Adults’ Knowledge About Memory: Awareness and Use of Memory Strategies Across Tasks

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Two studies investigated college students’ knowledge about the effectiveness of alternative memory strategies for different tasks and the relationship of this knowledge to strategy use and performance. In Experiment 1 students made paired-comparison judgments of the relative effectiveness of six strategies for increasing performance on one of three memory tasks. For each task some strategies were judged to be significantly more effective than others, whereas across tasks certain strategies were more likely to be judged effective for one task than for another. Experiment 2 examined the relationship of judgments of strategy effectiveness to actual strategy use and memory performance. Results indicated that different strategies were adopted across tasks and students were more likely to adopt strategies subsequently judged effective for that task. Students in Experiment 2 showed clearer discrimination among the strategies and an increased awareness of the efficacy of task-specific strategies.

Recent discussions of memory have included knowledge about memory as an aspect of metacognition related to memory performance (Brown, Bransford, Ferrara, & Campione, 1983; Justice, 1985). Such knowledge encompasses beliefs about personal memory abilities, task differences, potential strategic interventions, and interactions among these variables. Knowledge about memory has been found to be related to strategic behavior and memory performance in adolescents (Waters, 1982) and adults (Zivian & Darjes, 1983) and may be related to academic success (Leal, 1987).

Our research focused on adults’ knowledge of the interaction between task characteristics and appropriate strategic behavior. Adults report the use of a wide variety of memory strategies to aid recall, including verbal repetition, cumulative rehearsal, meaningful organization, verbal mediation or elaboration, imagery, self-testing, and external memory aids (Blick & Boltwood, 1972; Blick & Waite, 1971; Perlmutter, 1978). The effectiveness of a particular strategy, however, depends on the task. For example, elaborative strategies have been found to be effective for paired associate learning of verbal materials (Zivian & Darjes, 1983), imagery for picture recognition (Marks, 1973) and organization for categorizable materials (Frankel & Rollins, 1985). Although awareness of the usefulness of a particular task-appropriate strategy has been found to be related to use of the strategy (Waters, 1982), awareness of differential strategic effectiveness across tasks has not been addressed. Our studies were designed to examine adults’ knowledge of this Strategy × Task interaction and its relationship to their strategic behavior.

Experiment 1

In this study students judged the relative effectiveness of six strategies for one of three memory tasks: paired associate learning of verbal materials, recognition of pictorial information, or recall of categorizable materials. Judged strategies were drawn from those reported by college students for these tasks (Blick & Boltwood, 1972; Blick & Waite, 1971; Justice, 1982) and did not include techniques that require specific training (e.g., the keyword mnemonic). It was hypothesized that students would (a) show a preference for some strategies over others for each task and (b) judge some strategies as more effective for one task than another. This last finding would indicate an awareness of the interaction between strategy effectiveness and task characteristics.

Method

Subjects. The subjects were 53 men and 195 women, drawn from introductory psychology courses. Groups of from 10-25 students were randomly assigned to one of three memory tasks. The groups contained 83, 87, and 78 students, respectively, with mean ages of 20.5, 21.2 and 20.0 years. The men were distributed equally across the conditions.

Materials. The stimuli were three videotapes featuring a young adult model who was asked to remember for a set of 15 countries (5 Asian, 5 African, and 5 island) either (a) shapes, the map outlines of the countries; (b) areas, their geographical locations, or (c) capitals, their capital cities. The stimuli were chosen to be relatively unfamiliar, and a pretest indicated that students recognized an average of 15% of the stimulus countries in comparison with 59% of adjacent control countries.

For each task the model demonstrated six memory strategies: (a) rehearsing, verbally repeating to-be-remembered material; (b) elaborating, verbally noting similarities or relationships among to-be-remembered materials; (c) self-testing, physically covering the to-be-remembered material with the stated intention of probing recall; (d)
writing/drawing, physically reproducing the to-be-remembered material; (e) grouping, organizing to-be-remembered material into categories; and (f) imaging, covering one's eyes with the stated intent of visualizing the to-be-remembered material.

Each stimulus tape demonstrated the use of the six strategies for one of the tasks. After the demonstration of each strategy, the strategy name was provided both verbally and visually. Labels for the strategies were identical across tasks except that reproduction of material for visualizing the to-be-remembered material was called drawing, whereas reproduction for shapes was called writing.

We obtained judgments of effectiveness through a paired comparison procedure. Slides that showed the stimulus materials, the model in a pose unique to the strategy, and the written label of the strategy were prepared to represent each strategy for each task. The slides were duplicated and arranged to present all possible pairs of the strategies. The 30 pairs were divided into two blocks of 15 pairs, which were counterbalanced so that half of the students in each condition received each order.

