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ABSTRACT

A study examined the efficacy of the keyword method of vocabulary instruction by comparing it with five methods designed to increase semantic processing of the definitions of the vocabulary words. Subjects in all five experiments were college students. In the first three experiments, recall of the definitions from the vocabulary words was the critical dependent measure, with the keyword method producing greater learning than any of the semantic-based or control conditions. Also, none of the semantic-based conditions facilitated definition recall, relative to a no-strategy control condition. In the fourth and fifth experiments, the keyword method, two semantic strategies, and the no-strategy control procedure were compared with respect to associative- and response-learning components of vocabulary learning. Results indicated the keyword method enhanced vocabulary/definition (associative) learning, but not definition (response) learning per se. In contrast, the semantic conditions tended to increase nonassociative learning of the definitions. The results support the case that the keyword method is a vocabulary-learning procedure superior to the semantic-based strategies advocated by reading theorists. (HOD)

Working Paper No. 312

MNEMONIC VERSUS NONMNEMONIC VOCABULARY-LEARNING STRATEGIES: PUTTING "DEPTH" TO REST

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Abstract

The keyword method of vocabulary learning was compared with five methods designed to increase semantic processing of the definitions of the vocabulary words. In Exps. 1-3, recall of the definitions from the vocabulary words was the critical dependent measure, with the keyword method producing greater learning than in any of the semantic-based or control conditions. Also, none of the semantic-based conditions facilitated definition recall, relative to a no-strategy control condition. In Exps. 4 and 5, the keyword method, two semantic strategies, and the no-strategy control procedure were compared with respect to associative- and response-learning components of vocabulary learning. The keyword method enhanced vocabulary/definition (associative) learning, but not definition (response) learning per se. In contrast, the semantic conditions tended to increase nonassociative learning of the definitions. These results bolster the case that the keyword method is a vocabulary-learning procedure superior to semantic-based strategies of the kind advocated by reading theorists.

Mnemonic Versus Nonmnemonic Vocabulary-Learning Strategies: Putting "Depth" to Rest

The keyword method (Atkinson, 1975) is a two-stage procedure for improving one's memory for materials that have an associative component. In the case of vocabulary learning, the learner must first acquire a stable association between the unfamiliar vocabulary item and a familiar English word that sounds like a salient part of the to-be-learned item. This acoustically similar word is the keyword. In the second stage, the learner encodes a meaningful interaction between the keyword and the vocabulary word's definition. Thus, for example, to remember that carlin means old woman, a subject might use the keyword car and imagine an old woman driving a car. In a number of recent studies, subjects using the keyword method have been better able to recall the definitions of vocabulary words than have subjects in two types of control conditions. In no-strategy control conditions, subjects have been left to their own devices to learn the vocabulary words. In repetition control conditions, subjects have been instructed to say the words and their meanings over and over to themselves. (See Pressley, Levin, & Delaney, Note 1, for a review of relevant research.)

An important question arising from such research, however, is whether or not the keyword method would prove as effective if comparisons were made with procedures designed to increase the processing of the meanings of the vocabulary words, instead of comparing the method to the traditional control procedures. Most notably, Johnson (Note 2; Johnson & Adams, Note 3) has reported several experiments in which keyword-like mnemonic strategies did not increase vocabulary learning beyond that observed in two semantic strategy conditions.[1] In those two conditions, subjects either created internal

visual images of the definition referents alone, or they paraphrased the definitions of the vocabulary words. In another condition designed to minimize semantic processing of the words and their meanings, subjects read and copied the words and their definitions. It was only in comparison to this last condition--a form of repetition control--that the keyword method proved more successful.

Exp. 1 reported here was conducted in response to Johnson's (Note 2; Johnson & Adams, Note 3) research, in that the Johnson studies cannot be considered conclusive for several reasons. In particular, interpretive problems arise from a massive reported failure of subjects to adhere to strategy instructions, apparent ceiling effects, and the use of "keyword" strategies that differ from those used in previous studies. Also, because Johnson did not include a no-strategy control condition, one cannot make statements about absolute levels of strategy facilitation.

There are other grounds on which to doubt that semantic-processing strategies are as effective as the keyword method for vocabulary learning. First, in two recent studies of our own--one with children and one with adults--the keyword method was compared with a limited set of semantic-based alternatives, wherein subjects were required to process meaningful sentences that included the vocabulary items. The keyword method was clearly superior to these semantic-contextual procedures (Levin, McCormick, Miller, Berry, & Pressley, in press; Pressley, Levin, & Miller, in press).

Second, there is really no good theoretical reason--apart, perhaps, from increased time and attention--why such semantic-based alternatives should be facilitative in a vocabulary-learning context, relative to no-strategy control instructions. Most of the research documenting the efficacy of semantic-processing

strategies has been concerned with memory for individual items, as in free recall and recognition of nouns, usually in an incidental-learning paradigm (e.g., Craik & Tulving, 1975; Hyde & Jenkins, 1969; McDaniel & Masson, 1977; Nelson & Vining, 1977). Vocabulary learning, in contrast, is an intentional associative-learning task, in which connections must be formed between new, unfamiliar terms and their definitions. "Deeper" (Craik & Lockhart, 1972) processing of the meanings of the to-be-learned vocabulary words might well enhance subjects' recall or recognition of individual item definitions. However, because such processing does not operate on the vocabulary word/definition link per se, there is no theoretically compelling reason to predict enhanced associative recall (i.e., recall of definitions when cued with the vocabulary items). In order for a memory strategy to work in an associative situation, there must be a direct route from the cues provided at testing back to the to-be-recalled information (Baddeley, 1976). Because semantic strategies of the kind proposed by Johnson (Note 2) focus primarily on the definitions, they do not provide a direct route. In contrast, the keyword method does provide linkages from the vocabulary word to the definition and, thus, should produce enhanced associative recall of definitions. That is, when cued with the vocabulary word, the learner has a direct mnemonic route (via the keyword interaction) leading to the appropriate meaning. The experiments reported here compare the keyword method with a number of semantic-based strategies.

