

# Mnemonics in Education: Current Research and Applications

Adam L. Putnam

Washington University in St. Louis

Mnemonic techniques are a powerful way to learn large amounts of information, but are not used widely in education today. Why is this? One reason is that the practical demands of the classroom may not be conducive to the use of mnemonics. This review explores how students actually use mnemonics and examines 4 questions about using mnemonics in education: (a) Do mnemonics contribute to more than just rote memory? (b) Do mnemonics work with educationally relevant materials? (c) How much time is required to learn and prepare a mnemonic? (d) Do mnemonics promote long-term learning? With these considerations, the usefulness of mnemonics in the classroom may be limited to certain contexts. However, I provide a few alternative approaches for considering the use of mnemonics in educational settings, such as combining them with other learning techniques and treating mnemonics as a retrieval aid rather than a core learning strategy.

*Keywords:* classroom education, learning, memory, mnemonics

At the inaugural Extreme Memory Tournament in April 2014, the eventual tournament champion, Simon Reinhard, memorized the order of a pack of playing cards in 26.32 seconds. Over the 2-day event, all of the competitors demonstrated similar impressive feats of memory. Perhaps surprising to the average spectator, every competitor attributed their abilities to years of focused training with mnemonic techniques, such as visual imagery, rather than any innate memory abilities. If mnemonic techniques can allow people to quickly learn and remember vast amounts of information, why are they not a central part of classroom education today? Many mnemonists and researchers have strongly advocated for the use of mnemonics in education (e.g., Levin, 1993; Lorayne, 1990), a view supported by scores of empirical studies showing that mnemonics are highly effective in the right circumstances (see Worthen & Hunt, 2011). Previous reviews of mnemonics, how-

ever, have reached different conclusions about whether mnemonics should be used in the classroom. Some reviews have been supportive (Manalo, 2002), others have been mixed (Levin, 1993; Worthen & Hunt, 2011, Chapter 9), and others have been critical (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013). Proponents of mnemonics are encouraged by the results of research done with education in mind (e.g., studies conducted in real classrooms or using educationally relevant materials), whereas detractors suggest that mnemonics have limited utility compared with other techniques that are easy to use and applicable to a wide range of materials, such as retrieval practice or spacing.

The current review focuses on three main points. First, past reviews have overlooked whether students actually use mnemonics and if such use is correlated with academic performance. Second, although many studies have shown mnemonics to be effective learning devices, many of these have not taken classroom conditions into account. Thus, I will briefly review the research on the following questions related to using mnemonics in the classroom: Do mnemonics contribute to more than just rote memory? Do mnemonics work with educationally relevant material? How much time is required to learn and prepare a mnemonic technique? And do mnemonics promote long-term learning? Finally, I provide some additional

---

The research and writing of this article were supported in part by National Science Foundation Grant DGE-1143954. I thank Henry L. Roediger and K. Andrew DeSoto for helpful comments and feedback on this work.

Correspondence concerning this article should be addressed to Adam L. Putnam, Department of Psychology, Washington University in St. Louis, One Brookings Drive, Campus Box 1125, St. Louis, MO 63130. E-mail: [adam.putnam@wustl.edu](mailto:adam.putnam@wustl.edu)

perspectives to consider when evaluating whether to use mnemonics in the classroom or designing research related to mnemonics.

### What Are Mnemonics?

Mnemonics are techniques for improving memory. The ancient Greeks developed the basic principles more than a thousand years ago (Yates, 1966), and today those principles have been implemented in many different ways, ranging from simple acronyms to help remember specific ideas to complex strategies that help to remember numbers by recoding them as distinctive words and phrases. Modern memory research has shown clearly that mnemonics can be powerful learning tools in certain contexts, such as remembering a list of concrete objects (Bower, 1970). Most researchers believe that mnemonics improve memory by capitalizing on naturally occurring memory processes such as visual imagery, organization, and elaborative encoding (e.g., Bellezza, 1981; Higbee, 2001;

Pressley, Levin, & Delaney, 1982; Worthen & Hunt, 2011).

