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ABSTRACT

Using Atkinson's Keyword Method--an imagery mnemonic for vocabulary learning--as a vehicle, this paper argues that even the most well-reasoned and explainable psychological outcomes need to be validated empirically. The paper provides 12 examples of applications of the keyword method in which an eminently reasonable cognitive outcome was anticipated and yet, under experimental scrutiny, some other equally reasonable cognitive outcome materialized. The 12 examples presented are (1) vocabulary word recall, (2) provided versus generated pictures, (3) nonkeyword pictures versus keyword pictures, (4) provided versus generated keywords, (5) ideal versus representative materials, (6) modality by materials interactions, (7) keyword method by ability interactions, (8) the keyword method versus other methods, (9) vocabulary comprehension and usage, (10) strategy maintenance and generalization, (11) group administered keyword instruction, and (12) fictionally versus factually effective mnemonics. The paper concludes that empirical validation should be a foremost concern among those who offer prescriptions for the improvement of educational products and processes. (FL)

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# UNDERSTANDING MNEMONIC IMAGERY EFFECTS: A DOZEN "OBVIOUS" OUTCOMES

by

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Report from the Project on
Studies in Language: Reading and Communication

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Abstract

Using a recently devised imagery mnemonic as a vehicle, the authors argue that even the most well-reasoned and explainable psychological outcomes need to be validated empirically. Twelve examples are provided in which an eminently reasonable cognitive outcome was anticipated and yet, under experimental scrutiny, some other equally reasonable cognitive outcome materialized. Empirical validation behavior should be a foremost concern among those who offer prescriptions for the improvement of educational products and processes.

> Some cynics tell a story, which may be apocryphal, about the theoretical chemist who explained to his class, "And thus we see that the C-Cl bond is longer in the first compound than in the second because the percent of ionic character is smaller." A voice from the back of the room said, "But Professor X, according to the Table, the C-Cl bond is shorter in the first compound." "Oh, is it?" said the professor. "Well, that's still easy to understand, because the double-bond character is higher in that compound." (Platt, 1964, p. 350)

We are about to disprove the obvious. In fact, we are about to do so many times. The idea behind this venture came to us inadvertently from an anonymous referee of a widely read psychological journal, to whom we are grateful. In a recent series of experiments, we had been experiencing considerable difficulty adapting a pictorial mnemonic technique to improve a particular aspect of students' vocabulary learning. Finally, at the end of what seemed like an eternity of well-intentioned trials that ended in nonsignificant results, we developed a procedural variation that "worked." As soon as it did, the theoretical rationale that gave rise to the approach: (a) became believable to us; (b) clarified the reason for our earlier failures; and (c) suggested a related replication experiment that would enhance the validity of the theoretical explanation.

Although our findings apparently seemed interesting and worth reporting to the journal referee, (s)he couldn't refrain from commenting that they seemed "obvious" as well. That is, the theoretical explanation we proposed was reasonable and, given the explanation, the data were hardly surprising. From our point of view, however, the data were "hardly surprising" only <u>after they were in hand</u>. It certainly wouldn't have surprised us if any of

the x empirically unsuccessful attempts that preceded attempt no. x + 1 had been successful. Clearly, the empirical operationalizations had not been devised haphazardly, nor in a vacuum devoid of theoretically appealing prospects for success. Yet, only one of several promising theoretically derived alternatives in fact materialized, and that was the one that was declared "obvious."

The "obviousness" phenomenon is not unique to the area of investigation we review here. Indeed, as is abundantly clear from Platt's (1964) classic "strong inference" article, matters of plausible competing theoretical explanations and postdictions (i.e., proffering theoretical justifications for the data on hand) are not restricted to education, psychology, and the social sciences. We are similarly convinced that the obviousness phenomenon is a ubiquitous one. People like to think that they understand nature and, because human nature can often be comprehended as "common sense" observables unfettered by sophisticated technical terminology, psychology is an especially ripe discipline for obviousness picking.

