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Effects of a memory strategy on second-graders' performance and self-efficacy

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Abstract

This study investigated the mediating effects of learning a memory strategy on second-graders' performance of a memory task and their self-efficacy for the task. Specifically, second graders were taught a strategy for organizing words into categories to increase their ability to remember lists of words. Their predictions of how many words they would subsequently remember were taken as a measure of self-efficacy for the task. The trained students not only outperformed their untrained counterparts on the memory task, but also predicted higher levels of future performance, indicating that their efficacy for the task had increased. Quantitative data were collected to measure students' predictions and performance, while qualitative data provided insight into students' strategy use and ability to articulate their actions.

Keywords: Self-efficacy; Learning strategies; Young children; Motivation

1. Introduction

Perceived self-efficacy refers to beliefs about one's capabilities to execute a particular performance (Bandura, 1986). Self-efficacy judgments are made as people acquire information through their own mastery attainments, vicarious experiences, verbal persuasion, and physiological indices (Schunk, 1984). Information from these sources does not automatically influence efficacy, but is weighed and used to cognitively appraise personal and situational factors influencing ability to perform a task

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(Schunk, 1990). Recent research has shown that efficacy beliefs significantly influence academic achievement. Essentially, highly efficacious students select more challenging tasks, put forth more effort, and persist longer when tackling difficult tasks (e.g., Bandura, 1997; Schunk, 1990).

Although the powerful role of self-efficacy in academic achievement has now been substantiated by decades of research, most of this work has focused on older students from the intermediate grades through college (e.g., Pajares, 1996; Tuckman & Sexton, 1991). Little research has addressed what might be done earlier in school careers to promote positive efficacy beliefs. Some researchers have questioned whether children under nine years of age have the cognitive capacity to make the kind of judgments necessary for deriving self-efficacy information or the ability to articulate the judgments they do make (Deutsch & Pechmann, 1982). Yet, clearly children are beginning to develop conceptions of themselves as students during the primary school years. Given that efficacy is most malleable early in the learning experience (Bandura, 1977), what happens to young children in the first few years of school will lead them to develop self-beliefs that will become increasingly stabilized.

Finding concrete ways for parents and teachers to facilitate the development of positive self-efficacy beliefs early on is an important step. Teaching strategies that have the potential for improving performance is a tool that may also boost children's judgments that they are more efficacious for performing a task in the future.

1.1. Factors contributing to limited research

Among the more potent reasons for the paucity of research at earlier ages are young children's limited cognitive and verbal skills. Some believe children under nine years of age simply have not developed the necessary level of cognitive and reflective skills to make self-efficacy a viable concept (Kaley & Cloutier, 1984; Nicholls, 1978; Paris & Newman, 1990). They are often unable to attend simultaneously to multiple sources of information or distinguish between important or minor points, causing their self-appraisals to be relatively unstable (Bandura, 1986). Their ability to think in an organized logical fashion deteriorates when applied to abstract ideas (Berk, 2000), such as those necessary for making efficacy judgments. Limited semantic language development causes children of this age to have difficulty articulating their cognitive activities even when they are aware of them, exacerbating measurement difficulties (Berk, 2000; Deutsch & Pechmann, 1982). In addition, young children aged 5–7 have many misconceptions regarding competence. Examples of misconceptions include: a hugged student is smarter than an unhugged student (Lord, Umezaki, & Darley, 1990); children who stay in their seat, obey the teacher, and do not tease others are smart (Stipek & Tannatt, 1984); children with good work habits such as following directions, are also considered smart (Stipek, 1981). Rosenholtz and Simpson (1984) found that classroom conditions influence children's ability formations whether they are realistic or not. These confounding factors combine to discourage or preclude self-efficacy research in children younger than third grade.

Nonetheless, a few promising studies of early self-efficacy lend support to additional study in this area. Collins (1985) found that lack of efficacy to use acquired skills in mathematics was as detrimental to students as not having the skills in the first place, indicating that efficacy does play an early role in performance. Stednitz (1985) found the existence of stable self-efficacy for ability to perform school-related tasks in children as young as 4–6-years of age. Wang and RiCharde (1987) found both performance and self-efficacy benefits from teaching second graders to use a paired-associate memory strategy. Wang and RiCharde compared the students' choice of ineffective versus effective learning strategies based on whether or not they received training to monitor their performance. They found that "changes in memory-monitoring skills can elicit concomitant changes in strategy use and learning as well as self-efficacy" (p. 648) for second graders but not for fourth graders, who already used the strategy spontaneously. These studies provide a rationale for further exploration of the notion that teaching learning strategies early in the schooling experience may be a key to promotion of positive self-efficacy beliefs.

1.2. Learning strategies

It appears that one way to enhance self-efficacy in intermediate students is to promote self-regulated learning through instruction of learning strategies, tools that will assist students in their learning (Schunk, 1982, 1983a,b, 1990; Schunk & Gunn, 1986). It has been shown that a sense of "self as agent" is developed when students are provided with specific tools or strategies that will enable them to experience success (McCombs & Marzano, 1990). The resultant mastery experiences or enactive attainments, if positively interpreted by the individual, provide a strong source of information for increasing self-efficacy judgments. Links between strategy use and efficacy beliefs have been examined in numerous studies with students older than fifth grade (Pintrich & DeGroot, 1990; Pokay & Blumenfeld, 1990; Zimmerman & Martinez-Pons, 1990). Schunk (1989) found a connection between strategy use and self-efficacy in students as young as fourth grade when they learned a strategy for finding the main idea of a reading passage. The fourth and fifth graders who learned a strategy they could apply for finding the main idea of a passage believed they had greater control over their reading comprehension, which in turn can raise self-efficacy.