Procedure. Groups of from 10 to 25 students were shown a videotape in which the model, introduced as a geography student, received one of the memory tasks and demonstrated the six strategies in relation to that task. Students then made 30 paired-comparison judgments by choosing which strategy in each pair would be more effective for the task. Each trial consisted of a 5-s exposure of each of two strategy slides and a 15-s response interval during which the subjects indicated on an answer sheet whether they judged the first or second strategy presented to be more effective.

Results and Discussion

An initial analysis examined the consistency of judgments on the paired-comparison task. Each strategy pair was presented twice. On average across subjects, the same strategy was chosen as more effective on both presentations for 81.7% of the pairs. Consistency did not vary significantly across condition.

Judged strategy effectiveness within tasks. Table 1 shows the proportion of times each strategy was chosen over all other strategies in Experiment 1. Underlined proportions were not significantly different from one another. These data indicate that for each task some strategies were judged more effective than others, although no single strategy was judged to be the only strategic alternative for any task.

The proportions in Table 1 show overall differences in the choice of each strategy but do not reflect differences in the probabilities of choosing each strategy as a function of the strategy with which it was paired. For example, for shapes in Experiment 1, rehearsing was chosen for an average of 49% of the trials; however, it was chosen for 70% of the trials in which it was paired with grouping and for only 26% of the trials in which it was paired with self-testing.

The strategy that students would discriminate among the strategies for each task was examined through multiple comparison tests for correlated proportions (Zwick, Neuhoff, Marasculo, & Levin, 1982). The proportion of times each strategy was chosen over every other strategy was tested with the Bonferroni adjustment to hold alpha at ≤ .05 across the 15 comparisons carried out for each task. The critical value was 2.77 (Dayton & Schafer, 1973).

Across the three tasks, 29 of the 45 comparisons were significant. As indicated in Table 1, self-testing and elaboration were judged more effective for shapes than the other strategies. For areas, self-testing, grouping, and writing/drawing were judged to be relatively effective, whereas rehearsing, elaborating, and imaging were seen as relatively ineffective. For capitals, self-testing was judged as most effective, with writing/drawing, elaboration, and rehearsal also judged more effective than grouping or imaging. Thus, although no strategy was judged to be the only strategic alternative for any task, students clearly judged some strategies to be more effective than others for each task.

Judged strategy effectiveness across tasks. The second hypothesis of this study involved students' awareness of the interaction between the task and strategic behavior. This question was examined through tests for correlated proportions across independent samples (Zwick et al., 1982), that is, the probability of choosing one strategy over another for one task was compared with that probability for a second task. All possible strategy pairs were compared across the three possible combinations of task. The critical value, with alpha at p ≤ .05 across the 45 comparisons, was 3.27 (Dayton & Schafer, 1973).

Eighteen of the 45 comparisons were significant, which indicates some discrimination among the strategies across tasks. Nine of the 18 significant comparisons involved judgments of the grouping strategy. The subjects in the areas task were more likely to choose grouping over the other strategies than were those in the shapes or capitals tasks (9 of 10 comparisons significant). In addition, elaboration was more likely to be chosen over rehearsal and writing/drawing by students in shapes than by those in the other conditions, whereas imaging was more likely to be chosen over writing/drawing by students in shapes than by those in areas or

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<tr>
<th>Task and experiment</th>
<th>Most effective</th>
<th>Least effective</th>
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<tr>
<td>Areas/seasons Experiment 1</td>
<td>S-T</td>
<td>Grp.</td>
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Note. Underlined strategies are not significantly different from one another. S-T = self-testing, Elab. = elaborating, Reh. = rehearsing, W/D = writing/drawing, Imag. = Imaging, and Grp. = grouping.

*Proportions for Experiment 2 were derived from rank order data using the comparative judgment approach (Guilford, 1954).
The material; second, to choose from a list of the six strategies equipped with a one-way mirror, behind which a videocamera was allowed. A posttest questionnaire was prepared in which students were asked, first, to report in their own words how they had studied for the task; and third, to rank the six strategies from least to most effective for the task. It was hypothesized that (a) ranking of strategic effectiveness would differ within and across tasks and would be related to strategy use, (b) observed and reported strategic behavior would vary as a function of the task, and (c) use of strategies ranked as more effective for the task would result in higher performance.

Experiment 2

The data from Experiment 1 indicate that college students discriminate among strategies for a particular task and show some sensitivity to differences in strategic effectiveness across tasks. An issue that is not addressed, however, is whether the strategies that were judged effective would also be used by the students for these types of tasks. Recent studies suggest that strategic knowledge is moderately related to strategic behavior (Waters, 1982), recall (Zivian & Darjes, 1983), and academic performance (Leal, 1987).

