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ABSTRACT

Two experiments compared the effectiveness of two separate mnemonic devices for learning the states and their capitals--one a complex key word system using substitute words for each syllable, the other a simple key word device interacting key words from the state and capital names in an illustration. In the first experiment, 88 fourth and fifth grade students were randomly assigned to 1 of 4 experimental conditions to learn the capitals of 14 states. Students in the control group used their own "best method" for learning the capitals, those in the second group used the complex key word device, and those in the third and fourth groups used a one-stage (similar to the complex device) and a three-stage version of the simple key word device. Students were tested for immediate recall after the session and again the following day for delayed recall. In the second experiment, 59 fourth grade students were assigned to control, simple key word, or complex key word groups. The procedures paralleled those in experiment 1 except that in both experimental groups the capital key word learning stage contained an additional trial to raise the level of subsequent recall. Students were tested immediately and 2 days later. The results of both experiments indicated that the purportedly effective complex key word method was no more effective than students' own devices when subject to controlled experimentation. On both the immediate and delayed recall measure, simple key word students surpassed both control and complex key word device students. (HTH)

Working Paper No. 306

MORE ON HOW (AND HOW NOT) TO REMEMBER THE STATES AND THEIR CAPITALS

by

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Report from the Project on
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Abstract

An empirically developed set of mnemonic materials for learning the states and their capitals was compared with a set of commercially available materials in two experiments with elementary school children. The empirically developed materials, which were considerably less complex than the commercially available ones, also proved to be more effective in both experiments. Students receiving the commercially available materials learned no better than students left to their own devices. Concrete suggestions are offered concerning how to maximize children's chances for success with mnemonic curriculum materials.

More on How (and How Not) to Remember the States and Their Capitals

The present study is a postscript to an experiment that was recently reported by Levin, Shriberg, Miller, McCormick, & Levin (1980). In that study, we described some mnemonic (memory-enhancing) materials that we had developed to teach children the capitals of the United States. We also provided some data, based on controlled experimentation, to substantiate the claim that our materials "work." In comparison to fourth and fifth graders who were given an equivalent amount of time to learn states and capitals however they wished, students who were taught according to our procedures remembered substantially more.

At about the same time that we had completed our research, however, we discovered a book authored by the ex-basketball player, Jerry Lucas (1978). Lucas, who had become interested in mnemonics while in college, had written previously on the subject of mnemonic systems (e.g., Lorayne & Lucas, 1974). Interestingly, from the present perspective, a major section of Lucas's recent book dealt with teaching the states and capitals mnemonically. In that section, he provided colorful illustrations that he claimed would make learning the states and capitals "...easy and fun" (Lucas, 1978, p. 11).

We certainly have no personal bone to pick with Lucas; however, we do have a scientific bone to pick with his claim. As best as we could tell, Lucas's mnemonic illustrations were developed in his own mind's eye and in the absence of scientific corroboration. What appeared to us was that his materials would not "work" as well as he claimed--especially with children. This is because upon careful examination of the materials

we were left with the distinct impression that they were "busy," overly complex, and as likely to lead to obfuscation as to illumination. Our own materials, in contrast, had been developed expressly to be as simple as possible, and yet effective. The simplicity criterion was considered during the materials development stage of the research, by applying the collective wisdom of a team of psyehologists and educators. The effectiveness criterion was considered during the materials validation stage of the research, by refining specific items that proved ineffective in actual tryouts with children.

A sample item that provides a nice contrast between the nature of many of the Lucas creations and our own is Annapolis, Maryland. With our materials students first learn a "keyword" (Atkinson, 1975) for the state, in this case, Maryland = marry. They then learn a keyword for the capital, here, Annapolis = apple. Finally, they are shown an illustration in which the two keywords are interacting in some fashion (see Figure 1). Lucas's materials also capitalize on a word-recoding approach, but rather than recoding only a salient syllable of each

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Insert Figure 1 about here

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to-be-associated item, they attempt to recode all of the item (or, at least, as much as possible). For example, for Maryland, Lucas uses the "substitute words" Mary-land, and for Annapolis, he uses a-nap-pole-less. All of these pieces are put together in an illustration in which a girl rowing a boat with "Mary" printed on it comes to shore where a man is sleeping on top of a flagpole.[1] Beneath the illustration is printed the

verbal description: "As MARY rows a boat, she comes to LAND. She sees a person taking a NAP on a POLE, no LESS!" (p. 33). Previous theoretical and empirical work in the area of associative learning suggests that such illustrations will create potential problems for children, in that: (a) the interactions contained therein are not always plausible; and (b) retrieval of the relevant picture components is not a straightforward process (see, for example, Bower, 1972; Levin, in press; and Paivio, 1971). Hereafter, we will refer to our and Lucas's keyword approaches, respectively, as "simple" and "complex."