Experiment 1

Experiment 1 included conditions in which subjects were instructed either to use an imagery or a sentence version of the keyword method (Keyword Imagery and Keyword Sentence, respectively). In addition, three conditions were

designed to capture the spirit of Johnson's (Note 2) semantic-processing conditions. In the Imagery condition, the subjects were instructed to construct an image of the meaning referent. In the Synonym condition, subjects were instructed to think of a synonym for each of the vocabulary words. A Read and Copy condition was also included, as was a No-Strategy Control condition.

Method

Subjects. The participants were 108 students (all native Anglophones) enrolled in introductory psychology at the University of Western Ontario. Eighteen subjects were randomly assigned to each of the six experimental conditions.

Materials. Each subject was asked to learn a list of 30 one- and two-syllable low frequency English nouns. The items were selected using the double criteria that university-level students would not likely know the meanings of the words, and that it was possible to generate a concrete keyword for some part of each of the vocabulary words (see Pressley, Levin, & Miller, 1981). Examples of the vocabulary words are: gemsbok (keyword = gem), meaning antelope; windling (wind), meaning wheat; and manchet (man), meaning bread. While being instructed in vocabulary learning, all subjects were exposed to two sample words, carlin (car), meaning woman; and poteen (pot), meaning whiskey.[2]

All vocabulary items were typed in capital letters on 5" x 7" (12.7 x 17.8 cm) white cards, one vocabulary word to a card. Reading from left to right, each card had a word and its definition printed on the same line in the middle of the card. For subjects in the two keyword conditions, the keyword portion of the vocabulary word was underlined.

Procedure. All subjects were seen individually in a quiet room at the university. Immediately after subjects entered the laboratory room, they were instructed that they were going to be presented some vocabulary words to learn, and that they should closely follow the directions that would be given to them.

Keyword Imagery subjects were instructed to use the imagery-based keyword method to learn the sample vocabulary words. Thus, as they were shown the vocabulary word carlin, they were told that the way to remember that carlin means woman is first to note that part of carlin sounds like the English word car (the car syllable was underlined on the card). They were further instructed to make up an interactive picture in their heads of a car and a woman doing something together, and were then asked what their picture was like. The experimenter then informed the subject that he had formed a picture of a woman driving a car, but assured the subject that any interactive image involving a car and a woman was fine. The experimenter then repeated the above outlined sequence for the second sample word, poteen. After the presentation of the method using the sample words, subjects were instructed to use the imagery version of the keyword method to learn all of the vocabulary words that they were subsequently presented.

Subjects in the Keyword Sentence condition received the same instructions as Keyword Imagery subjects, except that they were instructed to create meaningful sentences instead of interactive images.

Imagery subjects were told to picture the vocabulary referent in their heads. Thus, to remember carlin, subjects were instructed to picture a woman in their heads, and were given practice at doing this. The sequence was repeated for poteen. As in all of the other conditions, the subjects were instructed to use the strategy for all the items that they would be presented.

Subjects in the Synonym condition were instructed to think of a synonym for each vocabulary word as it was presented. Thus, as they were shown carlin and its meaning, they were asked to provide a synonym to the experimenter (e.g., lady). This sequence was repeated for poteen.

Read and Copy subjects were instructed to write down each vocabulary word ar its meaning on 5" x 7" (12.7 x 17.8 cm) white cards that were provided. After writing the vocabulary item down, subjects flipped the card over as a new item was presented. Subjects practiced doing this using the sample items.

No-Strategy Control subjects were simply instructed to try hard to remember the meanings of all the words that were presented, and they were given practice doing this with the sample words.

Immediately after subjects were instructed in strategy usage, they were given a practice quiz on their memories for the meanings of the sample words. Thus, subjects were asked to recall the meaning of poteen and then carlin. After the practice quiz, all subjects were again instructed that they would be given a number of vocabulary words to learn, and they were reminded to use the strategy appropriate to their condition.

The vocabulary words were presented at a rate of one word every ten secs. The experimenter silently displayed each vocabulary word, and flipped the card to a new word after 10 secs. The words were presented in a different random order to each subject, determined by shuffling the deck prior to the subject's participation. After the sixth vocabulary word w esented, subjects were again briefly reminded to use the strategy for thei dition. For example, Keyword Imagery subjects were reminded to make up a picture in their heads--relating the keyword to the definition--for each item presented. Synonym

subjects were told to think of a synonym for each vocabulary word presented. Ten secs were allotted to this reminder in each condition.

Immediately after the last vocabulary word was presented for 10 secs, the subjects were administered the vocabulary test. The test consisted of a printed list of the 30 vocabulary words, with a space provided for each word where the subject was to write the definition. The words were presented in the same random order to each subject.

After each subject completed the definition recall test, the experimenter asked several questions in order to determine whether the subject attempted to execute the instructed strategy, what proportion of the time the subject was successful in executing the strategy, and whether nonkeyword condition subjects engaged in keyword-like strategies. Subjects in all conditions except the control condition were first asked to estimate how many items they attempted to study with the assigned strategy. For example, Imagery subjects were asked, "For how many of the vocabulary words did you <u>try</u> to get a picture of the meaning in your head?" Then, subjects were asked to estimate the number of vocabulary words for which they succeeded in generating the instructed type of mediators. Thus, Imagery subjects were asked, "For how many of the words did you actually succeed in getting a picture in your head of what the word meant?" Subjects in all conditions except the two keyword conditions were also asked to estimate the number of items for which they spontaneously created keyword-like mediators. The imagery and sentence keyword strategies were both described to the subjects at this point, and they were asked if they ever generated such mediators during the vocabulary task and, if so, for how many of the words. The experimenter asked the subject for examples of these mediators from subjects who claimed to have used them.