Table 1 provides short descriptions of some major mnemonic techniques. Other authors (Higbee, 2001; Worthen & Hunt, 2011) have provided detailed explanations of each technique, their underlying mechanisms, and how to use them effectively (see also McCabe, Osha, Roche, & Susser, 2013 for shorter descriptions). One important distinction to make is the difference between single-use and repeated-use mnemonics (Bellezza, 1981). A single-use mnemonic helps to remember a specific fact (e.g., the acronym HOMES to remember the Great Lakes: Huron, Ontario, Michigan, Erie, Superior), whereas a repeated-use mnemonic is a cognitive cuing structure that, once learned, can be used to store different information on different occasions (e.g., the method of loci: learning a mental map of your house, and then storing your grocery list in that map each week). Another distinction is between organizational mnemonics and encoding mnemonics. Organiza-

Table 1  
Descriptions of Popular Mnemonic Techniques and Systems

Mnemonic	Description
Link method	Interactive visual imagery connects items in a list, making a chain. Item 1 is joined with item 2; a separate image joins item 2 with item 3 and so on. Thus, retrieving one item in the list cues the next item.
Method of loci	First, a memory palace—a mental map of a building or walk that you know well, such as your house—is memorized. Then, imagery is used to store list items at different locations throughout the palace. Items are retrieved by “walking” through the palace.
Peg system	A “peg list,” or a list of concrete objects in a specific order (e.g., <i>one</i> is a bun, <i>two</i> is a shoe, <i>three</i> is a flea) is learned. Then, visual imagery combines the to-be-remembered items with the peg items. Items can be retrieved by thinking of a number and the corresponding peg, which cues the target item.
Keyword method	First, a keyword is found that sounds like the unfamiliar word (e.g., “dentist” sounds like “la dent”). Then imagery joins the keyword with the definition of the unfamiliar word (an image of a “dentist” holding a large “tooth”). Seeing “la dent” activates dentist, which in turn should activate tooth.
Phonetic system	Each number corresponds to a consonant sound ( $1 = t, 2 = n, 3 = m$ etc.). Then numbers can be remembered as words, using vowels as necessary. For example, 321 can be remembered as “manatee.” Words can be decoded back into numbers.
Acronyms	The first letters of a list of words are used to create a new word. For example, the colors of the rainbow (red, orange, yellow, green, blue, indigo, violet) can be remembered as ROYGBIV. Each letter serves as a retrieval cue for the target items.
Acrostics	The first letters in a list of words serve as the first letters in a new sentence or phrase. For example, the colors of the rainbow can be remembered as <b>R</b> ichard <b>O</b> f <b>Y</b> ork <b>G</b> ave <b>B</b> attle <b>I</b> n <b>V</b> ain. The first letter in each word of the acrostic serves as a retrieval cue.
Songs, stories, and rhymes	Words in a list are joined together by being elements in a story, or by being included in a song or rhyme. Songs and rhymes can also be written to remember specific pieces of information (e.g., <i>i</i> before <i>e</i> except after <i>c</i> ).

tional mnemonics provide a structure for unorganized materials, such as the loci example above, which provides the user with a retrieval plan to recall all of the to-be-remembered items. Encoding mnemonics involve recoding information into a more easily remembered—or more meaningful—format. For example, the number 74125 translates to CARDINAL in the phonetic system. Some mnemonics rely only on organization or encoding, whereas others use both.

### How Are Mnemonics Used in Education Today?

As noted earlier, previous reviews of mnemonics have not addressed how often students actually use mnemonics, or if such use is correlated with academic performance.

This may be because there is not much research directly exploring the issue. However, survey studies have shown that students ranging from 8th grade to college typically know about mnemonic techniques, but prefer to use other study strategies (McCabe et al., 2013; Soler & Ruiz, 1996; Stalder, 2005). For instance, an online survey of 481 undergraduates revealed that students rated mnemonics as less useful than rereading notes, relating material to themselves, doing practice problems, self-testing, or spacing (McCabe et al., 2013). In another survey, only 14% of students reported using mnemonics at all (Karpicke, Butler, & Roediger, 2009). First-letter mnemonics (acronyms and acrostics) appear to be the most widely used mnemonics, followed by the keyword method and the use of stories, songs, and imagery. Complex methods such as the method of loci, the peg system, and the phonetic system are the least popular (Soler & Ruiz, 1996; McCabe et al., 2013). Thus, by the time most students are in college, they have at least a passing familiarity with mnemonics (but prefer alternative study strategies), and when they do use mnemonics, they favor simple techniques such as acronyms.