The research on execution of strategic behaviors alerts us to another factor that must be considered. Justice, Baker-Ward, Bupta, and Jannings (1997) have shown that in order for students to effectively use newly learned strategies, "an understanding of the causal relations of such behaviors to desired outcomes may be necessary" (p. 313). The teacher not only needs to increase awareness of the strategy when performing a task, but also to demonstrate the effectiveness of the strategy use in order to establish the causal relationship. These relationships play "an important role in the efficacy of strategy use" (p. 313) and need to be made explicit. Harris, Graham, and Freeman (1988), however, found that strategy training in memorization of spelling words among students with learning disabilities produced important metacognitive improvements even when specific metacognitive training and feedback were not included. The students' prediction accuracy improved across two sessions and contributed significantly to the students' performance in spelling.

1.3. Memory strategies

Among the earliest strategies available to young children are those related to memory (Wellman, 1988). Numerous studies have investigated the emergence and use of memory strategies in children over the past decades, starting from ages as young as one-and-a-half years old (e.g., DeLoache & Brown, 1983; DeLoache, Cassidy, & Brown, 1985; Wellman, Ritter, & Flavell, 1975). Morrison, Smith, and Dow-Ehrensberger (1995) found that formal schooling in first grade resulted in the growth of immediate memory skills and strategies. Part of the acquisition of improved memory strategies is believed to be due to increasingly higher levels of knowledge base in older children, allowing access to more elaborated semantic information in memory with less mental effort, and thus allocating more available mental resources to the execution of strategies. Worden and Sladewski-Awig (1982) found that kindergartners overestimated their actual recall, but older students were more likely to underestimate. Wellman (1988) specified that in order to be considered a memory strategy, the behavior not only needs to aid remembering but must be deliberately used as well.

The memory strategy of organizing or grouping items has been shown to have a positive impact on recall (Bousfield, 1953; Tulving, 1962). Moynahan (1973) showed an emerging facilitative effect of categorization on recall of early school-aged children. Moely, Olson, Halwes, and Flavell (1969) found that even young children from kindergarten to third grade improved their recall when they were shown how to physically cluster pictures of categorized objects. Rabinowitz (1988) found that the younger the children, the more dependent their strategy use was on the use of highly typical materials, rather than on less common items. Bjorkland, Schneider, Cassel, and Ashley (1994) studied third graders' acquisition of an organizational strategy by training students to physically sort word cards into categories. The extensive work of Bjorkland and colleagues (e.g., Bjorkland & Buchanan, 1989; Bjorkland et al., 1994) documents the benefits of organizational strategies for recall increases in young children.

1.4. Research questions

The current study was an effort to bring research linking strategy development to improved performance and efficacy judgments to the second-grade level. It has been well documented that young children can benefit from learning memory strategies, and the benefits of sorting strategies have been acknowledged. Thus, the organizational strategy of sorting was selected for this study. Considering the notion of a corresponding relationship between the use of memory strategies and self-efficacy, as noted by Wang and RiCharde (1987), the present study was designed to ascertain whether developing an awareness and subsequent use of the memory strategy of sorting/categorizing is directly related to increasing students' performance on a memory task and of raising self-efficacy for the memory task. Specifically, the study explored the following questions: (a) To what extent do students use a sorting strategy once it has been taught?; (b) To what extent does the memory strategy instruction influence actual task performance?; and (c) To what extent does learning and applying the sorting strategy mediate students' self-efficacy for the memory task? We predicted no initial differences in students' use of the sorting strategy, performance, or self-efficacy for the task. We also predicted that trained students would use the sorting strategy and outperform their untrained counterparts because of the positive impact of clustering on recall. Finally, we predicted that the trained students would feel more efficacious for subsequent tasks due to the increased sense of self as agent they would experience by having access to a beneficial strategy.

In order to measure these judgments and their effects, we deemed it necessary to design mechanisms that would allow for concrete, visible outcomes. This could be accomplished by creating a task in which the teacher could make concrete measurements based on actual performance, or by allowing children to make concrete predictions on an actual task, thus eliminating the need for articulation of abstract ideas. We did both. The question arises, however, as to whether student predictions actually serve as a measure of self-efficacy. In previous research, young children typically assessed their efficacy for a task by using scales ranging from 10 to 100 in 10-U increments (e.g., Schunk, 1982, 1983a; Schunk & Rice, 1987, 1989). Children circled an efficacy value that represented their certainty for completing a particular task successfully. When asked about efficacy judgments for solving a particular type of subtraction problem, for example, children would be shown sample pairs of problems for about 2 s each and then judge their ability to solve that type of problem rather than the particular problems.

The situation in the present study was different. The problem remained the same throughout; that is, recall as many of the 16 words as you can after 2 min of study. We were asking students how many of the words they thought they would be able to recall with complete certitude during each trial. We knew the children would be able to perform the task at some level. Their predictions indicated the level at which they judged that they could perform with a high level of certainty. In this sense, their predictions could be considered to be an adequate measure of their efficacy for the task, whether their judgments were correct or not. This is in keeping with the definition of self-efficacy as one's judgments of capability to perform a certain task.

2. Method

2.1. Participants

Seventy second-grade students from a middle-class, suburban public school in the Mid-Western United States were asked to participate in this study. Of those 70 students, only 40 returned signed consent forms. While we were unable to make detailed comparisons between the participants and nonparticipants due to data limitations, we were able to make some initial comparisons between the groups based on observable characteristics (see Table 1). We conducted Cross-tabs analyses on the characteristics of gender, language, and teacher ratings of achievement ability. We had the teachers

Table 1
Frequencies for student characteristics of participants and nonparticipants and for the experimental and control groups

Variable	Participant *n*	Nonparticipant *n*	Experimental *n*	Control *n*
Gender				
Female	25	15	13	12
Male	15	15	8	7
Teacher rating				
Low	10	17	5	5
Medium	15	11	9	6
High	15	2	7	8
First language				
English	30	18	13	17
Other	10	12	8	2
Classroom				
Researcher	16	4	9	7
Nonresearcher	24	26	12	12

rate the students because the school does not give letter grades and no IQ scores were available for second graders. Teachers were asked to provide achievement ratings (i.e., high, medium, and low) based on students' classroom performance. The analyses revealed nonsignificant statistical findings among the student characteristics (i.e., for gender and English as a second language) and their participation/nonparticipation. However, a statistically significant relationship was detected between participation/nonparticipation and teacher rating ($\varphi = .458,\ p = .002$). It appears that more students rated as low achievers by their teacher chose not to participate or failed to return the consent forms, while more students rated by the teacher as high achievers chose to participate and returned the consent forms.