In this paper we provide a dozen examples of "obvious" outcomes associated with the mnemonic vocabulary-learning method of which we have been speaking. But there is a catch. In each of the 12 examples, the "obvious" outcome was not the one obtained empirically. Rather, some other outcome--which subsequently may or may not have been declared equally obvious--was the one obtained. The larger lesson to be learned throughout all of these examples is simply this: "'Obviousness' is in the mind of the beholder" or "Without accompanying empirical data, there is nothing 'obvious' under the sun." Although all 12 examples will be drawn from one specific content

domain,[1] similarly salient examples could certainly be provided for any other media or educational technology domain of interest. Each reader is encouraged to conduct an "obviousness" phenomenon assessment of his or her own particular substantive area.

## Atkinson's Keyword Method

The focal mnemonic technique is Atkinson's (1975) keyword method. Although originally devised to improve college students' foreign vocabulary learning, recent work in our own and others' laboratories has indicated that the method can be adapted to subsume much more than foreign language vocabulary (Pressley, Levin, & Delaney, Note 1). Indeed, Levin (in press a) has argued that the keyword method, and extensions thereof, constitute a highly versatile and powerful set of procedures that could give birth to "mnemonic curricula" in virtually all school content areas. Recent research based on the keyword method will furnish our dozen obviousness examples.

The basics of the keyword method are as follows. To remember the definition of (or any information associated with) a new term, the learner must first transform the "nominal" stimulus (the new term) into a more meaningful--and, ideally, picturable--"functional" stimulus (the keyword)--see, for example, Underwood & Schulz (1960). The keyword generally sounds like a salient part of the new term. Thus, for example, a reasonable keyword for the Spanish word pato (pronounced something like pah-toe) is pot; a reasonable keyword for the low-frequency English word carlin is car; reasonable keywords for the state of Maryland and its capital, Annapolis, are marry and apple, respectively; and reasonable keywords for the surnames McKune and Tyler are raccoon and tie, respectively. This keyword derivation process

has been referred to as the "acoustic link stage" (Atkinson, 1975) or the "phonetic recoding component" (Levin, Note 2).

Once the keyword has become a stable response to the new term, the learner must encode a relationship between the keyword and the to-be-associated definition or information. Either a pictorially or a verbally constructed relationship will do, as long as it is vivid and meaningful. Thus, to remember that pato means duck, one could picture a duck with a pot on its head or a duck in a soup pot (Pressley, 1977). Alternatively, one could generate a sentence such as "Duck, here comes the pot!" (Pressley, Levin, & McCormick, 1980). For carlin (old woman), one could imagine an old woman driving a car (Pressley, Levin, & Miller, in press). To remember that Annapolis is the capital of Maryland, one could conjure up a scene in which two apples are getting married (Levin, Shriberg, Miller, McCormick, & Levin, 1980); to remember that someone by the name of McKune was famous for having a counting cat, one could picture a cat beside a tally board counting raccoons jumping over a fence (Shriberg, Levin, McCormick, & Pressley, Note 3); and to remember that Tyler was our tenth president, one could relate a tie to a recoded stimulus for ten (e.g., the rhyming word hen).[2] Atkinson (1975) has referred to this process as the "imagery link stage," and Levin (Note 2) has called it the "semantic relating component."

In sum, the keyword method is a two-stage mnemonic process for associating information of many kinds. The empirical research that has been conducted in the last few years has shown that, without question, the keyword method is a highly effective and efficient procedure for acquiring

such information (Pressley et al., Note 1). We now consider specific aspects of the keyword method that would be considered "obvious", were it not for empirical data to the contrary.

## A Dozen "Obvious" Keyword Findings

### Example 1: Vocabulary Word Recall

We begin this exercise by considering an extended example. The keyword method is designed primarily for remembering definitions or other information in response to the new term. That is, the method is designed to work well when one is asked, "What does pato mean?" or "What was Charlene McKune famous for?" In each of these cases, the nominal stimulus will presumably evoke its corresponding functional stimulus (e.g., pato = pot and McKune = raccoon). The functional stimulus, because it was well integrated with the to-be-associated definition or information, should then help one to retrieve the same (e.g., pot = duck being cooked and raccoon = cat beside tally board). From these reconstructed episodes, the appropriate definition or information can (hopefully) be derived (duck and counting cat). What do you suppose would happen, however, if students were asked instead to recall the new term in response to its definition as, for example, "What was the Spanish word for duck? Of course, there is an "obvious" prediction for this problem of vocabulary word recall.