In Experiment 2 these relationships were examined by giving students a memory task similar to one of those judged in Experiment 1. Measures of observed and reported strategy use and recall were obtained, and subjects were asked to rank order the six strategies used in Experiment 1 on the basis of their effectiveness for the task. It was hypothesized that (a) ranking of strategic effectiveness would differ within and across tasks and would be related to strategy use, (b) observed and reported strategic behavior would vary as a function of the task, and (c) use of strategies ranked as more effective for the task would result in higher performance.

Method

Subjects. Seventy-two college students were randomly assigned to one of three memory tasks and one of two rehearsal conditions. Half of the students in each condition were women. The mean age was 20.3 years (SD = 2.17 years).

Materials. Three memory tasks that were similar but not identical to those in Experiment 1 were chosen. The tasks involved remembering the following information about 16 astronomical constellations: (a) shapes, the shape of each constellation outlined by its stars, (b) seasons, the season in which each constellation is visible from the United States, and (c) stars, the major star of each constellation. As in Experiment 1, imagery, categorization, and elaboration, respectively, were hypothesized to be the most appropriate strategies for these tasks. For each stimulus a 3 × 4 in (7.62 × 10.16 cm) card showed the name of the constellation along with the information appropriate for the task. For example, for the constellation Andromeda, shapes showed the characteristic pattern of stars, seasons indicated that it can be seen in the Fall, and stars indicated that the major star is Alpheratz.

A 12-item multiple-choice test was prepared for each condition, with all distractors drawn from the stimulus set. Pretesting indicated that performance on this test was below ceiling for the study time allowed. A posttest questionnaire was prepared in which students were asked, first, to report in their own words how they had studied the material; second, to choose from a list of the six strategies examined in Experiment 1 the strategy they had used most for the task; and third, to rank the six strategies from least to most effective for the task.

Procedure. Students were tested individually in a small room equipped with a one-way mirror, behind which a videocamera was positioned. Students were randomly assigned to the shapes, seasons, or stars task and given 16 stimulus cards for that condition. They were instructed that they had 3 min to study the cards in any way they liked and would then take a multiple-choice test over the information. The study behavior was videotaped.

The students were also randomly assigned to the overt or covert rehearsal condition. The students in the covert condition were given no additional instructions. Those in the overt condition were told that we were interested in how individuals study and that they should study the material as they normally would but to do it out loud. This method has been found to allow assessment of strategy use without disrupting performance (Naus, Ornstein, & Aivano, 1977).

After the 3-min study period, the 12-item multiple-choice test was administered. Subjects then completed the strategy-use questionnaire. Results and Discussion

The analyses were designed to examine strategic knowledge based on rankings of strategic effectiveness, strategy use based on observed and self-report data and choice of primary strategy, and the relationship of strategic knowledge and strategy use to performance on the memory task.

Strategic knowledge. As in Experiment 1, judgments of strategic effectiveness were examined both within and across tasks. Strategy judgment data in this study were the rank orderings of the six alternative strategies (Guilford, 1954, pp. 178-186). The probabilities of choosing each strategy over all other strategies in Experiment 2 are shown in Table 1.

For strategy judgments within tasks, multiple comparisons (Zwick et al., 1982) of the proportion of times each strategy was chosen over every other strategy indicated that 34 of the 45 Z values were significant. As in Experiment 1, where 29 of the 45 comparisons were significant, the students clearly discriminated among the strategies for each task. An examination of Table 1, however, shows that the order of judged effectiveness in this study differed from that in Experiment 1. For example, self-testing and elaboration were judged most effective for shapes in Experiment 1, whereas imaging and grouping were judged most effective in Experiment 2. In the second study those strategies hypothesized to be most effective for each task tended to be judged most effective, that is, imaging for shapes, grouping for seasons, and rehearsal or elaboration for stars. This increased preference for task-specific strategies may stem from task differences between the experiments or from the fact that in Experiment 2, the students completed the memory tasks before they made strategy judgments.

As in Experiment 1, however, judgments of strategy effectiveness differed across tasks. Tests for correlated proportions across task groups, p ≤ .05 for 45 comparisons, indicated that 35 of the 45 comparisons were significant. By comparison, 18 of 45 comparisons were significant in Experiment 1, which suggests a clearer discrimination among the strategies in Experiment 2. Similar to Experiment 1, grouping was chosen over other strategies more often for seasons than for shapes or stars (8 of 10 comparisons). Elaboration was chosen over all strategies except grouping more often for seasons than shapes (4 significant comparisons), over writing/drawing and imaging more often for stars than for seasons, and over rehearsing and self-testing more often for shapes than stars.
Finally, imaging was chosen over rehearsing and self-testing more often for shapes than for seasons or stars, and more often for seasons than for stars. Thus, judgments of the strategies across tasks indicate a clear awareness of the relationship between task and strategy effectiveness.