The present study was conducted specifically to evaluate the effectiveness of Lucas's (1978) materials under controlled conditions. Moreover, it pitted Lucas's materials against our own--sort of a Lucas vs. Levin, one-on-one, as it were. Although we were, of course, not disinterested observers with respect to how our materials fared, we certainly did our best to maintain impartiality throughout the course of the research (as will be indicated in the two experiments reported here).

Experiment 1

Method

Subjects. Eighty-eight fourth- and fifth-grade children participated in the experiment. Forty-nine fifth graders were selected from two classrooms at the same school in a midwestern university community. The 39 fourth graders were selected from two classrooms at different schools, one in the same community that served the fifth-grade sample and the other in a more rural community.[2]

Design. All pupils were randomly assigned to one of four experimental conditions in order to learn the capitals of 14 states. In the Control

condition, students were allowed to use their own "best method" for studying the states and capitals. Students in the Simple Keyword-3 condition learned the states and capitals in three discrete stages, according to the procedure that had previously proven effective (Levin et al., 1980). In particular, they learned keywords for the states and capitals during Stages 1 and 2, respectively, and then viewed interactive illustrations during Stage 3. In the Complex Keyword-1 condition, students learned the states and capitals using the keywords, illustrations, and supporting verbal descriptions found in Lucas's (1978) book. Each state-and-capital set was presented on a separate single page and, thus, students learned keywords and viewed interactions simultaneously (i.e., in one stage). Because our approach (Simple Keyword-3) differs from Lucas's (Complex Keyword-1) with respect to both the assumed complexity of the materials and the number of discrete stages employed (three vs. one), we also included a one-stage version of our materials to help clarify the locus of whatever differences might materialize. Thus, in the Simple Keyword-1 condition, our materials were put into Lucas's single-page format and students studied them in only one stage. As an aside, it should be noted that in almost all of our keyword research with children (Levin, in press), we have elected to establish stable keyword responses prior to providing the critical pictorial links. Inclusion of the Simple Keyword-1 condition here affords an empirical test of the criticality of our adopted stage-separation approach.

Each child participated in two experimental sessions. In the first session students in all conditions learned the capitals of 14 states and were tested immediately thereafter for recall of them. The next day, students returned for a second session in which their delayed recall of the capitals was assessed.

Materials and procedure. Two female experimenters instructed and tested the students individually. Each student was tested by the same experimenter in the two sessions. All students were given a practice item (Kansas : Topeka) to apprise them of the requirements of the condition to which they were assigned. At the beginning of the first session, students were told that they were going to learn the capitals of 14 of the United States. (The 14 particular states had been randomly sampled, so as not to bias the item selection in favor of one method or another.)

Students in the Simple Keyword-3 condition were taken through three discrete instructional stages. First they were asked to learn keywords ("word clues") for each of the 14 states. Each keyword sounded like a salient part of the state's name (e.g., Kansas = cans, Tennessee = tennis). The students were read the entire list of state-keyword pairs while the experimenter simultaneously displayed 5" x 8" (12.7 x 20.3 cm) index cards with the states and their keywords typed on them. These state-keyword pairs were presented in a different random order to each student. After all of the cards were presented, the student was asked to supply the appropriate keyword when shown the name of a state typed on another deck of 5" x 8" (12.7 x 20.3 cm) index cards. If a student's response was incorrect, the experimenter immediately displayed and pronounced the keyword typed on the back of the card. Each student was given two randomly ordered test trials.

Upon completion of the state-keyword learning trials, the second stage was implemented. Here, students were asked to learn keywords for the 14 capital cities. Students were read the entire list of capitals and associated keywords (e.g., Topeka = top, Nashville = mash). The procedures

and materials were similar to those employed in Stage 1. However, because the students' criterion task was to recall the name of the capital city for each state, the testing process was reversed. That is, students had to supply the capital name upon presentation of the keyword. Testing proceeded in the same manner as in the state-keyword stage. Each student was presented with two randomly ordered capital-keyword test trials.