For the task just stated, do you think that the keyword method would fare better than, the same as, or worse than a no-strategy control condition? In keeping with the theme of this paper, one can present "obvious" logical arguments in support of each of these outcomes. Would it be better? Sure. Atkinson (1975) argued that the method should work as well for vocabulary word

recall as it does for definition recall. Worse? Sure. Various critics of the method have argued that by focusing on just the keyword portion of the vocabulary word (e.g., pot in pato) one is ignoring the rest of it, which would hurt when it comes to recalling the whole vocabulary word (see Pressley, Levin, Hall, Miller, & Berry, 1980). The same? Sure. What one gains from the increased associative strength between the keyword and the definition, one loses by focusing on just the keyword and not on the whole vocabulary word.

In a series of experiments on the subject (Pressley & Levin, in press; Pressley, Levin, Hall, Miller, & Berry, 1980), we learned that the answer to the vocabulary word recall question depends on the extent to which the nominal stimulus (the vocabulary word) is reliably evoked by the functional stimulus (the keyword). With vocabulary words that are dependably evoked by the keywords, the keyword method improves vocabulary word recall. With vocabulary words that are not dependably evoked by the keywords, the keyword method does not improve vocabulary word recall. Let's take this example a little further, however, for the instructive benefit of those readers who may have answered the previous question in the correct "conditional" sense. Does it seem obvious which specific procedures one would implement to verify the just described principle? Consider the question first in the context of foreign vocabulary learning (e.g., duck → pot → pato; pencil → lap → lapiz).

Surely an obvious approach is to teach students the keyword method in combination with a verbal rehearsal strategy that is directed at the critically needed integration of keyword and nonkeyword portions of the

vocabulary words (e.g., lap + iz). Sorry, we had students adopt a keyword method plus rehearsal strategy, but that didn't work (Pressley, Levin, Hall, Miller, & Berry, 1980, Exp. 1). Ah ha! Students could be given lots of practice at producing the foreign words, either through pre-familiarization or through multiple learning trials. Uh uh! That didn't work either, at least not with foreign words and their unfamiliar orthographic patterns. Null results were obtained with both sophisticated college students and elementary school-aged children (Pressley, Levin, Hall, Miller, & Berry, 1980, Exps. 3 and 4).

On the other hand, if low-frequency English words--with their somewhat more predictable orthography--constitute the vocabulary items and if college students are given adequate pre-learning familiarization with these items, then indeed the keyword method will facilitate vocabulary word recall (Pressley & Levin, in press, Exp. 2). Similar facilitation can be obtained when college students are asked to learn a new (low-frequency) definition for an already familiar vocabulary word (Pressley & Levin, in press, Exp. 3).

The point of this exercise is simply to emphasize that at the time of conception, each procedural variation seemed plausibly practicable. The prefamiliarization approach that ultimately succeeded was no more "obvious" than some that failed. Thus, to declare a particular finding "obvious" upon seeing the data is tantamount to decrying the need for empirical research of any kind. Responsible scientists must avoid being caught in this kind of armchair obviousness net!

Example 2: Provided Versus Generated Pictures

In the keyword method research discussed this far, the pictures of the imagery link/semantic relating stage have been left up to the learners to

generate for themselves. That is, subject-generated or "induced" (Levin, Note 5) imagery links have been needed. What, on the other hand, would happen if the pictorial scenes were actually provided to the learners via "imposed" (Levin, Note 5) illustrations? It is "obvious" to some that induced pictures would surpass imposed pictures in effectiveness, because the former (being specially constructed by learners for their own use) are more personally meaningful and relevant (Atkinson, 1975). Yet, it is "obvious" to others that induced pictures would be inferior to imposed pictures, because the latter are more concrete representations (Paivio, 1971) and are guaranteed of being provided for all items and to all learners. In contrast, internal images may not occur as consistently within and between learners (see also Levin, in press b).