It is unclear, however, whether mnemonics have any significant impact on academic performance. Gruneberg (1973) surveyed 142 recent graduates and showed that final exam scores did not differ between students who used mnemonics and those who did not. In contrast, Stalder (2005) provided acronyms to an introductory psychology class and showed that students who

used the acronyms scored more points on acronym-related items than those who did not (90% vs. 61% on one exam). Similarly, VanVoorhis (2002) reported that students who learned musical jingles to remember statistical facts performed better on a chapter test than students who simply reread the facts. Additionally, two studies have attempted to evaluate whether spontaneous use or familiarity with mnemonics is correlated with college grades. Carlson, Kincaid, Lance, and Hodgson (1976) reported that students who spontaneously used mnemonics in a list learning experiment had better GPAs than those who did not (2.80 vs. 2.37), whereas McCabe et al. (2013) showed that GPA was positively correlated with familiarity with the first-letter ( $r = .22$ ) and keyword mnemonics ( $r = .15$ ). Although the latter two studies seem promising, they are correlational—making causality claims difficult—and do not address whether students actually use mnemonics in the classroom (only that students use them in list learning experiments or know about them). In sum, there is no clear evidence about whether mnemonic use is correlated with overall academic performance, although the results of Stalder (2005) and VanVoorhis (2002) indicate that providing students with specific mnemonics may lead to some improvement on related test questions.

### Research Relevant to Classroom Applications

Previous research has shown mnemonics can enhance memory, but can they do so in the classroom, where content is complex, time is limited, and students are expected to retain information for long periods of time? The next section reviews research related to classroom applications of mnemonics.

### Do Mnemonics Go Beyond Rote Learning?

A common criticism of mnemonics is that they only encourage rote memorization and do not help with higher order skills, such as comprehension or the transfer of knowledge. This criticism can be addressed with two responses. First, many mnemonics researchers (e.g., Bower, 1973; Higbee, 2001) have argued that mnemonics were designed to enhance recall, not facilitate higher order learning, and thus

should be used as intended. Bower (1973) argued that although many teachers aspire for their students to be “critical, insightful, curious, and deeply appreciative of the subject matter” (p. 70), education still requires a great deal of fact learning, which mnemonics can help with. Learning basic facts with mnemonics leaves more time for higher order learning.

Second, there is some limited evidence that mnemonics may directly help with higher order learning. For example, Carney and Levin (2003) showed mnemonics led to better performance on a hierarchical relationship reasoning test compared with a control condition, whereas Carney and Levin (2000b) showed that using mnemonics led to better performance on a transfer task that required identifying the artists of paintings. Although promising, more research is needed before reaching conclusions about the effects of mnemonic use on higher order learning. Until then, mnemonics should be used primarily as intended, as an aid to memorization.

### Do Mnemonics Work With Educationally Relevant Materials?

Each mnemonic is designed to help remember a specific kind of information. Acronyms and acrostics, for example, help a user remember word lists, but the words can refer to anything (e.g., the planets, or the personality factors in the Big Five) perhaps explaining why students use first-letter strategies more than other mnemonics (e.g., Soler & Ruiz, 1996). Unfortunately, there is mixed evidence about whether first-letter mnemonics actually facilitate recall. Carlson, Zimmer, and Glover (1981) failed to show any positive effects of first-letter mnemonics compared to a control condition (see also Waite, Blick, & Boltwood, 1971), whereas other studies have shown some positive effects in certain contexts (Nelson & Archer, 1972; Stalder, 2005). Researchers have argued that first-letter mnemonics are not effective retrieval cues, and thus will likely not aid recall unless students are already familiar with the material (Carney, Levin, & Levin, 1994). Thus, despite being theoretically applicable to a wide range of educational materials and popular among students, first-letter mnemonics may not be effective memory aids.

In contrast, a large body of evidence suggests the keyword method enhances foreign language vocabulary learning in several languages (Atkinson, 1975; Pressley et al., 1982). It can also be applied to learning more complex material such as state-capital associations, botanical hierarchies, and information in prose passages, although the results are not quite as convincing (Levin, Shriberg, Miller, McCormick, & Levin, 1980; Levin & Levin, 1990; Rosenheck, Levin, & Levin, 1989). Despite the generally positive results, there have been some negative findings (e.g., van Hell & Mahn, 1997). One specific concern is that the keyword method may be less effective when the target materials are not “keyword friendly”—that is, when they lack an obvious keyword or are difficult to visualize (see Hall, 1988). Until future research clarifies which factors influence the success of the keyword method (e.g., how much experience does the user have with learning languages), its use should be limited to keyword friendly materials.