Results and Discussion

Subjects' responses were counted correct if they were either verbatim or synonym definitions. Mean percent correct, by condition, was as follows: Keyword Imagery, 48.9%; Keyword Sentence, 55.0%; Imagery, 23.1%; Synonym, 20.9%; Read and Copy, 24.1%; and No-Strategy Control, 28.9%. The mean square error was 330.31, based on 102 degrees of freedom; and all 15 pairwise comparisons involving the means were evaluated using $\alpha = .01$ for each.

The statistical results are easy to describe. The two keyword conditions were comparable in effectiveness, each differing from all other nonkeyword conditions, all ts > 3.29, ps < .005; but not from one another, $t = 1.01$, $p > .20$. No differences among the four nonkeyword conditions were detected, all ts < 1.32, ps > .10.

The supplementary post-learning interview data were most informative, and consistent from one experiment to the next. Discussion of them will be postponed, however, until the main results of all experiments have been presented.

The most prominent aspect of the Exp. 1 results was that vocabulary learning in none of the comparison conditions approached that in either of the keyword conditions. Percent facilitation ranged from 69% (Keyword Imagery vs. No-Strategy Control) to 163% (Keyword Sentence vs. Synonym). Nonetheless, only a small number of semantic-based alternatives was represented here and in other keyword experiments conducted to date (Levin et al., in press; Pressley et al., in press). Accordingly, in Exps. 2 and 3 additional nonkeyword vocabulary-learning strategies were considered.

Experiment 2

In recent years, Rogers, Kuiper and their colleagues have investigated a type of semantic strategy that is especially powerful relative to semantic

strategies included in traditional depth-of-processing studies. An experiment that well illustrates the research techniques of these investigators, and the kind of results typically obtained in these experiments, was that of Rogers, Kuiper, & Kirker (1977, Exp. 1). University subjects were presented a list of 40 trait adjectives, and for each adjective they answered one of four questions: (1) whether the adjective was typed in letters larger than the letters the question was typed in; (2) whether the adjective rhymed with another word that was included in the question (i.e., "Rhymes with _____?"); (3) whether the adjective meant the same thing as a word provided in the question (i.e., "Means same as _____?"); or (4) whether the adjective described the subject him- or herself. Each of the four questions accompanied 10 of 40 adjectives, with adjective-question matchings counterbalanced across subjects. After the entire list of 40 adjectives was presented, the subjects were given an unexpected recall task in which they were to write down all of the adjectives that they could remember. As in other depth-of-processing research, recall of adjectives in the semantic-processing task (Task 3 above) was higher than for the two tasks that focused attention on the physical features of the adjectives (Tasks 1 and 2). However, adjective recall in the self-referent task (Task 4) was the highest of all.

To date, Rogers and Kuiper have presented a large volume of data confirming that self-referent processing produces greater incidental recall of information than do activities in which subjects process the items either with respect to other people (i.e., "Is Person X described by the adjective?") or with respect to a variety of other meaning-orienting activities. Self-reference is hypothesized to be so effective because an individual's concept of self is a rich semantic structure. When subjects are asked to perform a task that makes contact with the self, semantic embellishment occurs due

to the richness of self knowledge, relative to knowledge about other people and aspects of the world.

Because of the apparent power of self-referent techniques in incidental item-learning paradigms, it seemed prudent to investigate their potential in a vocabulary-learning context as well. Moreover, based on the same self-referent literature, it could be argued that adding a self-referent component to the traditional keyword method would make an already effective vocabulary-learning strategy even more effective. In Exp. 2, both of these possibilities were explored.

In addition to the Keyword Imagery, Imagery, and No-Strategy Control conditions of Exp. 1, Exp. 2 included two imagery self-referent conditions. In one, subjects were asked to imagine an exemplar of the meaning referent with which they were personally familiar. In the other condition they were asked to imagine themselves interacting with the meaning referent, again including an exemplar of the referent with which they were familiar. The experiment also included two imagery keyword conditions that incorporated self-referent components. In one condition, subjects were instructed to think of an interaction between the keyword and definition referents that was personally meaningful to them. In the other, they were instructed to construct an interactive image involving the keyword and definition referents, as well as themselves.

Method

Subjects. The participants were 112 students enrolled in the same introductory course that supplied subjects for the previous experiment. Sixteen subjects were randomly assigned to each of the seven experimental conditions.

Materials. The materials were identical to those used in Exp. 1, except that the item drugget (meaning rug) was deleted because it was discovered during the course of Exp. 1 that the vocabulary word actually contained the meaning. As a result, the item was very easy to remember.

Procedure. The procedures in the Keyword Imagery, Imagery, and No-Strategy Control conditions were identical to the corresponding conditions of Exp. 1.

In the Keyword Imagery Familiar condition, the subjects were given instructions identical to those in the Keyword Imagery condition, except that they were instructed that their images were to contain the keyword interacting with a personally familiar instance of the definition. The subjects were told that the interaction should involve familiar objects and events that could plausibly be encountered in their lives. Thus, for the sample item carlin (woman), the experimenter reported that he thought of an image of his secretary in her car. For poteen (whiskey), he imagined a pot full of his favorite whiskey--Jack Daniels--at a party.

In the Keyword Imagery Self condition, the directions were identical to those just given, except that the subject was to include him- or herself in the imagined scene. Thus, for carlin the experimenter told the subject that he thought of an image of himself giving a push to his secretary in her car when it would not start. For poteen, the experimenter described an image of the experimenter pouring a bottle of Jack Daniels, his favorite whiskey, into a pot at a party he attended a few years ago.

In the Imagery Familiar condition, the directions were the same as in the Imagery condition, except that the exemplars of the to-be-imagined definition referents were supposed to be ones that were personally familiar

to the subject. Thus, the experimenter reported imagining a picture of his secretary for carlin and a bottle of Jack Daniels for poteen.

In the Imagery Self condition, the instructions were identical to those just given, except that the subject was instructed to imagine him- or herself interacting with a familiar instance of the definition. Thus, for carlin, the experimenter described an image of himself talking to his secretary. For poteen, the experimenter described an image of himself drinking some Jack Daniels, his favorite whiskey.