The available data indicate that at least for elementary and junior high school students, imposed pictures are certainly as good as induced images, and in some cases are better (Pressley & Levin, 1978; Shriberg et al., Note 3). The "better" statement is known to apply with young children (i.e., children younger than 7 or 8 years of age). It is also the case that with more complex learning tasks and materials, the only studies in which positive effects have been convincingly demonstrated have utilized imposed pictures (Levin et al., 1980; McCormick et al., Note 4; Kessler, Levin, McCormick, Miller, & Pressley, Note 6). These studies were conducted with older elementary school children and middle school children, however, and whether or not similar conclusions would obtain for adult subjects remains to be seen.

Example 3: Nonkeyword Fictures Versus Keyword Pictures

Suppose that an imposed picture version of the keyword method is compared with a no-strategy control condition. Further suppose that keyword

subjects by far surpass control subjects with respect to later definition recall. Isn't it "obvious" that the superiority of the keyword condition is not at all due to the keyword method itself, but rather to the fact that keyword subjects were shown pictures and control subjects were not? This at least is what various keyword method critics have thought to be "obvious."

The impact of pictures per se has been found to be negligible. Thus, when simple pictures of the definition (Miller, Levin, & Pressley, in press; Pressley & Levin, 1978) or pictures providing a context for the definition (Kessler et al., Note 6) have been used, the performance of such nonkeyword picture subjects more closely resembles that of control subjects than that of keyword picture subjects. Similarly, when the critical imagery link of the dual-component process is obliterated--but pictures are still available--adults' performance on an analogous names-and-faces task deteriorates (McCarty, 1980).

Example 4: Provided Versus Generated Keywords

What about the issue of provided versus generated keywords? Atkinson (1975) believed that providing keywords to subjects would be preferable, in that with many vocabulary items effective keywords may not readily come to mind. We concur with this "obvious" prediction, although the data bearing on it are far from conclusive. As Pressley et al. (Note 1) have argued, of the several experiments that have been conducted to address the issue, there is little consistency in outcomes. However, virtually all of these experiments have been conducted using vocabulary items for which keywords could be readily generated. Based on anecdotal reports, we would not be surprised to find that with vocabulary items containing less obvious keyword possibilities, providing keywords would be more helpful (relative to having

subjects generate their own). Indeed, in all of the successful experiments that we know of that contained vocabulary with difficult-to-generate keywords, the keywords were provided. The critical experiment bearing directly on the anticipated "keyword obviousness" interaction has not yet been conducted, however, and so the answer to the initiating question must remain far from "obvious."

Example 5: Ideal Versus Representative Materials

"Obviously"--and somewhat related to the preceding example--the keyword method is a very restrictive system. It is applicable only to those items that have conveniently derived keywords and easily pictured definitions. One might view this as a small set of "ideal" materials that an experimenter must take great care to select, in contrast to the larger more "representative" set of materials that an experimenter must exclude if (s)he wants the keyword method to function effectively.

Not true! In several experiments, learning materials have either been selected randomly from a larger corpus, selected because of the difficulties believed to be created for the keyword method, or selected as a total existing body of knowledge. In all cases, the keyword method has proven successful. Thus, we now believe it "obvious" that the keyword method can improve students' learning about individuals whose names are randomly selected from a local phone directory (Shriberg et al., Note 3), vocabulary randomly selected from previous nonkeyword studies (Kessler et al., Note 6, Exp. 2), vocabulary with either abstract (Delaney, 1978; Pressley, Levin, & Miller, Note 7) or otherwise complex (Kessler et al., Note 6, Exp. 1) definitions, and existing U.S. social studies materials, including states and capitals (Levin et al., 1980) and presidents (McCormick et al., Note 4).

Thus, rather than having been proven restrictive, the tremendous versatility of the keyword method has been documented through recent empirical research (see Levin, in press a). Moreover, even if there are materials for which convenient acoustic correspondences are not readily available, keyword method variations can be implemented based on nonacoustic orthographic resemblances. Preliminary data indicate that such variations are effective (Pressley & Mullally, Note 8).