**Strategy use.** Strategy use across tasks was examined on the basis of (a) videotaped strategic behavior of students in the overt rehearsal condition, (b) reported strategic behavior by all students and (c) student's choice of their primary strategy from the six alternatives. Videotaped and reported strategic behavior were scored by independent raters who were unfamiliar with the hypotheses of the study. Forty-two randomly selected videotapes and 40 self-report protocols were also scored by an additional rater. Strategic behaviors were coded into the six strategies identified in Experiment 1 with the additional categories of no strategy behavior for the observational data and other for the self-report data. For each subject the raters identified, first, all the strategies evident in the videotaped behavior or self-report protocol and, second, the study behavior they judged to be the primary strategy. Reliability was assessed by the kappa statistic (Cohen, 1960) to measure the proportion of joint judgments in agreement after chance is removed. Kappa for the videotaped behavior was .72 (z = 16.65, p < .01) for all strategies observed and .55 for the primary strategy (z = 7.61, p < .01). This difference in reliability was because although both raters often identified the same strategies, they sometimes judged different ones to be primary. Kappa for the reported strategic behavior was .74 (z = 13.94, p < .01) for all strategies and .67 (z = 6.29, p < .01) for the primary strategy.

The data in Table 2 give limited support to the hypothesis of differential strategy use across tasks. Grouping was most frequently observed and reported for seasons, whereas rehearsing tended to be observed and reported more for seasons and stars than for shapes. Table 2 also suggests, however, some differences between observed and reported strategy use for subjects in the overt condition. Although the distribution of reported strategies is virtually identical for subjects in the overt and covert conditions, rehearsal tended to be more frequently observed than reported for subjects in the overt condition, whereas elaboration was more reported than observed. These frequency differences were not statistically significant (p > .05) but do suggest that self-report and observational measures of strategy use may differ.

Despite these distribution differences, observed and reported strategic behavior were significantly related. For 14 of the 36 subjects in the overt condition, the primary strategy observed was also the primary strategy reported, \( \kappa = .54, z = 2.15, p < .05 \). When criteria were relaxed to examine the degree to which any observed strategic behavior was also identified in the reported strategy set, 78% of the subjects reported at least one strategy observed during the study period, \( \kappa = .71, z = 5.51, p < .01 \). These data suggest that reported strategy use was a measure of actual strategic behavior.

Primary strategy use also differed across tasks. Elaboration was more likely to be the primary strategy both observed and reported for shapes than for the other two tasks, \( \chi^2(2, N = 36 \text{ and } 72) = 13.82 \text{ and } 6.41, p < .05, \) for observed and reported, respectively. Rehearsal was more likely to be the primary strategy observed for stars than for shapes, \( \chi^2(1, N = 36) = 6.04, p < .01, \) and this difference also approached significance in reported strategy use, \( \chi^2(1, N = 72) = 3.57, p < .06. \) Grouping was more likely to be the primary reported strategy for seasons than for stars, \( \chi^2(1, N = 72) = 5.44, p < .05, \) but this difference was not significant in the observation data. Thus, elaboration, rehearsal, and grouping strategies were differentially adopted across tasks.

The subjects' choice of their primary strategic behavior from the six options showed a similar pattern of results; however, the differential choice across task was not as marked. Only grouping was chosen significantly more often for seasons than for shapes or stars, \( \chi^2(2, N = 72) = 28.49, p < .01 \).

**Strategic knowledge, strategy use, and performance.** The analysis of the hypothesized relationship between strategic knowledge and strategy use was complicated by the fact that students judged more than one strategy to be relatively effective for each task and adopted multiple strategies. Thus, no simple relationship between strategy use and judged effectiveness was evident. The primary strategy reported was more likely, however, to be one of those judged to be relatively effective for the task. Twenty-three of 24 shapes students used imaging, grouping, or elaborating; all 24 seasons students used grouping, elaboration, or rehearsal, whereas 18 of 24 stars students used rehearsal, elaboration, or self-testing.