Results and Discussion

Mean percent correct, by condition, was as follows: Keyword Imagery, 63.4%, Keyword Imagery Familiar, 63.4%; Keyword Imagery Self, 47.6%; Imagery, 33.8%; Imagery Familiar 23.7%; Imagery Self, 23.7%; and No-Strategy Control, 35.3%. The mean square error was 333.94, based on 105 degrees of freedom. Fifteen of the 21 possible pairwise comparisons involving the means were evaluated, using $\alpha = .01$ for each, as will now be described.

As can be seen from the above means, performance in the Keyword Imagery and Keyword Imagery Familiar conditions was identical. The level of performance attained in each of those conditions exceeded that in its corresponding nonkeyword imagery condition, as well as in the control condition, all ts > 4.33, ps $< .001$. Apparently, adding oneself to a keyword image complicated the process, resulting in a nonsignificant Keyword Imagery Self vs. No-Strategy Control difference, $t = 1.90$, $p > .05$. Performance in the Keyword Imagery Self conditions also appears to be lower than that in the two other keyword conditions, although it was not significant at the chosen α level of .01, both ts $= -2.43$, $.01 < p < .05$. Despite their relatively poorer performance, however, Keyword Imagery Self subjects significantly outperformed their nonkeyword

Imagery Self counterparts, $t = 3.70$, $p < .001$. Finally, no significant differences among the three nonkeyword imagery conditions were detected, all $|t|$s < 1.58, ps $> .10$.

In summary, generating images of the definition referents per se did not enhance vocabulary learning in Exp. 2, even if the subjects were instructed to generate images that were personally meaningful to them. Moreover, constructing meaningful imaginal interactions per se was not enough to enhance learning, in that Imagery Self subjects did just that. Only when subjects constructed images involving both the keywords and the definitions did performance improve over that obtained in the control condition. In short, mnemonically effective vocabulary-learning images have very specific characteristics. The image must contain a link between the definition and the vocabulary word, and the keyword method is the only one of the alternatives explored in Exp. 2 that contained such a link.

It is also notable in this experiment that the effects of the keyword method were not improved upon by "personalizing" the interactions, either by instructing the subjects to apply the keyword method to familiar exemplars or by instructing the subjects to add themselves to the familiar interaction. Indeed, the Keyword Imagery Self instructions produced a lower level of recall than did the two other keyword instructions (albeit, not significantly lower at the a priori determined α level).[3]

The failure in Exp. 2 to augment the memory increment produced by a simple interactive image is consistent with the results of other recent experiments on semantic supplements to mnemonic procedures. For instance, Bellezza, Cheesman, and Reddy (1977) showed that once a list of items was organized into a story mnemonic, additional semantic processing of either

the individual items or the mnemonic elements (i.e., the sentences of the story that comprised the memory aid) did not enhance recall further. Also, Pressley and Bryant (Note 5) reported that supplementing interactions by having subjects answer questions about the interactive relationship did not enhance mnemonic effects with children who were presented the task of associating paired nouns. Thus, when the results of the present Exp. 2 are combined with those of Bellezza et al. (1977) and Pressley and Bryant (Note 5), there is consistent evidence that naturalistic semantic supplements do not appear to increase the potency of mnemonic techniques--at least not the particular semantic supplements that have been tested to date.

Thus far in this study, a number of different semantic-processing strategies have been compared with the mnemonic keyword method. All of these were inspired by other laboratory-based research. In contrast, in Exp. 3 the keyword method was compared with a condition in which the vocabulary words were accompanied by the types of semantic supplements that have been recommended by curriculum theorists for improving vocabulary learning in the course of actual classroom instruction.

Experiment 3

If one peruses current methods textbooks on vocabulary learning (e.g., Johnson & Pearson, 1978), one will uncover an impressive variety of procedures that are recommended for use during vocabulary instruction. Unfortunately, very few of the proposed techniques have ever been subjected to empirical scrutiny (Dale & Reichart, 1957; O'Rourke, 1974). The question of interest here is whether these recommended semantic strategies (based principally on providing the learner with contextual elaborations of the vocabulary word) are, in fact, more effective than the mnemonic keyword method.

To date, two studies (Levin et al., in press; Pressley et al., in press) have compared keyword effects with those produced by the vocabulary-building strategies recommended by reading theorists. Pressley et al. presented college students with vocabulary items and their definitions, in the company of one of the following supplements: 1) meaningful sentences that included the vocabulary items; 2) sentences that contained either correct or incorrect usages of the vocabulary items, with subjects assigned the task of deciding on the correctness of usage; 3) directions to generate meaningful sentences containing the vocabulary words; 4) directions to use the keyword method; and 5) simple try-hard-to-remember-the-items (control) instructions. Even though the first three of these supplements were based on procedures recommended in the reading literature as methods for facilitating vocabulary learning, none of them led to better learning than what was obtained in the control condition. Moreover, performance in all of these conditions was well below that in the keyword condition. In the Levin et al. (in press) study, elementary school-aged children did not benefit from a semantic-contextual vocabulary-learning procedure, whereas they benefited greatly from an application of the keyword method. Thus, the two studies cited here provide evidence that the keyword method fares well against at least some techniques held in high regard by reading theorists.[4]

One potential criticism of the Pressley et al. (in press) and Levin et al. (in press) studies is that subjects in the semantic context conditions were exposed to only one adjunct when, in fact, exposure to multiple adjuncts has been recommended (see, for example, Johnson & Pearson, 1978). Exp. 3 was designed to address that criticism, as well as to provide an additional comparison of the keyword method with semantic-based vocabulary learning procedures.

In Exp. 3, the vocabulary learning of Keyword Imagery subjects was compared to that of subjects presented the vocabulary words along with a variety of adjunct materials, all of which are recommended as useful vocabulary-learning supplements by reading theorists (see Johnson & Pearson, 1978). In particular, subjects in this Multiple Context condition were shown words related to the vocabulary words, more specific definitions of the items, sentences containing the vocabulary words, and depictions of the meanings of the vocabulary words. This experiment was considered an especially challenging test for the keyword method, in that Multiple Context subjects were provided with four different kinds of semantic adjuncts, each of which has been assumed to increase vocabulary learning in a classroom instructional context.