Example 6: Modality by Materials Interactions

Recall that two variations of the keyword method are the picture or imagery version (discussed almost exclusively until now) and the sentence or verbal version. It would seem "obvious" that the latter version is more versatile than the former, in that it would be adaptable to vocabulary items that are not necessarily picturable, and for learners who have difficulty generating visual images (when induced links are required). At the very least, it is "obvious" that although the imagery version may prove more effective than the verbal version with relatively concrete (easy-to-picture) materials, the verbal version would be more effective with relatively abstract (difficult-to-picture) materials.

What little empirical data there are on the subject suggest that, if anything, the imagery version of the keyword method is slightly superior to the verbal version (Delaney, 1978; Pressley, Levin, & Miller, Note 9). Of even greater interest, there is absolutely no hint of a keyword method modality (imagery vs. verbal) by materials (concrete vs. abstract) interaction (Delaney, 1978; Pressley et al., Note 7). Apparently, subjects are quite adept at "concretizing" abstract materials for effective use with the imagery version of the method.

Example 7: Keyword Method by Ability Interactions

Equally "obvious" is the possibility of method by ability interactions. As this easy-to-understand phenomenon goes, good vocabulary learners are presumed to have developed their own effective learning strategies that are at least as good as a keyword strategy. Poor vocabulary learners, on the other hand, have not. Thus, there is every good reason to suspect that poor learners will benefit from keyword method usage considerably more than will good learners (relative to no-strategy controls). Indeed, it may well be the case that the performance of good learners may suffer from their being forced to employ a keyword strategy.

There is absolutely no empirical support for these predictions. Both adults (presumably more proficient vocabulary learners) and children (less proficient vocabulary learners) benefit considerably from use of the keyword method (see Pressley et al., Note 1). Even more direct evidence to refute the method-by-ability-interaction argument comes from a study by Pressley, Levin, Nakamura, Hope, Bispo, and Toye (in press, Exp. 2). In that study, very proficient adult vocabulary learners benefited every bit as much as less proficient learners from use of the keyword method. Another study by Mullis (Note 10), in which ability was defined by students' creativity, was similarly unable to uncover a method by ability interaction. This is not to say that with extreme enough ability differences, the interaction would not materialize. It might. Yet, at this point in history it certainly seems plausible that various versions of the keyword method could be devised to benefit learners at virtually all levels of ability.

Example 8: The Keyword Method Versus Other Methods

The keyword method has been reported to improve vocabulary learning relative to a variety of "control" conditions. It is "obvious," however, that the same or even larger performance increases would be associated with other theoretically and empirically derived techniques for improving vocabulary learning. Among such techniques are those that provide a good deal of contextual and experiential support for the to-be-learned vocabulary items (e.g., Gipe, 1979), as well as those requiring the learner's contextual analysis in the form of sentence verification, construction, and continuation (e.g., Craik & Tulving, 1975; Johnson & Pearson, 1978; Turnure, Buium, & Thurlow, 1976).

Not only has the keyword method proven to be by far superior to other vocabulary-learning alternatives in direct comparisons with children (Kessler et al., Note 6, Exp. 2) and adults (Pressley, Levin, & Miller, Note 9; Pressley & Levin, Note 11), but the presumed effective alternative strategies have in fact proven to be ineffective.

Example 9: Vocabulary Comprehension and Usage

There is no doubt that the keyword method can improve students' learning of vocabulary item-definition associations. However, as some argue, this is not really "knowing" a vocabulary word. Knowing a word usually implies being able to understand and apply it in context. For those who advance arguments such as these, it is "obvious" that the increased associative strength one gains from the keyword method is lost on the more valued educational tasks of vocabulary comprehension and usage.

To date, only one study has addressed this important topic (Pressley, Levin, & Miller, in press). Following vocabulary learning, college students

were given tests of comprehension (measured by both judgments of sentence appropriateness and a standard cloze procedure) and usage (measured by subjects' construction of novel sentences). Students who had learned the vocabulary items according to the keyword method were by no means at a disadvantage, relative to no-strategy control subjects, on any of these measures. In fact, they significantly outperformed control subjects on all of the measures.

Example 10: Strategy Maintenance and Generalization

The keyword method has been shown to work under very circumscribed conditions; in particular, under the watchful eye of an experimenter who instructs students in the method and guides students through the task in which the method is to be used. "Obviously," once the experimenter structure is removed, or as soon as a slightly different task situation is presented, the positive effects of the keyword method would dissolve into nothingness, as a result of student disuse.