After the capital-keyword learning phase, the students were told that the final stage would consist of learning the states and their appropriate capitals. In particular, students were shown a series of 8-1/2" x 11" (21.5 x 20 cm) colored illustrations in which the state and capital keywords were related to one another (see Figure 1). The appropriate state and capital names, and associated keywords, were printed at the top of each illustration. The children were instructed to remember the pictures in order to aid their later recall of the capitals. As each picture was displayed, the experimenter simultaneously provided a brief verbal description of what was illustrated in the picture. For example, for Figure 1, the experimenter said: "The capital of Maryland is Annapolis. Here is a picture of someone about to marry these two apples." For Topeka, Kansas, the picture description was: "Here is a picture of some cans being knocked over by this top" and for Nashville, Tennessee, it was: "Here is a picture of this tennis racket which is being used to mash these potatoes." After the description was completed, students were allowed 10 secs to study the illustration. This procedure was repeated for each of the other 13 states and capitals.

In the Simple Keyword-1 condition, learning consisted of only one stage. Specifically, children viewed the same set of illustrations as in

the Simple Keyword-3 condition, but they were not provided with separate state-keyword and capital-keyword learning phases. During presentation of the pictures, the children were read the names of the states and capitals, the keywords for the states and capitals, and a verbal description of the illustration. Each student was required to respond orally with each capital's name twice (once at the beginning and once at the end) during each picture presentation. This was done in order that the children would have the same amount of experience as Simple Keyword-3 subjects did at producing the names of the capitals. After the students provided the capital's name the second time, they were allowed 15 secs to study the illustration. (The extra time was to equate the total study time in this condition with that in the Simple Keyword-3 condition.) Each student was presented the state-capital illustrations in a different random order.

The procedures in the Complex Keyword-1 condition directly paralleled those in the Simple Keyword-1 condition. The only difference was in the specific materials presented to the students, ours in the case of Simple Keyword-1 versus Lucas's (1978) in the case of Complex Keyword-1. Sample Lucas keywords are: Kansas = can-sews and Topeka = toe-peek-A, and Tennessee = tin-a-sea and Nashville = mash-ville, and the corresponding verbal descriptions are: "A CAN SEWS a shirt as a TOE is PEEKing around at the letter 'A' on the side of the can" and "A TIN can is standing by A-SEA. As you can see the tin can is preparing to MASH a small ant VILLE with its foot. (Ville is another word for village.)" The Lucas illustrations also contained a small outline of the shape of the state, which the students were told to ignore. Again, each student was presented

the pictures in a different random order, with 15 secs to study each picture.

Students in the Control condition were instructed to use their "own best method" of studying. Auxillary materials were also provided to help them learn the capitals. These materials consisted of: a list of the states and their capitals, printed in black letters on a laminated 8-1/2" x 11" (21.5 x 28 cm) sheet of white paper; a pencil and pad of paper for writing down the names of whatever else would help them learn; and a stack of 3" x 5" (7.6 x 12.7 cm) laminated flashcards that had a state name on one side and its corresponding capital on the other, both printed in black letters. It was suggested to the students that they could use these cards to test themselves on the states' capitals. To familiarize the students with the correct pronunciation of the capitals, the experimenter read through the list of state-capital pairs. After each pair was read, the student was required to repeat the capital's name. The list was read twice, once from top to bottom and once from bottom to top. Then, each Control student was allowed to study the states and capitals, using whatever method (s)he wished, for a total of seven minutes. (Again, this amount of time was devised so as to equate the total study time in all conditions.)

Immediately following study of the 14 items, students in all conditions were tested for their recall of the capitals. Students in the three picture conditions were told to "think back to the pictures for each state-capital pair in order to remember the capital names," whereas the Control students were told to "try hard to remember the capital for each state." During testing, the state names were read aloud while

displayed in black print on 5" x 8" (12.7 x 20.3 cm) index cards. The test items were presented in a different random order to each student, with all responses recorded by the experimenter. Two days later, students were again tested for their recall of the capitals in the same manner as in the initial test.

Results and Discussion

The responses were scored by two judges who were "blind" with respect to students' experimental conditions. Responses that were off by only one syllable were accepted as correct (e.g., "Annipolis" and "Tallenhassee"), although blatantly incorrect substitutions (e.g., "Harrison" for Harrisburg), and other partially recalled items (e.g., "Tallis" for Tallahassee) were not counted as correct. These latter responses were scored as partial or "syllable" responses, and will be discussed later.