The 40 s-graders who participated (25 girls and 15 boys) ranged in age from 7 years 0 months (84 months) to 8 years 2 months (98 months). The ethnicity of the participants was 82.5% Caucasian, 7.5% Asian, 7.5% Middle-Eastern, and 2.5% Hispanic. The participants were assigned to one of two study conditions (i.e., experimental and control) for the purposes of the study using stratified, random sampling. Stratified sampling was employed because two of the students in the study had been formally diagnosed with learning disabilities, and we felt that their use of the memory strategy might be impeded. As such, these two students were assigned to different conditions. The characteristics (e.g., gender or ethnicity) of the two groups are shown in Table 1. Cross-tabs were conducted to analyze categorical equivalency across the experimental and control groups. The analysis revealed statistically nonsignificant relations across the groups for all variables except language ($\varphi = -.318,\ p = .044$). Specifically, the number of students for whom English was their second language in the experimental group was a statistically significant higher number than ESL students in the control group. This finding suggests that the impact of the intervention may be more conservative than what one might expect with students for whom English was their first language.

It was also important to verify that there were no statistically significant group variations in students' predictions or performance due to their classroom assignment or gender that would confound differences between the experimental and control groups. Specifically, 16 of the students were enrolled in a class taught by the first author, while the remaining 24 students came from classes taught by three colleagues. Given that the first author was involved in the administration of the training, it was important to establish that there were no statistically significant differences due to class placement. In addition, previous research has established that adolescent boys tend to be more efficacious than girls (Lunderberg, Fox, & Puncochar, 1994; Pajares, Miller, & Johnson, 1999). As such, we wanted to determine whether any statistically significant differences existed between the girls and boys in this study. To analyze these group differences, we conducted a multivariate analysis of variance (MANOVA) with group, gender, and class as between-subject variables and students' initial predictions and actual task performance (i.e., word recall) for Trial 1 as dependent variables. The results of this analysis revealed statistically nonsignificant main effects for group [$F(2,31) = .3.12$, $p = 068$, $\eta^2 = .157$], gender [$F(2,31) = 1.11$, $p = .343$, $\eta^2 = .067$], and class [$F(2,31) = 2.60$, $p = .090$, $\eta^2 = .144$]. All two-way and three-way interactions were also statistically nonsignificant. Thus, the results revealed that there were no statistically significant differences in students' initial predictions or word recall due to class affiliation or gender. As such, these factors were not considered in any subsequent analyses.

2.2. Instruments and materials

To address the research questions, both quantitative and qualitative data were collected. While numerical predictions and actual scores were the main focus of the study, other information derived from student responses to probes and researcher observations provided insight into students' use of learning strategies, ability to articulate their actions, and affective reactions to the task.

Quantitative measures. Students were asked to recall as many of 16 presented words as possible following a 2-min study period. Students were given three recall trials over two sessions. The number of correct responses was used as a measure of their performance. Students were awarded one point for each correctly recalled word, with a maximum result of 16 points. Thus, there were three actual performance scores, with a maximum of 16 points each, for each student. Prior to each recall trial, students were asked to predict how many of the 16 words they would be able to recall following their study period. Their predictions were used as the measure of their efficacy for the task. A fourth prediction was taken following the third trial. As such, there were four prediction scores, with a maximum of 16 points each, for each of the students. As students performed the recall activity, their words were written on a response sheet by the first author, in the same order as the student said them, providing a permanent record of the groupings students used. All of the students' prediction scores and actual scores were recorded on individual record sheets.

To assess the extent to which students retrieved and clustered the words into categories using the strategy taught during the intervention, we also calculated adjusted ratio of clustering (ARC) scores (Roenker, Thompson, & Brown, 1971). ARC scores were calculated according to the formula $\mathrm{ARC} = R - E(R)/\max R - E(R)$, where R equals the total number of observed category repetitions (i.e., the number of times a category item follows an item from the same category), $\max R$ equals the maximum number of category repetitions, and E(R) equals the expected (chance) number of repetitions. ARC scores have a distributional range from .00 to +1.00, with +1.00 being perfect strategic organization and chance falling at .00. We expected the experimental group to exhibit higher ARC scores after the intervention.

Qualitative measures. Qualitative data were collected by means of interviews and observations throughout the sessions. Scripted interview questionnaires were read to each participant and their responses were both audio recorded and written on individual students' recording sheets by the first author. To help students access their background experience with memory and to focus their attention on the memory process, each student was asked the introductory questions "Are you good at remembering?" and "How do you know?" Probes were used to determine what strategies students may have attempted to use during their initial 2-min study period and to ascertain whether or not students were aware of the sorting strategy prior to its demonstration. Specifically, students were asked, "What did you do to help yourself remember?" immediately following their first study period. In addition to eliciting articulation of any strategy use of which they were aware, the question also served as a buffer task. Following the first recall attempt, all students were asked the question, "Can you think of anything else you could have done to help yourself remember more?" These questions allowed us to probe the students to see whether they already knew the sorting strategy, at least explicitly enough to be able to talk about it. To the degree possible, student answers to the probes were coded into keywords and themes for further analysis.