This conclusion appears neither to be obvious nor generalizable across subject population and task domains. As Pressley et al. (Note 1) have pointed out in a lengthy discussion, questions of students continuing to use a strategy spontaneously in the same task (maintenance) or in a different task for which a very similar strategy could be applied (generalization) are complicated by a number of variables. However, it certainly appears to be the case that at least junior high school students do show evidence of keyword method maintenance and generalization (Pressley & Dennis-Rounds, 1980; Shriberg et al., Note 3, Exp. 1; Jones & Hall, Note 12). The limited research on this topic suggests that the keyword method is an eminently teachable strategy

which, given the proper eliciting conditions, students can continue to employ spontaneously in appropriate learning situations.

Example 11: Group-administered Keyword Instruction

Most of the keyword method studies to date have been conducted in one-to-one laboratory settings. That is, an experimenter deals with one subject at a time when administering the task and instructions. We all know by now that the keyword method has proven highly effective under such individually administered conditions. It is perfectly "obvious," however, that similar degrees of keyword method success can be demonstrated if the procedures are administered to either small or classroom-sized groups.

This particular issue has been the most disturbing and puzzling of all keyword method phenomena, at least as far as the present authors are concerned. One large set of experiments already published (Levin, Pressley, McCormick, Miller, & Shriberg, 1979) and another yet to be (Levin, Pressley, McCormick, & McGivern, Note 13) have indicated that the transfer of conditions from individuals to groups is far from straightforward. At this writing, the difference between the typical individual keyword successes and the group keyword failures appears to reside in a combination of variables, including the cognitive-developmental level of the learner, as well as the manner (free study vs. paced) and modality (oral vs. written) in which the learning task is administered. Clearly, optimistic claims about the keyword method, vis-à-vis its potential for classroom practice, cannot be offered until the various group-administration wrinkles have been ironed out satisfactorily.

Example 12: Fictionally Versus Factually Effective Mnemonics

Our final example brings us full circle back to the place we began our "obviousness" treatise. We have continued throughout this article to expound our belief in the notion that very few psychological prescriptions are obvious to the point of having to forego the conduct of empirical research on their behalf. A case in point for the mnemonic domain is represented by recommendations and materials developed by "memory experts" in the tranquility of their own "mind's eye." A recent book by Lucas (1978), for example, contains presumably effective mnemonic materials for teaching children such curriculum content as the presidents, the states and capitals, spelling, and arithmetic facts. It is "obvious" that because these materials were developed by someone with a showcased memory of his own, they must be very effective.

Indeed, certain of Lucas's (1978) materials may be effective. However, one set (states and capitals) has been examined under controlled conditions (Levin, Kessler, Miller, & Bartell, Note 14) and did not fare too well. In comparison to no-strategy control subjects, fourth graders shown the Lucas materials learned no more states and capitals. In contrast, students who were given mnemonic materials whose development and refinement were based on analyses of relevant keyword-component processes (Levin, in press a) learned more states and capitals than each of the two preceding groups.

Concluding Comment

The last example is offered not in a personal "horn tooting" vein, but rather as evidence that the media developer and the media researcher must work together if the final product is to fulfill its promise. In

particular, it contains a message for media researchers about the need for empirical validitation of products that are designed to improve educational practice. This is in contrast to the armchair validation approach that many product developers prefer to adopt. It also follows from this state of affairs that researchers who are convinced only by the results of carefully controlled experimentation must, of necessity, be overly cautious in offering educational prescriptions. In the specific case of the keyword method, based on the empirical data collected to date we are cautiously optimistic. As a result, we will continue to conduct programmatic research aimed at acquiring a better understanding of the keyword method's range of potential educational applications and limitations. Obviously, there is a good deal of work yet to be done.

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## Footnotes

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[1]More than a dozen other examples were identified, but not included here, in the interest of economy of space.

[2]Although simple rhyming equivalents can easily be applied to the numbers 1-10, with 40 president numbers to be encoded a more complex system is required. McCormick, Levin, and Dretzke (Note 4) detail a system that was successfully used by eighth-grade students.