Method

Subjects. The participants were 34 students from the same subject pool that provided subjects for the previous experiments. Seventeen subjects were randomly assigned to each of the two experimental conditions.

Materials. The same 29 vocabulary words used in Exp. 2 were employed in Exp. 3. Keyword Imagery subjects were exposed to the same materials that were used in Exps. 1 and 2. Multiple Context subjects were presented the vocabulary words on cards that contained the following information. The word and its meaning were typed in capital letters on the top line of the card. The second line was labeled RELATED WORDS. To the right of that phrase were typed one to four familiar words that were close in meaning to the vocabulary word. For example, the related words for cordite (meaning explosive) were gunpowder and dynamite. and the related words for ratine (meaning fabric) were cloth, textile, and material. The next line was labeled MORE SPECIFIC, ELABORATED MEANING. To the right of this label, an

expanded (3 - 9 word), more precise meaning of the word was printed [e.g., a fishing boat for dogger (meaning boat)]. The next line was labeled SENTENCE USING THE WORD. To the right of this line was typed a contextually appropriate sentence containing the vocabulary word. For example, for claymore (meaning sword), the accompanying sentence was, "The claymore sparkled in the sun as the man showed his skill in fencing." Finally, on the lower half of each page was a colored line drawing of the definition referent (i.e., a sword for claymore, a boat for dogger, cloth for ratine, etc.).

Procedure. The procedures in the Keyword Imagery condition were identical to those in the same condition in the previously discussed experiments.

The Multiple Context subjects were instructed that to remember the meanings of the to-be-presented vocabulary words, the subjects should:

> ...read this card that has listed out words that are related to _____. Also, a more specific definition of the word is given on the card and a sentence using the word is put on the card. You should read all of the information on the card and look at the picture of the _____ that is put on the bottom of the card.

The subjects were given practice doing this (using the sample words poteen and carlin) and were then quizzed on the meanings of the sample words, as in the Keyword Imagery condition. Just before the presentation of the words, Multiple Context subjects were once again reminded to read the contents of each card as it was presented. The items were presented at a 10-sec rate which, based on pilot testing, proved to be a more-than-adequate exposure interval.

No post-learning interview data were collected in this experiment.

Results

Keyword Imagery subjects recalled a substantially higher percentage of the definitions, in comparison to Multiple Context subjects (means of 62.1%

vs 28.0% respectively, $t(32) = 6.36$, $p < .001$). Thus, the keyword method proved to be more potent than the simultaneous provision of a number of verbal supplements that are widely assumed to be helpful in vocabulary acquisition.

Summary of Experiments 1-3

The results of the first three experiments were unequivocal. The keyword method produced greater learning of the definitions than did any of the procedures with which it was contrasted. Indeed, none of the comparisons between the nonkeyword semantic-processing procedures and the control condition produced a significant definition recall difference. The sum total of this evidence is that semantically based vocabulary-learning procedures that focus only on the definition of a vocabulary item do not appear to be useful for enhancing the critical association between the vocabulary word and its definition.

The results of the first three experiments clearly permit such a conclusion, at least with respect to associative recall. At the same time, vocabulary learning (as an exemplar of paired-associate learning) consists of a number of components (see Pressley, Levin, Hall, Miller, & Berry, 1980). It is therefore possible that the semantic-processing strategies of the first three experiments affected certain components, but not the ones critical to the cued recall of the definitions from the vocabulary words. This possibility was explored in Exps. 4 and 5. Additional discussion of the general significance of the first three experiments will be deferred until after the presentation of the data of Exps. 4 and 5.

Experiments 4 and 5

As mentioned in the preceding paragraph, paired-associate learning can be conceptualized as consisting of a number of components. The two that will be distinguished here are associative learning and response learning (e.g.,

Brainerd, Howe, & Desrochers, 1981; Underwood & Schulz, 1960). With reference to the vocabulary-learning paradigm, response learning would consist of learning the definitions per se. The associative-learning component would be the learning of the link between the vocabulary words and the definitions.

Earlier work by Kee and Rohwer (1974) and others has established that the effects of mnemonic mediators during simple noun-pair learning are confined to the associative-learning component. In the Kee and Rohwer study, subjects were better able to match stimuli with their responses (a measure of the pure associative component) following exposure to mnemonic mediators, but response learning independent of the associative component (measured by free recall of the stimuli and responses) was not affected by the provision of mediators.

Exp. 4 included four of the conditions of Exp. 1 (Keyword Imagery, Imagery, Synonym, and No-Strategy Control). However, instead of recalling definitions in response to vocabulary items, subjects were provided all of the vocabulary words and definitions at testing and were required to match them. It was anticipated that on this measure of associative learning, Keyword Imagery subjects would outperform subjects in all other conditions, in that in contrast to subjects' activity in the other conditions, that of keyword subjects was directed explicitly at the association between the vocabulary word and its definition. If this were the result, it would extend Kee and Rohwer's (1974) finding with respect to simple elaborations of noun pairs to the more complex case of keyword method usage with new vocabulary words.

The Keyword-Imagery, Imagery, Synonym, and No-Strategy Control conditions were also included in Exp. 5. In that experiment, however, two measures of response learning were taken. The first measure simply required the subjects to recall the definitions that were provided on the study list. That is, subjects were told to recall as many of the definitions as they could,

without the presentation of the vocabulary words as cues. Because both Imagery and Synonym subjects had carried out activities designed to increase processing of the definitions, it was anticipated that subjects in those conditions might recall more of the definitions than would subjects in the control condition. Exactly how Keyword Imagery subjects would fare, relative to subjects in the other conditions, was of particular interest. Regardless of the level of recall in the keyword condition, however, it was expected that a prevalent type of error in that condition would be recall of keywords in place of definitions. This was expected because keyword subjects actively process the keyword syllables, and in a way very similar to the way in which the definitions are processed (i.e., both keyword and definition referents are included in the interactive image).