Task. Materials used included two sets of 16 index cards with one word printed in black letters on each card. Half of the words for Set 1 and Set 2 (Fig. 1) were selected from a science unit on Life Cycles that had recently been completed by all of the students so that the vocabulary would be familiar. The other half were familiar items in the children's lives. In this respect, all of the items could be considered typical items for the categories. It was anticipated that the 16 cards could easily be grouped into four sets of four by all of the students. The same set of words was used for both the experimental and control groups. Set I words included: (Group 1) insect, caterpillar, chrysalis, butterfly; (Group 2) amphibian, tadpole, frog, toad; (Group 3) marker, paintbrush, pencil, crayon; and (Group 4) sleep, bed, blanket, pillow. Set 2 words included: (Group 1) moth, caterpillar, cocoon, antenna; (Group 2) bird, feathers, beak, nest; (Group 3) pants, jacket, shirt, socks; and (Group 4) playground, swing, slide, monkey bars. Although the difficulty of these words varied in terms of association, syllabication, and complexity, it was anticipated that the recent concrete exposure to the words in students' classroom study and personal experience would

amphibian	**insect**	**marker**	**sleep**
tadpole	**caterpillar**	**paintbrush**	**bed**
frog	**chrysalis**	**pencil**	**blanket**
toad	**butterfly**	**crayon**	**pillow**

(a)

moth	**bird**	**pants**	**playground**
caterpillar	**feathers**	**jacket**	**swing**
cocoon	**beak**	**shirt**	**slide**
antenna	**nest**	**socks**	**monkey bars**

(b)

Fig. 1. Word card Set 1 (a) used during Week 1 for Trials 1 and 2 and (b) used during Week 2 for Trial 3.

provide a level of familiarity strong enough to overcome the variation (Kelly, Scholnick, Travers, & Johnson, 1976).

2.3. General procedures

During all three trials, the 16 word cards were presented to students one at a time in random order and read aloud by the students. If students had difficulty reading any of the words as they were presented, they were told the word. A few students who struggled with several of the words were given an additional opportunity to read through the words until they could recognize them all with ease. As each card was presented and read, the researcher laid it down on the table in front of the child from top to bottom, forming a 4×4 grid. Care was taken to neither present words from the same category consecutively nor to place words from the same category next to each other in the matrix.

When the cards were all on the table and read, the students were asked, "If I give you 2 min to study these words and then take them away, how many do you think you will be able to remember?" Their response was taken as their prediction and recorded for later analysis. After being told they could do anything they wanted to help them study, the students were observed for strategy use during the 2-min study period. At the end of 2 min, or before if the students indicated they were ready, the cards were gathered up and the students were then asked to recall as many of the words as possible. As the students' lists were generated, the words were written down by the first author in the order that they were recalled. In all recall attempts, enough time was given until the students either named all 16 words or said they could not remember any more. The total number recalled was recorded and shared with the students. This predict–study–recall process was repeated twice, Trial 1 and Trial 2, with each participant during the first session.

During Trial 3, exactly one week after the first session, each student performed an identical task to the earlier trials, using Set 2 words. We did not counterbalance the presentation order of the lists, yet the control groups' relatively stable recall scores on Trial 1 and Trial 3 corroborated our expectation that the words were so familiar to the students that the lists would be similar in difficulty. The second session began with the same probes as the first session, with questions read to the students and their oral responses both written on the recording sheet by the first author and audio recorded. Following Trial 3, all students were asked to predict how many words they thought they would recall if given one more attempt.

2.4. Instructional procedures

The sessions for the experimental and control groups were identical except that students in the experimental group were taught a sorting strategy between the first and second trials during session one. Following the first recall attempt, explicit strategy instruction was used to show students in the experimental group that the words could be grouped into four distinct categories. The first author told the students, "I'll teach you something that might help you to remember more of the words" and showed them how some of the words were related to each other. These students then physically sorted the words into four groups, again laying them in 4×4 grids but this time categorizing them from top to bottom. If children had difficulty sorting into the categories, help was given. When the cards were correctly sorted into four categories of four, the above procedure was repeated. The students made new predictions for recall, studied the words for 2 min, and then named as many as they could remember once the words were removed. A discussion of the sorting strategy and its benefits followed, in keeping with Justice et al.'s (1997) findings that effectiveness of strategy use should be made explicit.

Control group. Students in the control group did not learn the sorting strategy following Trial 1 but were simply given a chance to study the 16 words for 2 min and recall as many as they could, thereby giving evidence of the influence of the practice effect. The control group did receive the training, however, after data collection had been completed so that they, too, would have access to the sorting strategy as a result of participating in the study.

Procedure. Each student met individually with the researcher in a quiet conference room at the school for two 15-min sessions, held one week apart. All sessions were audiotaped. All student information was kept confidential by assigning a participant code number that substituted for the students' names on materials. During the first session, each student participated in two predict/study–recall trials. In the second session the following week, students participated in the third predict/study–recall trial.

3. Results

3.1. Quantitative outcomes

Strategy use. The first step in our analysis was to determine the extent to which students employed the sorting strategy in which the experimental condition was trained. Certainly, as seen in Table 2, students in both conditions showed some evidence of sorting the cards as a memory technique. Our primary question, however, was whether the students in the experimental condition used the sorting strategy more than the students in the control condition as measured through ARC scores. To explore this question, we conducted a repeated-measures analysis with time as the within-subject variable, group as the between-subject variable, and students' ARC scores for the three trials as the dependent variables. There was a statistically significant main effect for time [$F(2,37) = 62.71$, $p < .0001$, $\eta^2 = .77$] and group [$F(1,38) = 34.64$, $p < .0001$, $\eta^2 = .48$]. The results also revealed a statistically significant time by group interaction [$F(2,37) = 36.35$, $p < .0001$, $\eta^2 = .66$]. That is, students' use of the sorting strategy changed over time, but the change in strategy use was different for the two groups.