Unlike the keyword method, which was designed specifically for educational applications (Atkinson, 1975), the relevance of the method of loci and peg system to education is less clear. Both techniques are great for remembering lists of concrete objects (especially if the exact order is important; see Roediger, 1980), but students rarely need to remember such a list in the classroom. However, researchers have explored combining the method of loci and peg system with other strategies to extend their use to educational materials. For example, Carney and Levin (2011) had subjects learn keywords for the 10 tallest mountains and 10 largest islands, and then store those keywords in a peg list, in order. Subjects who used the combined peg/keyword system performed better on a matching test than an own-best-method control group even after a 2- or 5-day delay. The method of loci can also be combined with outlining or prose analysis techniques to enhance memory for prose passages. In one striking example, students took a 14-week study course focusing on either mnemonic training or traditional study skills (e.g., note taking, identifying main ideas); at the end of the session students in the mnemonic training group recalled twice as much information from a 2200 word passage as the control group (Snowman, Krebs, & Lockhart,

1980). However, other research suggests that supplemental techniques (i.e., the prose analysis) may be driving more of the effect than the method of loci (Snowman, 1987), and that such methods may only be effective when passages are presented orally, such as in a lecture (Cornoldi & De Beni, 1991).

To summarize, the keyword, loci, and peg mnemonics all effectively enhance recall for some materials, such as keyword-friendly materials and lists of concrete nouns. However, the evidence about whether those same mnemonics enhance recall for complex materials—abstract words, prose passages, and lectures—is much shakier. From an application perspective, these mnemonics should primarily be used when the materials are compatible with the technique, and the first-letter mnemonic should be avoided entirely.

### How Much Time Is Required to Learn and Prepare a Mnemonic Technique?

A recurring question with the use of mnemonics is whether the time required to learn and practice the techniques justifies the gains to memory (Bellezza, 1983; Higbee, 2001). Mnemonic training has two parts: first, memorizing any components required by the technique (e.g., learning the peg images for a peg system), and second, practicing the basic steps involved in using the mnemonic until they can be done on the fly (e.g., learning to visualize interactive images of the peg and the target). A mental palace can be memorized in less than an evening (Roediger, 1980), whereas a 10-item peg list can be learned in minutes (Elliott & Gentile, 1986). Of course, a larger memory palace or longer peg list would take longer to learn. Most studies (e.g., Elliott & Gentile, 1986) do not give subjects in the control conditions extra time to study while the subjects in the mnemonic condition are learning their technique, so it is difficult to know how much the extra study time would help recall. In general, learning a peg list or mental palace is not worthwhile if it will only be used once—the real utility comes from using it on different occasions.

After memorizing any additional components, the next step in training is to practice the basic procedures (e.g., creating keywords, generating bizarre images etc.) until they can

be done on the fly. The main hurdle in achieving proficiency is becoming faster at successfully encoding information. Bugelski, Kidd, and Segmen (1968) showed that after a few minutes of practice with the peg system, students showed enhanced recall for words when they were presented at a four or eight second rate, but not at a two second rate. Similarly, Hall (1988) showed that two to three hours of training with the keyword method led subjects to a 70% increase in their ability to recall German language vocabulary, but the benefits were much smaller when subjects saw multiple short exposures of each word rather than one long exposure (four 2.5 second presentations instead of one 10 second presentation). The exact amount of training before proficiency is achieved depends on several factors, including the difficulty of the mnemonic (the phonetic system is considered so hard as to be useless for education, Levin, 1993), the difficulty of the materials, any individual differences, and any time constraints during encoding.

One workaround for less experienced users is to provide some elements of a mnemonic to them, rather than having them generate all of the components. For example, a student could be provided with a keyword, a description of an image combining the keyword with the target word, or even a picture of that image. Providing at least some of these elements is necessary for the keyword mnemonic to work when there is a large cognitive load, such as when the users are young, insufficiently trained, or have strict time limits during encoding (Manalo, 2002; McGivern & Levin, 1983). In general, however, students are probably better off generating their own mnemonics, as long as they are sufficiently trained and have adequate time to do so (e.g., Bloom & Lamkin, 2006; Moe & De Beni, 2005).

Clearly, opportunity cost is important in a classroom. Any time spent learning or practicing a mnemonic takes time away from covering additional content. Bellezza (1983) argued that it was nearly impossible to determine whether the time required to learn a mnemonic justifies the gains to memory. It appears, however, that most students can learn the basic procedures of most mnemonics fairly quickly, and that the largest obstacle to successful encoding is time available. Although students are often under

time constraints, those constraints are different from the time constraints in experiments where subjects may be limited to a few seconds per item. Thus, students should be able to adequately encode items in the classroom.