The second measure of response learning taken in Exp. 5 was a recognition test that required subjects to distinguish definitions that were presented from keyword portions of the vocabulary words. Such a task presumably taps, in particular, keyword subjects' ability to discriminate the concepts for which they have previously acquired new vocabulary items from the mnemonic aids associated with those vocabulary items.[5] Because all of the distractor items on this task were keywords (and therefore "old" only to keyword subjects), it was expected that keyword subjects would experience the greatest discrimination difficulty (see, for example, Ghatala & Levin, 1976). At the same time, it was possible that on this alternative response-learning measure, the performance of subjects in the two nonkeyword semantic-processing conditions would again surpass that of control subjects.

Thus, in summary, the expectations were that any facilitation exhibited by Imagery and Synonym subjects would be restricted to response learning

(Exp. 5)--and would not be evidenced in associative learning (Exp. 4). In contrast, Keyword Imagery subjects were expected to display superior associative learning (Exp. 4), though not superior response learning (Exp. 5) as a result of the additional difficulty created by having to discriminate definitions from previously processed keywords.

Method

Subjects. Two groups of 72 subjects enrolled in introductory psychology at the University of Western Ontario served as subjects in these experiments. In each experiment, 18 subjects were randomly assigned to each of the four experimental conditions.

Materials and procedure. Exps. 4 and 5 included the Keyword Imagery, Imagery, Synonym, and No-Strategy Control conditions of Exp. 1. The procedures in these conditions were identical to those of Exp. 1, except for the changes in dependent measures. In this regard, it is important to note that subjects were led to believe that they would be tested for associative recall of definitions. The 29 vocabulary words presented in Exps. 2 and 3 were the to-be-learned words in both experiments.

Following study of the vocabulary items and their definitions, testing proceeded as follows. In Exp. 4, subjects were given a matching task, in which the vocabulary words and definitions both appeared in alphabetical order in separate columns. Subjects were required to place the number corresponding to each definition in the blank space accompanying each vocabulary item.

Subjects in Exp. 5 were given a blank piece of paper on which they were to write down as many of the definitions as they could recall. They were given 4 mins to do this. Then, the subjects were given a three-column list of 58 words in alphabetical order. Half of the words ("targets") were the

definitions of the vocabulary items in the study, and the other half ("distractors") were the keywords for these items. The subjects were told to circle the definitions that had appeared in the study list.

Results

In both experiments, all pairwise comparisons among the four conditions were examined for the dependent variables of interest, using $\alpha = .01$ per comparison.

Vocabulary-definition matching. In Exp. 4, the number of correct vocabulary-definition matches was determined for each subject. The mean percentage correct, by condition, is presented in Table 1. Statistical analysis of these data revealed that Keyword Imagery subjects outperformed

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Insert Table 1 about here

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subjects in each of the other conditions, all ts > 3.21, ps < .01. In addition, the mean performance in the Synonym condition was statistically lower than that in both the Imagery condition, $t = -3.66$, $p < .001$, and the No-Strategy Control condition, $t = -2.97$, $p < .01$. Performance in the latter two conditions did not differ significantly, $|t| < 1$.

Definition recall. In Exp. 5, subjects' protocols were scored for the number of definitions that were free recalled. The mean percentages, by experimental condition are presented in Table 1. None of the comparisons between conditions resulted in a significant difference at the chosen α level, although the mean performance of Imagery subjects surpassed that of both Keyword Imagery and Synonym subjects at $p < .02$, as well as that of control subjects at $p < .05$. All other comparisons had associated $|t|$s < 1. Subjects

in the Keyword Imagery condition exhibited far more keyword intrusions (37, out of 51 overt errors) than were exhibited in all three nonkeyword conditions combined (7, out of 32 overt errors).

Definition recognition. The raw recognition data are summarized in Table 5 as percent "hits" (correct recognitions of definition targets) minus percent "false alarms" (incorrect recognitions of keyword distractors). Analyses were performed on the difference between standardized hit and false alarm scores, or $\underline{d} = \underline{z}_{H} - \underline{z}_{FA}$ (Baird & Noma, 1978). In these analyses, separate standardizations were performed across only those subjects in the two particular groups being compared.

Keyword Imagery subjects were statistically poorer at discriminating definitions from keywords, in comparison to subjects in all three other conditions, all $\underline{t}$s (34) > 3.77, $\underline{p}$s < .01. The mean recognition performance in the two semantic-processing conditions may be seen to be better than that in the control condition. Although the effect was statistically significant for the Synonym condition, $\underline{t}$ (34) = 3.03, $\underline{p}$ < .01, it was not significant at the chosen α level for the Imagery condition, $\underline{t}$ (34) = 1.92, $\underline{p}$ < .07. The difference in mean performance between the Synonym and Imagery conditions was statistically negligible, $|\underline{t}| < 1$.

Discussion

It is apparent from the results of Exps. 4 and 5 that the positive effects due to keyword method usage stem from certain subprocesses of vocabulary learning, and not from others. In Exp. 4, in which associative learning per se was measured, keyword subjects' performance was higher than performance in any of the other conditions. Notably, no positive associative-learning effects were produced by the two conditions designed to increase

meaningful processing of the definitions, with matching performance in the Synonym condition actually significantly lower than that in the No-Strategy Control condition.

The data of Exp. 5 were consistent with the position that the usual superiority of keyword subjects cannot be attributed to improved response learning per se. Such subjects were no better than nonkeyword subjects at free recalling the previously presented definition responses. As was seen from the nature of keyword subjects' errors--as well as from the statistically analyzed discrimination data--the previously presented keywords comprised a major source of difficulty for keyword subjects.