To examine this interaction, we first determined if there were statistically significant differences between both treatment groups for Trial 1, 2, and 3, separately. The results revealed no differences in sorting strategy use initially (i.e., Trial 1), but statistically significant differences between the conditions for Trial 2 [$F(1,38) = 52.26$, $p < .0001$, $Mse = 3.73$] and Trial 3 [$F(1,38) = 27.93$, $p < .0001$, $Mse = 3.84$]. Next, for each group, a test of the simple main effects was conducted to

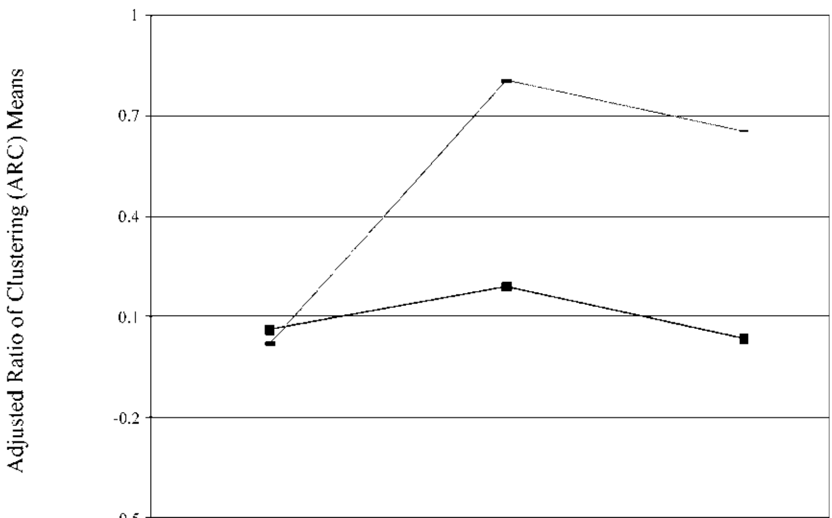
Table 2
Means and standard deviations for students' predictions and actual number of recalled words by condition

Trial	Condition	
	Experimental $M(SD)$	Control $M(SD)$
One		
Prediction	9.10(3.19)	8.47(3.63)
Actual	8.67(2.31)	9.95(2.17)
ARC	.02(.22)	.06(.20)
Two		
Prediction	13.76(3.19)	11.53(3.85)
Actual	15.14(1.49)	11.74(3.00)
ARC	.80(.24)	.19(.30)
Three		
Prediction	13.71(3.52)	11.32(3.35)
Actual	13.81(1.91)	9.32(3.94)
ARC	.66(.31)	.04(.43)
Final		
Prediction	15.05(1.50)	10.21(4.14)

Note. Maximum score = 16.

determine if there were statistically significant differences in the means for Trial 1, 2, and 3. The results revealed statistically significant time effect for only the experimental group [$F(2,19) = 76.80,\ p < .0001,\ \eta^2 = .79$]. Follow-up mean contrasts showed statistically significant increased retrieval clustering for the experimental group between Trial 1 and Trial 2 [$F(1,20) = 159.30,\ p < .0001,\ \eta^2 = .89$] and statistically significant decrease from Trial 2 to Trial 3 [$F(1,20) = 5.89,\ p = .025,\ \eta^2 = .22$]. Similar to word recall, students' retrieval clustering was more organized following the intervention, but decreased with the new word set in Trial 3. What is very clear in the ARC score results and in Fig. 2 is that students who were taught the sorting strategy employed it in recalling and organizing the words. By comparison, the organizational recall and clustering of the words by the control group was not better than chance.

Task performance. The second purpose of the study was to assess the extent to which sorting strategy instruction influenced task performance. Means and standard deviations for students' word recall for each trial are displayed in Table 2. To explore this question further, we conducted a repeated-measures analysis with time as the within-subject variable, group as the between-subject variable, and students' actual word recall and ARC scores for the three trials as the dependent variables. The results suggested a statistically significant main effect for time [$F(2,37) = 54.72,\ p < .0001,\ \eta^2 = .75$] and group [$F(1,38) = 13.87,\ p < .001,\ \eta^2 = .37$]. The results also revealed a statistically significant time by group interaction [$F(2,37) = 23.02,\ p < .0001,\ \eta^2 = .55$]. Essentially, the change in student recall



	Trial 1	Trial 2	Trial 3
Experimental	0.021	0.804	0.656
Control	0.064	0.192	0.035

Time

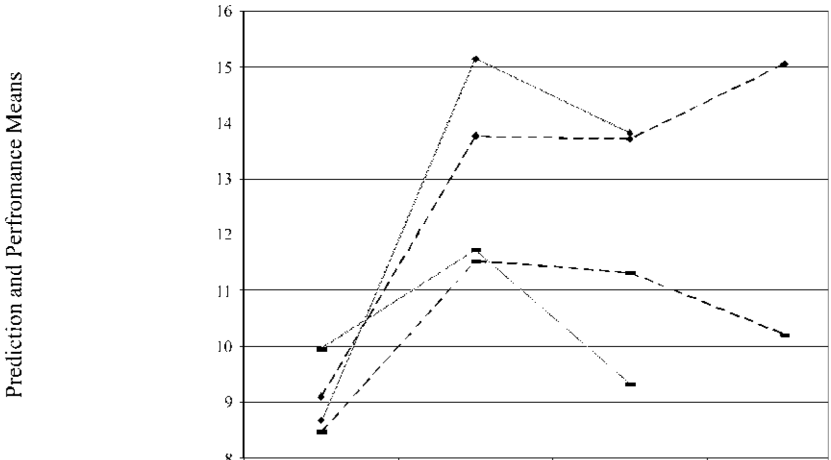
Fig. 2. Time by group interaction for students' ARC scores.

scores were statistically significant over the three trials, but the change was different for the two groups.

To look more closely at the time by group interaction for word recall, we first determined if there were statistically significant differences between the treatment conditions for Trial 1, 2, and 3, separately. As expected, the results revealed no initial performance differences. Student performance did display statistically significant differences between the conditions for Trial 2 [$F(1,38) = 21.32$, $p < .0001$, $Mse = 5.43$] and Trial 3 [$F(1,38) = 21.66$, $p < .0001$, $Mse = 9.30$]. Next, for each condition, we conducted a test of the simple main effects to determine if there were statistically significant differences in the means for Trial 1, 2, and 3. The results revealed statistically significant time effect for both the experimental group [$F(2,19) = 79.12$, $p < .0001$, $\eta^2 = .80$] and the control group [$F(2,17) = 4.73, p < .015$, $\eta^2 = .21$] suggesting significant changes in students' mean performance over time. Follow-up mean contrasts showed statistically significant increased recall for the experimental group between Trial 1 and Trial 2 [$F(1,20) = 142.94$, $p < .0001$, $\eta^2 = .88$] and statistically significant decrease from Trial 2 to Trial 3 [$F(1,20) = 5.90$, $p = .025$, $\eta^2 = .23$]. That is, students' recall scores were higher following the intervention, but decreased with the new word set in Trial 3. The results were somewhat similar for the control group despite not having an intervention. Specifically, the recall scores revealed a statistically significant increase in word recall from Trial 1 to Trial 2 [$F(1,18) = 10.22$, $p = .005$, $\eta^2 = .36$]. Of course, this increase could be attributable to the fact that the same words were used in Trial 1 and Trial 2. In addition, the control groups' recall statistically significantly decreased from Trial 2 to Trial 3 [$F(1,18) = 7.25$, $p = .015$, $\eta^2 = .29$]. As illustrated in Fig. 3, it is likely that the change in performance from Trial 1 to Trial 2 is the source of the interaction. Indeed, the slope from Trial 1 to Trial 2 is far more dramatic for the experimental condition. From these findings, we would posit that strategy training enhanced the students' word recall beyond that of the control group that did not receive training.