Between-conditions differences were examined via four nonorthogonal planned comparisons, after removing the effects due to grade level. The mean percentages recalled in each experimental condition on both the immediate and delayed tests, as well as the mean percentage of subjects' Session 1 recall retained in Session 2, are presented in Table 1. The

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Insert Table 1 about here

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four comparisons of interest included the Complex Keyword-1 condition vs. each of the other three conditions, as well as the Simple Keyword-3 vs. the Control condition. For each of the three Table 1 measures, the comparisons were tested for statistical significance using Dunn's procedure, based on a familywise Type I error probability of at most .05 (equally

divided among the four comparisons)--see Kirk (1968). All tests were based on 80 denominator degrees of freedom.

On the immediate test, the mean performance of Simple Keyword-3 subjects surpassed that of Complex Keyword-1 students, $t = 2.44$, $p < .01$ (one-tailed). On the delayed test, this difference was again significant, $t = 3.09$, $p < .01$, as was the difference between Simple Keyword-3 and Control students, $t = 2.33$, $p < .0125$ (one-tailed). Simple Keyword-3 subjects also exhibited a higher percent retained in comparison to Control students, $t = 2.92$, $p < .01$. No other differences were statistically significant.

Thus, the present results indicate that when it comes to remembering the states and capitals, the materials that we developed empirically (Levin et al., 1980) are more effective than those developed by Lucas (1978). This was demonstrated through both direct Simple Keyword-3 vs. Complex Keyword-1 comparisons, as well as through comparisons with the Control condition. On all learning measures, performance in the Complex Keyword-1 condition was statistically comparable to that in the Control condition, whereas performance in the Simple Keyword-3 condition statistically surpassed that in both conditions on two of the three measures.

At the same time, it should be noted that when our materials were couched in Lucas's presentation format (Simple Keyword-1), no measurable learning advantage was detected. Thus, what can be concluded from the present experiment is that: (a) the Levin et al. (1980) materials are effective when presented according to the authors' recommended three-stage instructional format; but (b) the Lucas (1978) materials are ineffective when presented according to the one-stage format in his book. Such results represent both "good news" and "bad news," however. The good news

is that our original intuition about physically separating the keyword-learning and linking stages when working with children (e.g., Levin, in press; Pressley & Levin, 1978; Pressley, Levin, & Delaney, Note 1) has been borne out; whereas the bad news is that because only a one-stage Lucas condition (Complex Keyword-1) was included here, it is impossible to conclude whether it is Lucas's materials per se that are not effective or, rather, the one-stage format in which they were presented. Because of this "bad news" interpretive problem, a second experiment was conducted in which Lucas's materials were presented according to the just proven-to-be-preferred three-stage format.

Experiment 2

Method

Subjects and design. Fifty-nine fourth graders were selected from two elementary schools in the same university community as in Exp. 1.[3] Students were randomly assigned to one of three conditions: Control, as in Exp. 1; Simple Keyword-3, as in Exp. 1; and Complex Keyword-3, in which Lucas's materials were presented according to a three-stage instructional format. Each child participated in two sessions, learning and an immediate test in the first session, and a delayed test two days later.

Materials and procedure. Two female experimenters instructed and tested the children individually, as in Exp. 1. Students learned the capitals of 14 states, with 13 the same as in Exp. 1 and one (Idaho) randomly selected as a substitute for Hawaii (for which virutally all subjects in Exp. 1 knew the capital). With one exception, the procedures paralleled those for the corresponding conditions in Exp. 1. The exception was that in the capital-keyword learning phase (Stage 2 of the three-stage

process), an additional trial was implemented in an attempt to elevate the level of subsequent capital recall. Thus, three capital-keyword learning trials were provided, in contrast to only two in Exp. 1.

To compensate for this additional trial, Control students were initially read the list of states and capitals three times (rather than twice, as in Exp. 1). In these trials, Control students repeated the capital's name as the pair was read by the experimenter. In addition, Control students were then allowed eight minutes of free study time (rather than seven minutes, as in Exp. 1).

An equivalent three-stage process was followed with Lucas's materials (Complex Keyword-3) as with our own (Simple Keyword-3). In particular, special state-keyword and capital-keyword cards were constructed for the Lucas materials so as to be comparable to the ones used with our materials, and his illustrations were changed so as to be comparable in format to ours.

Immediately following state-capital learning, the children were tested in the same manner as in Exp. 1. Two days later, the children were again tested for their capital recall. The scoring criteria and procedures on both tests paralleled those of Exp. 1.