At the same time, there was some evidence in Exp. 5 that definition-response learning was enhanced by the two semantic-processing conditions. Though not always statistically significant at the chosen α level, mean performance on the two measures investigated favored the semantic-processing conditions, relative to the control. Moreover, subjects in the two semantic-processing conditions were substantially (and statistically) better than keyword subjects on the definition/keyword discrimination task.[6] Such results are in accord with what would be expected on the basis of the activity required by semantic-processing subjects. There is nothing in these directions that increases attention to the vocabulary-definition association. Rather, all of the subject's attention is focused on the definitions. Consequently, whatever positive effects are produced should be restricted to tasks involving recall or recognition of the definition responses, as in the original "levels of processing" paradigms (e.g., Craik & Tulving, 1975; Hyde & Jenkins, 1969).

In summary, the lack of facilitation observed among keyword subjects was restricted to tasks that are atypical of those thought to represent what it

means for one to "know" a word. One is rarely required to discriminate the meanings of words from keyword syllables, nor is one often required simply to output the definitions of recently learned vocabulary words. "Knowing" a vocabulary word almost always entails having acquired an association between the word and its meaning. The keyword method enhanced the learning of this component, whereas no such associative enhancement was observed in the Synonym and Imagery conditions. Interestingly, the present data suggest that the converse is also true, viz., enhanced learning of definition responses in the semantic-processing conditions, with no such enhancement (or even reduced performance) in the keyword condition.[7] The conclusions associated with the keyword method are consistent with those of Kee and Rohwer (1974), as applied to a component analysis of noun-pair mnemonics. The present data extend to the vocabulary-learning domain the notion that benefits of the keyword method can be traced to a strengthening of the association between the vocabulary word and its definition, and not to a general strengthening of the desired responses.

Discussion of Interview Data

Several aspects of the post-learning interview data are of interest, and will now be discussed. First, in contrast to Johnson's (Note 2; Johnson & Adams, Note 3) subjects, those in the present study were highly compliant.[8] Across all experiments, all but two subjects reported having attempted to apply their assigned strategy to learn the majority of vocabulary items on the list. Despite this high degree of instructional compliance, however, two points should be highlighted. First, consistent with Johnson's findings and those of other vocabulary-learning researchers (e.g., Fuentes, 1976), even subjects in the various nonkeyword conditions reported having attempted to

employ keyword-like strategies for at least some of the list's items. The percentage of spontaneous keyword users in the various nonkeyword conditions varied from 11% to 72%, with some of these subjects reporting having attempted such a strategy for only one or two items, and others for all or almost all of the list items. (Across all nonkeyword subjects who reported having used a keyword-like strategy, the mean percentage of items for which the strategy was reported was 31%.)

Second, the present interview data make it quite apparent that attempting to employ a learning strategy is not at all synonymous with succeeding at employing a learning strategy. In this latter regard, even though virtually all subjects here reported having faithfully adhered to the strategy assigned to their condition, the interview data also revealed that across all subjects and all conditions (excluding the Read and Copy condition of Exp. 1), strategies could be successfully executed for only about 80% of the items attempted. This figure varied greatly across subjects, and slightly from keyword to nonkeyword conditions. Interestingly, keyword subjects reported being slightly more successful at executing their strategy (about 83% successes) than were nonkeyword subjects at executing theirs (about 78%), which argues against the notion that a keyword vocabulary-learning strategy is more difficult and impractical to employ, relative to alternative vocabulary-learning procedures.

The interview data representing subjects' estimated number of successful strategy executions can be correlated with their vocabulary-learning performance data to paint a picture remarkably consistent with the main findings. Across experiments in which interview data were collected (Exps. 1, 2, 4, and 5), within the keyword conditions much greater positive correlations were observed in those experiments tapping associative learning (median r = .48) than in Exp. 5

where only response learning was tapped (median r = .27). Exactly the reverse was observed within the nonkeyword strategy conditions, where larger correlations were observed for the response-learning measures of Exp. 5 (median r = .31) than in the associative-learning experiments (median r = .05). In the no-strategy control condition, reported use of spontaneous mnemonic strategies correlated positively with associative learning (median r = .43), but not with response learning (median r = -.31).

An important feature of such data is that they provide within-condition evidence that is consonant with the pattern of between-condition mean differences. Even though the interview data were based on crude estimates of the number of list items for which a given strategy was successful, they nonetheless possess valuable convergent and discriminant validity. That is, reported use of menmonic strategies better predicted performance on associative-learning tasks, whereas reported use of semantic strategies better predicted performance on response-learning tasks. A straight "demand characteristics" explanation of the interview data cannot adequately account for such results unless one is willing to make the implausible assumption that in Exps. 1, 2, and 4 subjects knew that they should report having frequently used a mnemonic strategy if they got many items correct, and that in Exp. 5 they should report not having frequently used a mnemonic strategy if they got many items correct!

Finally, these data suggest that subjects in the present study were reliably monitoring their processing behavior, inasmuch as the later reported metacognitions were valid predictors of their learning performance. Such findings blend nicely with those of researchers who have investigated the connections between the reported extent and sophistication of strategy usage and level of learning performance (e.g., Pressley, in press; Beuhring, Note 9).

General Discussion

When the results of previous research are considered, an overwhelming case can be made that the mnemonic keyword method is a superior vocabulary-learning strategy. This statement is true for learners from at least age 3 into adulthood, and for a wide variety of languages and other curriculum content (see Pressley et al., Note 1). In short, with few exceptions, strong claims can be made about the general utility of the keyword method.

As was pointed out in the introduction, there has been very little previous research in which the keyword method has been compared to anything except repetition control and no-strategy control conditions. The data presented here help to remedy the situation. Moreover, the results of these experiments bolster the case for the keyword method. The method proved superior to every alternative considered in this article when the provision of definitions in response to vocabulary words was the dependent variable. A residual product of these comparisons was the finding that none of the alternative procedures produced associative learning superior to no-strategy control instructions. A clear message emerges from this finding for reading researchers and practitioners: The procedures that are currently being recommended for instruction should be re-examined in controlled experiments to determine which ones really do work.