In a preliminary analysis of performance on the memory tasks, a 3 (task) \( \times 2 \) (rehearsal condition) analysis of variance of the number correct on the multiple-choice test showed no significant interaction effects.
significant differences in performance, which suggests that the tasks were of comparable difficulty and that the overt rehearsal requirement had not significantly affected performance. The mean number correct was 8.92, 7.71, and 7.29 items for shapes, seasons, and stars, respectively, and 8.31 and 7.64 items for the covert and overt conditions, respectively.

Analyses of recall as a function of primary observed strategy (overt subjects only), primary strategy reported, and strategy choice were conducted. Because of the small numbers of subjects who used or reported some strategies, strategies used by fewer than 4 subjects were grouped into other. No significant differences in recall as a function of strategy use or strategy reported were found (all $p < 1.0$). Thus, although some strategies were judged more effective than others and were more likely to be adopted for each task, differences in strategy use were not related to performance.

General Discussion

The data from these studies indicate that college students' knowledge about memory includes information on the relative effectiveness of potential memory strategies within and across task situations. In each experiment students (a) chose some strategies as more effective than others for each task and (b) chose different strategies as effective across tasks. Furthermore, in Experiment 2, students typically used the strategies they had judged to be relatively effective, which supports the hypothesized relationship between strategic knowledge and strategy use. These findings extend earlier research showing a relationship between strategy knowledge and strategy use in single tasks (Waters, 1982; Zivian & Darjes, 1983), and suggest that knowledge of the interaction between task characteristics and strategy effectiveness may be an important aspect of strategic knowledge for adults. Pressley, Borkowski, and O'Sullivan (1985) hypothesized that knowledge about the tasks for which a particular strategy may be appropriate is part of the "specific strategy knowledge" that is associated with individual strategies.

An unexpected finding in the current studies was that judgments of the relative effectiveness of the strategies differed across the two experiments. Although the two shapes tasks, the areas and seasons tasks, and the capitals and stars tasks were designed to require similar strategies, subtle differences may have resulted in differing judgments of relative effectiveness. Alternatively, these differences may have resulted from the fact that in Experiment 2 strategy judgments were made after the students' participation in the memory task. Thus, students' strategy use during the memory task may have provided feedback that affected their subsequent judgments of strategy effectiveness. Such experiences have been hypothesized to constitute "metamemory acquisition procedures" (Pressley et al., 1985), that is, the means through which one's knowledge about memory is developed.

Several differences in the order of effectiveness of the strategies across tasks are consistent with this hypothesis. In Experiment 1 the relatively "all-purpose" strategy of self-testing was judged to be most effective for all three tasks. This may reflect the students lack of specific experience with the task. In Experiment 2, after the students' experience with the task, more task-specific strategies were judged to be most effective, that is, imagery for shapes, grouping for seasons, and rehearsal and elaboration for stars. Thus, a reciprocal relationship between strategic knowledge and strategy use is hypothesized in which strategic knowledge affects strategy selection, whereas feedback on the strategy's effectiveness affects subsequent assessments of the strategy's usefulness.

Knowledge about memory is of most interest as a predictor of strategy use and memory performance. In comparing the strategy judgment data in Table 1 with the data in Table 2, a relationship between judgments and strategy use is clear for seasons (grouping and elaborating observed, reported, and judged most effective) and stars (elaboration and rehearsal) but less so for shapes. In particular, although imaging was judged most effective, it was not observed in any of the videotaped study periods, and only two of 24 students reported using it. There are at least two possible explanations for this finding. Imagery may have been used by the students but less easily observed or reported than the other strategies. Alternatively, students may have judged imagery to be effective but chosen to use other strategies. Previous research indicates that there are significant individual differences in the use of visual imagery (Marks, 1973). Elaboration and grouping, which were also judged to be relatively effective for shapes, were the most frequently adopted strategies for the task.

The hypothesized relationship between strategy use and memory performance was not found in this research. In contrast to previous findings that showed this relationship (Waters, 1982), there were no differences in recall as a function of strategy use. This finding may have resulted from lack of power in that most students adopted strategies judged to be relatively effective for the task, which resulted in small numbers of subjects who used relatively ineffective strategies. To examine further the relationship of performance to strategic knowledge and strategy use, tasks are needed for which different strategies lead to varying levels of performance.

The data from these studies support current models of metamemory in suggesting that strategic knowledge involves more than simple awareness that a particular strategy is useful (Pressley et al., 1985). Knowledge about the conditions for strategy use, the effort required, and the usefulness of the strategy in previous situations may all contribute to decisions to adopt a particular strategy. Such strategic knowledge would be expected to affect the strategic behavior adopted and, in turn, to be affected by experience in task situations. Additional efforts toward understanding this relationship appear to have important implications for fostering cognitive skills and academic achievement.

References


STRATEGIES ACROSS TASKS


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