Self-efficacy. The overall purpose of the study was to assess the extent to which learning and applying a sorting strategy mediated students' performance and subsequent self-efficacy for a memory sorting task. As mentioned previously, students' predictions of success were used as an indicator of task self-efficacy. Means and standard deviations for students' predictions by group are displayed in Table 2. Overall, students' sense of self-efficacy appears to change across the four sorting trials.

To further explore the role and influence of learning and applying a memory strategy on students' predictions, we submitted the data to more extensive analyses. First, we conducted a repeated-measures analysis with time as the within-subject variable, group as the between-subject variable, and students' four predictions as the outcome variable. The results revealed significant main effects for time [$F(3,36) = 21.29$, $p < .0001$, $\eta^2 = .55$] and group [$F(1,38) = 10.28$, $p = .003$, $\eta^2 = .21$]. That is, students' prediction scores changed significantly over time and the predictions of the experimental group were significantly different than those of the control group. There was also a statistically significant time by group interaction [$F(3,36) = 4.27$, $p < .0006$, $\eta^2 = .27$].



	Trial 1	Trial 2	Trial 3	Final
Experimental Prediction	9.1	13.76	13.71	15.05
Experimental Performance	8.67	15.14	13.81	
Control Prediction	8.47	11.53	11.32	10.21
Control Performance	9.95	11.74	9.32	

Time

Fig. 3. Time by group interaction for students' predictions and actual word recall.

To look more closely at the time by group interaction for predictions, we first determined if there were statistically significant differences between the treatment conditions for Trial 1, 2, 3, and the final prediction, separately. Students began the sorting activity in Trial 1 with very similar predictions of success; however, this was not the case for the remaining trials. Indeed, students' predictions of success were statistically significantly different for Trial 2 [$F(1,38) = 4.26$, $p < .05$, $Mse = 12.38$], Trial 3 [$F(1,38) = 4.84$, $p < .03$, $Mse = 11.85$], and the final prediction [$F(1,38) = 25.05$, $p < .0001$, $Mse = 9.32$]. What seems particularly important about these results are students' final predictions. Essentially, the results suggest that students in the experimental condition left the series of trials with statistically significantly higher levels of self-efficacy than students in the control condition.

Next, for each condition, we conducted a test of the simple main effects to determine if there were statistically significant differences in the means for Trial 1, 2, 3, and the final prediction. We also conducted a test of the simple main effects to detect differences over time for the two conditions to help pinpoint the source of the interaction. Specifically, we conducted a repeated measure analysis for each condition with time as the within-subject variable and prediction as the outcome variable. The results revealed statistically significant main effects for both the experimental group [$F(3,18) = 23.61$, $p < .0001$, $\eta^2 = .54$] and the control group [$F(3,16) = 4.86$, $p < .005$, $\eta^2 = .21$] suggesting statistically significant changes in students' mean predictions over time. Follow-up mean contrasts showed statistically significant differences for the experimental group between Trial 1 and Trial 2 [$F(1,20) = 30.83$, $p < .0001$, $\eta^2 = .61$] and Trial 3 and final prediction [$F(1,20) = 4.09$, $p = .05$, $\eta^2 = .17$]. That is, performance predictions were statistically significantly higher following the intervention and again after the students were successful on Trial 3. The same was not the case for the control group. The only statistically significant change in predictions for the control group occurred between Trial 1 and Trial 2 [$F(1,18) = 9.87$, $p = .006$, $\eta^2 = .35$]. These results are confirmed by the plotting of the marginal means in Fig. 3. It would appear that students who were taught the metacognitive strategy were more efficacious than those who were not taught the strategy.

Relationship between strategy use, performance, and self-efficacy. We also conducted a correlational analysis to establish the relationships among students' strategy use, word recall, and self-efficacy for each condition. Specifically, we made composite scores of students' scores across the three trials and submitted the composites to a Pearson correlation analysis. As expected, we found that students' predictions were statistically significantly related to students' ARC scores and word recall (Table 3). Certainly, we would expect this to be the case for both conditions. Indeed, the only deviation for the outcomes by condition was that the experimental condition correlations for self-efficacy appear stronger than those for the control condition. It may be that the students' self-efficacy in the experimental condition was more closely aligned with their actual ability due to the intervention.

3.2. *Qualitative outcomes from probes*

Nearly all of the students were confident about their general memory skills during the initial probe. When asked the introductory question "Are you good at remembering?" all but three of the students indicated that they were good at remembering, either by answering "Yes," "Sort of," or nodding their heads. Upon analysis, however, their responses to the follow-up direction to give an example revealed that 27 of the 33 (73%) students who gave a response related an episodic event involving their

Table 3
Correlations among students' predictions, word recall, and ARC scores across the trials by condition

Condition	Variable		
	Predicted	Word recall	ARC
Experimental			
Predicted	1		
Word recall	.764**	1	
ARC	.682**	.652**	1
Control			
Predicted	1		
Word recall	.557*	1	
ARC	.548*	.771**	1

* Correlation is significant at the .05 level (two-tailed).
** Correlation is significant at the .01 level (two-tailed).

families. Interestingly, although the interviews took place in a school setting with a known teacher, only three students related examples of remembering to school related activities. When asked the same questions at the beginning of session two, all but one of the 40 students (97.5%) said they thought they were good at remembering. The one remaining student from the control group said, "Not any more."

