Matching: king dog yellow cat queen

Practice 2
Presentation: girl white boy fish red woman blue man bird black
Matching: boy fish red white bird man black girl blue woman

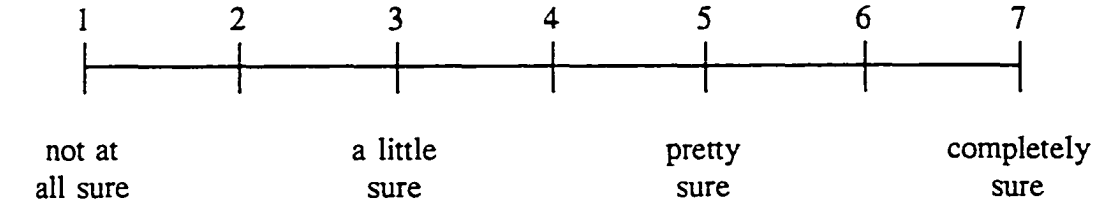
Experimental 1
Presentation: elephant train car spoon jacket zebra bowl bus knife plane
Matching: spoon bus zebra bowl car jacket knife train plane elephant

Experimental 2
Presentation: boat stand play nose ship eye sea fire mouth walk ride head drink water jump run ear sit ferry hand
Matching: hand sea run water boat head walk ferry sit jump stand play ear fire drink nose ship eye mouth ride

Experimental 3
Presentation: schoolbag cow bicycle gun kite cake telephone sky duck table shirt banana sun pen chair orange lamp moon hill ink pig ball grass pencil door hen doll egg window book flower bed classroom leaf bread foot handkerchief umbrella tree milk
Matching: table tree cake gun leaf kite chair flower hen milk schoolbag grass bicycle umbrella pencil sun shirt egg classroom cow moon lamp bread door pig handkerchief foot window orange duck book hill bed door banana ink sky ball pen telephone

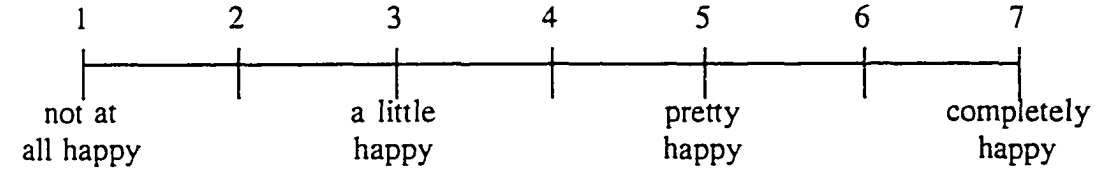
Appendix C. Self-Efficacy and Self-Reaction Scales

Self-Efficacy:



Self-Reaction (for 5th and 8th graders):

Self-Reaction (for 2nd graders):



Appendix D. Example of Transcription and Scoring Grid

ID_____

P1 = 5

P2 = 10

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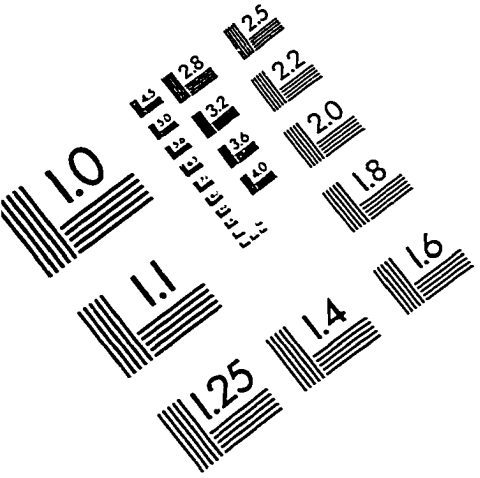
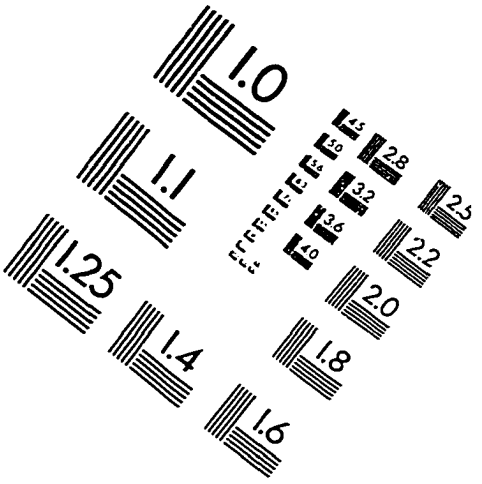
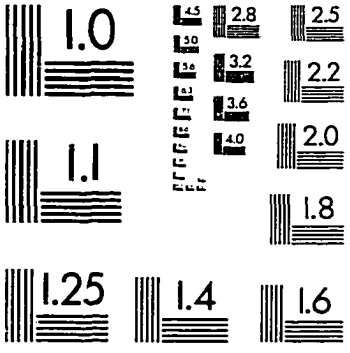
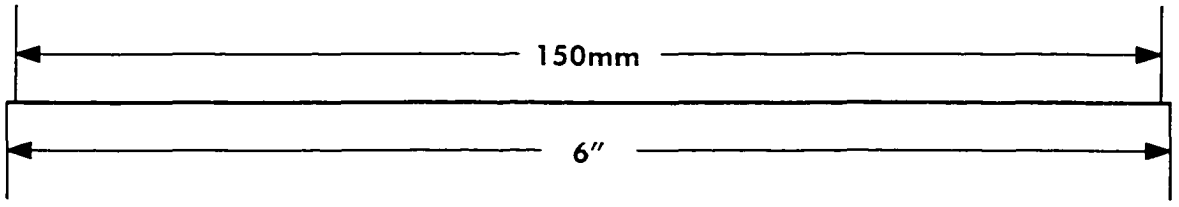
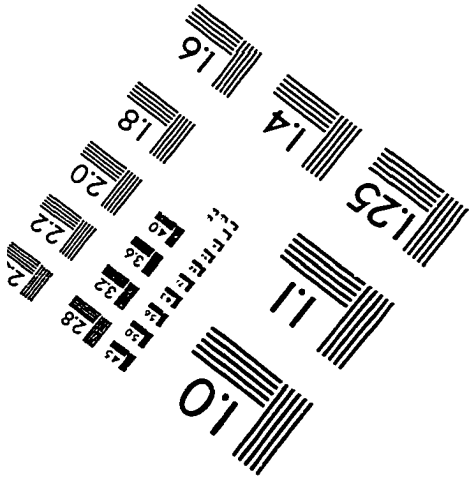
IMAGE EVALUATION TEST TARGET (QA-3)

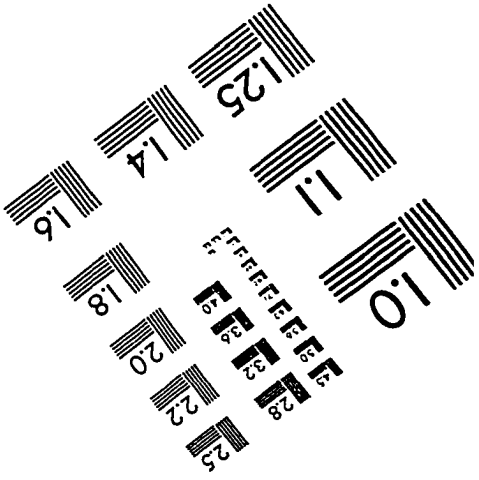












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