Results

The mean performance measures are presented in Table 2. For each dependent variable, the three pairwise comparisons involving conditions

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Insert Table 2 about here

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were performed using Dunn's procedure with a familywise Type I error probability of at most .05, equally divided among the three comparisons.

On the immediate recall measure, the performance of Simple Keyword-3 students statistically surpassed that of both Complex Keyword-3 and Control students, ts(56) = 2.80 and 2.31, ps < .01 and .015 (one-tailed), respectively, with no difference between the latter two conditions, $|t| < 1$. A similar pattern of results was detected on the delayed test, although neither the Simple Keyword-3 vs. Complex Keyword-3 difference nor the Simple Keyword-3 vs. Control difference was significant at the chosen α level, ts(56) = 1.78 and 1.41, ps < .05 (one-tailed) and .10 (one-tailed), respectively. Once again, the difference between Complex Keyword-3 and Control was statistically negligible, as were all differences on the percent retained measure, all $|t|$s < 1.

General Discussion

What have we learned from the present study regarding successful and unsuccessful keyword method adaptations for teaching the states and capitals to elementary school children? First and foremost, not all purportedly effective materials are in fact effective when subjected to controlled investigation. In the present instance, Lucas's (1978) states-and-capitals materials proved no more effective than students' own learning strategies when assessed either according to the single-stage presentation format of his book or according to our preferred three-stage presentation format that separated keyword learning from the to-be-learned associations. Of course, it should be recognized that keyword learning may not be as vital a component to the Lucas materials in that the keywords are always virtually identical to the names of the states and capitals

themselves (e.g., Maryland = Mary-land; Annapolis = a-nap-pole-less). At the same time, it is important to note that what Lucas gains from the complete acoustic correspondence between keywords and the words themselves, he apparently loses with regard to simplicity and meaningfulness of pictorial representation. In contrast to our illustrations, Lucas's are seemingly much more complex and less well-integrated. Although valid generalization is not warranted based on the present sample of only one set of materials apiece, a reasonable hypothesis is that keyword illustrations that are well-integrated and easy to interpret will be more effective than those that are not.

But everything is not "sweetness and light" regarding the performance associated with our own materials here. In contrast to our initial study (Levin et al., 1980), where keyword effects were large--especially on the delayed test--here, the effects were relatively smaller. Indeed, in Exp. 1, the keyword-control difference of eight percentage points was not statistically significant on the immediate test, and in Exp. 2, the 12 percentage-point difference was not significant at the chosen α level. Thus, the statistical superiority of the Simple Keyword-3 condition was spotty here, and the remainder of the discussion will attempt to account for this spottiness. As a result of this discussion, a general guideline will be developed concerning the conditions under which the keyword method is believed to be most effective.

In order for the keyword method to function effectively in the present context, the keyword for each capital must reliably evoke the name of the capital itself (see Levin, in press). Without such reliable activation, a student's recall of the keyword illustration would allow him or her to get as far as the keyword for the capital, but that is all. Thus, for

example, when asked for the capital of Maryland, a student might well remember the picture of two apples getting married, but getting from apple to Annapolis is quite a different matter. Evidence in support of this kind of "capital retrieval" breakdown is afforded by analyses of students' responses in the two present experiments. When capital "keyword" responses are counted as correct, the Tables 1 and 2 figures for Simple Keyword-3 students increase anywhere from 7 to 12 percentage points.[4] (No such increase is observed in either the control condition or with the Lucas materials.) Thus, it appears that the names of the capitals were not sufficiently retrievable from their associated keywords to produce a substantial keyword-control difference.

In the earlier Levin et al. (1980) study, the probability of successful capital retrieval was elevated on two accounts. First, students were given up to five keyword-learning trials to associate keywords and capitals. This is in contrast to the present two and three trials for Exps. 1 and 2, respectively. Second, in the previous study the pupils were purposely pre-experimentally familiarized with the names of the to-be-presented capitals. This was accomplished by the students' teacher presenting and making available the names of the capitals as part of the regular social studies curriculum in the weeks immediately preceding the study. Thus, it could certainly be expected that the previous students were quite familiar with the names of the capitals they would have to produce in the experiment--in contrast to the present students, where many capital names (e.g., Annapolis, Boise, Pierre) were undoubtedly experienced for the first time during the experiment.