Following the first recall trial, all students were asked the question, "What did you do to help yourself remember?" Responses revealed either no strategies (9/40 = 22.5%) or relatively ineffective strategies, including "reading the words over and over,' "saying them out loud," or "just looking them over." More effective strategies were related by some who tried to "remember where they were" as in a memory game, or tried to associate them with what they had been studying in school. At the second session, the 20 students in the experimental group showed a much higher percentage of relating their success to strategy use (8/20 = 40%) or their performance on the task the previous week (5/20 = 25%), for a total of 13 students (65%). Six others (30%) still listed home or school related activities and one gave no response (5%). In contrast, only five students in the control group (25%) referred to their performance the previous week, with the others still mentioning home activities (7/20 = 35%), school activities (2/20 = 10%), or offering no response (6/20 = 30%). None mentioned using any strategy.

Students' ability to generate new ideas for productive strategies was also limited. Over half (24/40 = 60%) of the students were unable to mention an alternative tactic to improve their recall on future trials. Those who did give a response had generally ineffective suggestions. Some were logical, such as "look at the words longer or harder," or "practice writing them." Others were less useful, such as saying they would "look at the first letters" or "write them on my hand." Yet we believe these responses were useful in the sense that they helped us to gain access to student cognition. It demonstrated that many students were looking for useful strategies that might help them to improve their performance. It also clarified that even though many of the students who were trained in the sorting strategy said they already knew it, only one of them had mentioned it prior to explicit instruction. Dialoguing with adult partners in children's zone of proximal development (Vygotsky, 1987) facilitated advancement to increasingly higher levels of psychological functioning. Compared to students' responses prior to training, the trained students were able to articulate the advantages of using strategies to a higher degree as a result of the discussions with the experimenter. Students in the control group did not improve.

3.3. *Qualitative outcomes from observation*

In addition to the ARC scores, we used either actual sorting of the cards or articulation of an understanding of the benefits of sorting in answer to the probes as indicators of strategy acquisition. If becoming aware of one's "self as agent" by using a learning strategy is a way to increase self-efficacy, then those students who were aware that they used the sorting strategy for improved recall should have felt more efficacious for remembering than they did before they were trained in the strategy use.

Evidence of strategy use. Clustering in recall (Bjorkland et al., 1994) provides evidence of strategy use. Seventeen of the trained students (85%) listed their words in groups of three or four related words, often physically keeping track of how many words they had named in each group of four. These observations were corroborated by students' ARC scores (Table 2). This gave the trained children an advantage by providing proximal goals they could use to check their progress. Only three students in the experimental group (15%) failed to cluster. One of these students was still able to name all 16 words on the second trial. It was obvious that the other two did not understand the strategy and they were retrained. The other students in the experimental group were systematic in attempting to name all the words in a category before going on to the next group. Trained students were clearly using the sorting strategy. The strategy served as an organizational tool that the children used to increase both their task performance and their self-efficacy for completing the task.

4. Discussion

Both quantitative and qualitative data from this study support the hypothesis that students who learn a memory strategy use it with positive influences on their task performance and increases in their efficacy to perform a future memory task. By designing a developmentally appropriate task and measuring concrete outcomes, we have begun to unpack underlying factors that exert an early influence on children's achievement.

It appeared that the second graders in the current study were at the optimum developmental level for being taught the sorting strategy, showing signs of using it but unable to describe the strategy until it was made explicit to them. Either actual sorting of the cards or articulation of an understanding of the strategy's benefits in answer to the probes served as indicators of this strategy acquisition. Also, the level of organization used in recalling the words was a strong indicator of the students' use of the strategy. The ARC scores supported our prediction that the trained students would use the sorting strategy after if was taught. The consistently higher numbers of recalled words by the experimental group in Trials 2 and 3 indicated their improved performance.

We interpreted the consistently higher predictions of words recalled over the three test trials of the experimental group as supportive data for the theory of increasing self-efficacy of the trained students. As McCombs and Marzano (1990) suggested, becoming aware of one's self as agent by using a learning strategy is a way to increase self-efficacy, and those students who were aware that they used the sorting strategy for improved recall should have felt more efficacious for remembering than they did before they were trained in the strategy use.

Although it is typically thought that some children hold naïve beliefs about their cognitive abilities and tend to greatly overestimate their capabilities, this was not the case for most of the students in the present study. Students' predictions often came to serve as goals for actual performance. Many students seemed to quit trying once they had reached the predicted number, and others even articulated this. For instance, one girl who had predicted 10 recalled words on the first trial listed 9 words and then said, "I need one more." This finding corroborates the understanding that higher levels of self-efficacy can increase effort and persistence. If students make higher predictions because they feel efficacious, the result should be that the students will reach for higher goals and thus higher levels of academic achievement.

Concrete outcome measures. The concrete task seems to have accomplished our goal. We overcame some of the difficulties that might be anticipated in a more abstract task. Student predictions were much closer to their actual number of recalled words than we initially expected, giving evidence that students were reflecting on their performance and making judgments accordingly. Making efficacy judgments in the form of predictions appeared to be within the students' cognitive repertoire when it was based on a concrete question. The final question, "How many words do you think you could remember if we played the game again?" was concrete enough to elicit a judgment of what the students believed they would be able to do in a future similar experience. After three predictions followed by actual trials, the students had enough experience for most of them to make realistic predictions for a new trial. The consistently higher predictions of the experimental group, almost twice as many words as the control group, provided quantitative data to support the theory of increasing self-efficacy of the trained students. Those students who had access to the memory strategy reflected higher levels of self-efficacy through their predictions.