The results of the present study also provide a sobering reminder for keyword method enthusiasts. The technique is not a learning panacea. It does not positively affect all aspects of vocabulary learning. In Exp. 5, nonkeyword users were less likely than keyword subjects to confuse the keyword portions of the vocabulary words with the definitions. Such results can now be added to those of previous studies in which the keyword method has

failed to enhance other aspects of vocabulary learning. For instance, Pressley, Levin, Nakamura, Hope, Bispo, and Toye (1980) found no evidence that use of the keyword method improves the spelling of new vocabulary words. In addition, it does not improve recall of vocabulary words from their definitions ("backward" recall) unless subjects already have the vocabulary words well integrated in memory (Pressley & Levin, 1981). There is also evidence that the keyword method does not improve pronunciation of vocabulary words (Fuentes, 1976).

When the entire pattern of keyword successes and failures is considered, there is a considerable data base to add to the backward-recall contentions made by Pressley, Levin, Hall, Miller, and Berry (1980), which were based on a model of general mnemonic effectiveness proposed by Baddeley (1976). Briefly, that model implies that the keyword-definition interactive link will promote learning of that association and that which can be directly accessed using that linkage. Recall of definitions from vocabulary words occurs because: (1) the keyword is readily elicited by the vocabulary word--especially when the keyword is a salient part of the vocabulary word--and (2) the keyword/definition linkage has been solidified through a vivid interactive image. In contrast, consider what happens when one must produce a vocabulary word in response to its definition. In that case, the definition can be expected to elicit the interactive image, which in turn should elicit the keyword. But there is no direct link from the keyword back to the vocabulary word. Thus, in studies of backward recall, keyword subjects have been very good at getting to the keyword, but no further. Similarly, the keyword method provides no direct link to spellings or pronunciations of vocabulary words and, as a result, no facilitation would be expected.

The data of the present experiments substantially strengthen the case that the keyword/definition linkage is critical to enhanced recall of definitions from vocabulary items. The Imagery, Synonym, Imagery Familiar, Imagery Self, and Multiple Context conditions were all directed at increasing the processing of what the words meant. That is, they were directed at the definition, without regard to building a mnemonic bridge between the vocabulary words and their definitions. The finding that none of these methods produced associative learning superior to that of control subjects emphasizes that the focus of vocabulary learning should not be on meaningful processing of only the definition, as has been ubiquitously recommended (e.g., Johnson & Pearson, 197). "Knowing" or processing definitions to a "deep" level of comprehension does not enable one to strengthen the association between a vocabulary word and its definition. On the other hand, encoding meaningful interactions between a vocabulary word proxy (i.e., a keyword) and the definition does strengthen that association.

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Footnotes

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[1]In a vocabulary-learning situation, a semantic strategy is one that attempts to enhance the meaningfulness, familiarity, or contextual associations of the stimuli as presented (i.e., the vocabulary items and their definitions) by relating them to one's prior knowledge and conceptual network. In contrast, a mnemonic strategy is one that operates on the stimuli as recoded in order to strengthen the associative link between the vocabulary word and its definition (Levin, Note 4). It is important to note, however, that a mnemonic strategy includes semantic components as well, inasmuch as the definition must be meaningfully processed and semantically related to the vocabulary-word proxy.

[2]As mentioned in the introduction, a carlin is really an old woman. Similarly, poteen is actually an Irish whiskey. However, to minimize the number of subjective decisions that had to be made when scoring subjects' protocols (see Pressley et al., 1981), all definitions were reduced to their core noun meanings.

[3]One need try to execute the Keyword Imagery Self strategy for only a few of the vocabulary items in order to appreciate its difficulty. The substantially restricted number of plausible images that could have been constructed in that condition more than likely accounts for the strategy's reduced effectiveness.

The post-learning interview data confirm this introspective impression of the strategy's complexity.

[4]The studies by Levin et al. (in press) and Pressley et al. (in press) are not the only ones that have failed to document the effectiveness of naturalistic semantic-contextual methods of vocabulary learning (see, for example, Crist & Petrone, 1977; Ahlfors, Note 6; and Hare, Note 7). Indeed, about the only empirical evidence in support of such methods was provided by Gipe (1979), and even that author could not replicate the modest positive effects associated with her experiential context method (Gipe, Note 8).

[5]Of course, it must be recognized that this is only one of several ecologically valid types of discrimination task that could have been devised.

[6]Note that inferior definition-recognition performance by keyword subjects was observed <u>despite a compensating bias in their favor</u>, resulting from the kind of list items included. First, keyword distractors were all one syllable, whereas about half of the definitions were more than one syllable. Thus, one test-taking strategy that could have been employed by keyword subjects was to select all multisyllable items. Second, it would be relatively easy to discriminate between one-syllable keywords and definitions on the basis of their obvious "blendability" with one or more following syllables. Thus, another test-taking strategy for keyword subjects would have been to choose only those one-syllable words that did not look like they could function as keywords.

[7]Note that this statement is restricted to the present situational arrangements, namely where: (<u>a</u>) performance is compared to a control condition in which subjects are free to employ whatever study strategies they wish; and, possibly more importantly: (<u>b</u>) distractor items on the discrimination task consist of previously presented keywords (rather than, say, new distractors).

It should also be mentioned, however, that the keyword method has previously been found to facilitate other aspects of "knowing" a word, such as vocabulary comprehension and usage (see Pressley et al., 1981).

[8]One possible explanation for this discrepancy stems from the manner in which treatments were administered in the two sets of experiments: in a group-instructional format by Johnson versus in individual testing situations here. For more information on group versus individual keyword method treatments, see Pressley et al. (Note 1).

Table 1

Mean Performance, By Condition, in Exps. 4 and 5

Measure	Condition: Keyword Imagery	Imagery	Synonym	No-Strategy Control
Percent Correct Vocabulary-Definition Matches (Exp. 4)[a]	79.1	54.8	27.2	49.6
Percent Correct Definition Recalls (Exp. 5)[b]	25.5	37.0	25.7	27.0
Adjusted Percent Correct Definition Recognitions (Exp. 5)	36.8	86.2	87.7	72.6

[a] MS_E (68) = 512.48

[b] MS_E (68) = 183.03