Apart from the confirming results of a recent study that has directly addressed the criticality of response familiarity in this context (Pressley & Levin, 1981), some data from the present study also bear on the issue. Assuming that stable keyword-capital associations must be established before effective state-capital learning can occur, one would expect there to be at least a moderate relationship between students' capital keyword-learning performance and their subsequent capital recall. Using scores on the last capital keyword-learning trial as an index of keyword-capital integration, we obtained correlations with immediate and delayed recall ranging from .50 to .71 in the present two experiments. Thus, students who were better able to produce the names of the capitals from their associated keywords were subsequently able to recall more capitals from their associated states. We therefore interpret the comparatively weaker keyword method effects of the present study (in comparison to those of the previous study) to be attributable in large part to the greater extent of capital name unfamiliarity among the present students. In making this statement, we are of course mindful of other likely differences between the two studies, including those associated with the student populations investigated, as well as those associated with specific item and procedural characteristics. In the latter category, for example, the assessment of retention in the previous study followed students' learning of a second states-and-capitals list, which appeared to have an especially detrimental effect on control students (thereby increasing the magnitude of the keyword-control retention difference).

In summary, three major conclusions concerning mnemonic instruction may be reasonably extracted from the results of this and the earlier Levin

et al. (1980) study. First, not all mnemonic instructional materials are equally effective. Indeed, certain thought-to-be-effective materials may fail miserably when appropriate controlled comparisons are made. The lesson to be learned here is that each new set of proposed materials needs to be empirically validated before it can be recommended for classroom use. Second, even with potentially effective materials, the degree to which they realize their potential depends on the manner in which they are presented to students for learning. With the Levin et al. (1980) materials, for example, learning is improved only when the materials are presented in a logically stage-separated fashion, so that the individual components of the to-be-acquired skill can be well understood and practiced. In contrast, no learning gains are found when the separate components are integrated and presented simultaneously (Simple Keyword-1 of present Exp. 1). Finally, and also related to the realization-of-potential issue, it is now abundantly clear from the keyword vocabulary-learning studies of Pressley, Levin, Hall, Miller, and Berry (1980) and Pressley and Levin (1981), as well as from the two states-and-capitals applications of the keyword method (Levin et al., 1980; and the present study), that if students are required to recall specific terms (such as new vocabulary or names of capitals), those terms must be sufficiently familiar that they can be readily retrieved from their associated keywords. Such familiarization can be accomplished either pre-experimentally (i.e., through students' existing knowledge or through purposeful instruction aimed at making new terms familiar) or experimentally (i.e., through an adequate number of keyword-response learning trials). In this sense, then, Atkinson's (1975) keyword method will be "mnemonic" only to the extent that the

desired verbal responses have been well established. Translated into the present context, it is imperative that students are aware of the Montpeliers, Helenas, and Frankforts of the country--and that these names can be produced in response to their associated keywords--before one can rightfully expect the keyword method to be a substantial facilitator of students' recall of state capitals.

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1. Pressley, M., Levin, J. R., & Delaney, H. D. The mnemonic keyword method (Theoretical Paper No. 92). Madison: Wisconsin Research and Development Center for Individualized Schooling, 1981.

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Footnotes

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[1]Attempts were made to obtain permission to reproduce an example of Lucas's (1978) materials here (however, without success).

[2]Five additional fifth graders were tested but their data were not included. Two were absent on the second day of testing and three were designated by the teachers as having learning problems.

[3]Four additional children were tested but their data were not included. Two were absent on the second day of testing, one was designated as learning disabled by his teacher, and one indicated that he had already known all of the states and capitals prior to the experiment.

[4]As noted earlier, the partial recall measure also included other (nonkeyword) syllables, but these did not occur in the keyword condition.

Table 1

Mean Performance, By Condition[a]

(Experiment 1)

Measure	Condition			
	Simple Keyword-3	Simple Keyword-1	Complex Keyword-1	Control
Percent Immediate Recall	69.4	62.3	54.3	61.3
Percent Delayed Recall	69.7	62.8	49.3	54.0
Percent Retained	102.5	101.5	89.4	84.6

[a]Adjusted for grade level effects

Table 2

Mean Performance, By Condition

(Experiment 2)

Measure	Condition		
	Simple Keyword-3	Complex Keyword-3	Control
Percent Immediate Recall	66.1	43.2	47.0
Percent Delayed Recall	52.1	36.8	39.8
Percent Retained	76.4[a]	82.4[a]	82.5[a]

[a]Excludes one subject who got none correct on the immediate test

Figure Caption

Figure 1. Example of the Levin et al. (1980) materials.

MARYLAND → marry

Annapolis → apple