Results of this study corroborate Skinner and colleagues' (Skinner, Zimmer-Gembeck, & Connell, 1998) premise that high perceptions of control are likely to produce high performances, confirming students' initial expectations and vice versa. As students experienced success with the task, they set increasingly higher judgments of future performance. Likewise, untrained students who were disappointed with their performance lowered their predictions. Many of the students used their previous attainments when making consecutive predictions, especially the control group students who had received no intervention and had no strategy upon which to rely. In contrast, even when an attempt was not totally successful, the trained students remained more confident on future predictions. Surprisingly, the judgments did not have to be immediate. Even on Trial 3, held a week after the first two trials, nearly all of the students remembered their previous performances and explicitly used the results to make their next predictions. For teachers of young children, this is an impressive finding. Teaching a learning strategy moved students into a desired upward positive spiral, both in performance and expectation.

Inferred outcome measures. Although some researchers posit that children hold naïve beliefs about their cognitive abilities and tend to greatly overestimate their capabilities, this was not the case for most of the students in this study. In fact, our students demonstrated the ability to make quite accurate appraisals of their ability. Only three students in the entire sample of 40 overestimated their performance by more than two words on the first trial, even though they had no prior experience upon which to base predictions. Rather, the opposite was more apparent as many children seemed concerned with sounding too presumptuous in their estimations. A level of social awareness became apparent as many children, especially the confident ones in the experimental group, seemed almost embarrassed to say they would recall all 16. Instead they would rather shyly say, "All of them." The first author also sensed that others even predicted 14 or 15, rather than the optimal 16, because they modestly underestimated their performance on purpose. Perhaps this behavior reflected students with cautious personalities not wanting to over-predict, or a lack of confidence in their ability to perform the task perfectly, but from the first author's perspective it seemed more likely to be an attempt to remain socially acceptable by not appearing boastful. At any rate, in contrast to the anticipated behavior of overestimating, the students in this study were more likely to underestimate.

5. Conclusions

The purpose of the present study was to determine whether second-grade students who were taught a sorting/categorizing strategy for memorizing would use the strategy to improve their performance on a memory task and whether their self-efficacy for such a task would increase as well. Our findings support the existence of such relationships. We acknowledge the difficulty of getting at underlying cognitive beliefs, however. Even experts who have been working diligently in the efficacy field for years to identify useful measures of self-efficacy in adults are still struggling to devise tools that will accomplish such a task. Trying to understand these same beliefs in young children who may not even have an awareness of their existence, let alone the ability to talk about them, is an understandable challenge. Yet we believe we have moved the boundaries forward in this investigation.

Many would argue against the advisability of using predictions as a measure of self-efficacy and we understand this concern. We maintain that for these children, their predictions did in fact represent the level of confidence at which they expected to perform the task, or their belief in their ability to perform the task. Perhaps those wishing not to accept these judgments as self-efficacy judgments will at least acknowledge that they may be more concrete precursors to self-efficacy to the extent that the students were developmentally able to make judgments about their future performance. What is important, we believe, is that the students made realistic judgments based on the available information they had.

5.1. Limitations

Although this study contributes useful information to the understanding of teaching memory strategies and its relation to efficacy beliefs, there are nevertheless limitations. Our findings cannot be generalized to any age group other than second graders. Replicating the study with first- or third-grade students could result in very different outcomes. It is possible that the results would have been different if we had counterbalanced the presentation of the two sets of words or if we had included more low performing students. In addition, using a higher number of words in the task may have eliminated the ceiling effect that we observed and may have altered the results. Finally, the artificial setting created for this study and the limited benefits of the strategy in real-life application must be acknowledged. Even though students had the opportunity to talk about using the new sorting skill when they need to learn a list of words in the classroom, the reality is that such a need does not arise often in the daily school experience. In addition, if the occasion did arise after a period of time, it is reasonable to suspect that some of the trained children would undoubtedly need a prompt to remind them of the strategy. Meaningful practice opportunities are not likely to exist on a regular basis. It is questionable how long the students would retain the strategy and its related benefits in performance and efficacy without regular practice.

There is, nevertheless, ample reason to be encouraged by the results of this study. The students' self-appraisals were not unstable or haphazard, but clearly related to previous levels of performance, indicating that students were reflecting on their past performance prior to making predictions. The predictions, taken as estimates of their efficacy for the task, held for their performance and were indicators of their success. The relationships between prediction, word recall, and ARC scores (Table 3) attest to the strength of strategy use. Students who were taught the strategy used the strategy to their advantage and made increasingly higher levels of predictions based on their increasing levels of task performance. We believe we have designed a viable mechanism for measuring self-efficacy, or its precursors, by teaching a memory strategy and using student predictions for performance.

5.2. Implications for future research

Future research should seek to enhance the findings of the present study. By extending the notion that other learning strategies besides a memory strategy have the potential to increase students' sense of self as agent, thus raising their efficacy beliefs for specific academic tasks, we can begin to document the need for intentional teaching of learning strategies in the classroom. More qualitative data that delves into students' thoughts in greater depth could prove enlightening. Creating case studies with a few representative students with various behavior styles would be a useful follow-up to this study. Several related questions might be answered. Does one type of student (e.g., reflective or impulsive, students with learning disabilities or not) benefit more from learning a strategy than another? How do students use the information they gather to make predictions for the next trial? Are students able to affectively describe their performance after each trial, giving information about their efficacy? Such in-depth information would be of relevance to classroom teachers.

The clear difference in both performance and self-efficacy between the two groups in our study validates the impact of teaching the memory strategy. It seems that children as young as 7- and 8-years-old are capable of making accurate judgments of their future performance and that teaching them a strategy is beneficial in at least two critical ways that answer our research questions. First, there is a greater likelihood of their performance increasing to a higher level than would be possible without use of the strategy. The resultant success provides a basis for higher expectations for future performances. Second, as a result of the increasingly improved level of performance with strategy use, students' efficacy for the task continues to increase. Their higher efficacy judgments tend to be self-fulfilling as students then apply more effort and persistence to the task at hand. The upward spiral is activated. With this knowledge about how we can give young students in their critical first years of school an added boost toward success, students should reap the ultimate benefits.

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