### Do Mnemonics Promote Long-Term Learning?

To be relevant for education, mnemonics should promote long-term learning; that is, they should enhance memory on a test, even if it occurs 24 hours (or more) after initial learning. This issue has been explored most extensively with the keyword mnemonic, with some research suggesting that keyword techniques promote long-term retention (e.g., Atkinson & Raugh, 1975; Carney & Levin, 2011) and other research suggesting that keyword techniques lead to a faster forgetting rate than rote learning (Carney & Levin, 1998; Wang, Thomas, & Ouellette, 1992). Wang and his colleagues (e.g., Wang, Thomas, & Ouellette, 1992) suggested that the critical factor in whether keywords promote long-term retention is whether subjects take an immediate test on the material after study, which can serve as its own learning event (a testing effect, see Roediger & Karpicke, 2006). Previous research showing long-term effects typically tested students both immediately

and after a delay. Wang et al. (1992) manipulated retention interval between-subjects, so half of the subjects took a test after 30 seconds and half took a test after 1-week (they studied French vocabulary with the keyword method or rote rehearsal). Figure 1 shows that the keyword method was superior at the immediate test, but equivalent to rote rehearsal at the delayed test, suggesting that without an immediate test, the keyword method does not enhance long-term retention.

In other work, Wang and Thomas (2000) showed that unlike the keyword method, the method of loci and peg system might enhance recall compared to rote rehearsal even after a 2-day delay (but see Krinsky & Krinsky, 1994). They argued that students are unlikely to forget the cueing structure with the method of loci or peg system because the cues stay the same and are well learned. In contrast, with the keyword method, subjects may forget what each keyword stands for (e.g., does “dentist” refer to mouth, gums or tooth?), making it difficult to recall the correct definition.

In sum, the method of loci and peg system may lead to long-term learning, but the keyword method likely does not. However, the keyword method may support long-term learning if com-

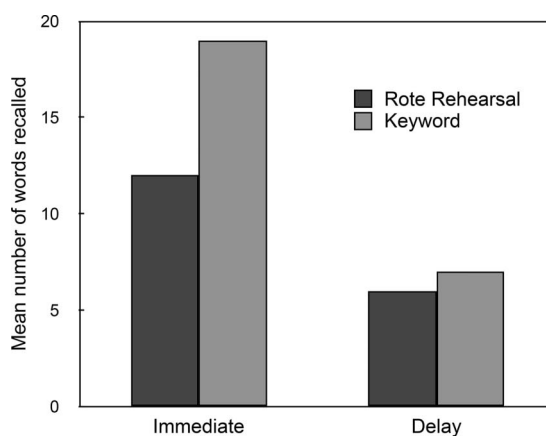


Figure 1. Mean number of French vocabulary words recalled on an immediate or 1-week delayed cued-recall test in Wang, Thomas, and Ouellette (1992, Experiment 1). Both delay and study method were manipulated between-subjects, indicating that the keyword method may only benefit recall at an immediate test. Standard errors were not available. From “Keyword Mnemonic and Retention of Second-Language Vocabulary Words,” by A. Y. Wang, M. H. Thomas, and J. A. Ouellette, 1992, *Journal of Educational Psychology*, 84, p. 523. Copyright 1992 by the American Psychological Association. Adapted with permission.

bined with other strategies that prevent forgetting, such as providing subjects with pictorial representations of the keywords (Carney & Levin, 2000a), or using retrieval practice (Carney & Levin, 1998; Fritz, Morris, Acton, Voelkel, & Etkind, 2007). An immediate test is not unfathomable in an educational context—a quiz at the end of the day, for example—and such a quiz may slow forgetting. Combining the keyword method and retrieval practice may even have additive benefits (Fritz et al., 2007). Repeated retrieval practice with mnemonics might explain why people still remember some well-trod acronyms (e.g., ROYGBIV for remembering the colors of the rainbow) despite evidence suggesting that first-letter mnemonics do not enhance recall after a delay (Waite, Blick, & Boltwood, 1971). From an educational perspective, educators should use low-stakes testing (a quiz worth only a few points) immediately after studying to facilitate long-term retention. From a research perspective, future research should continue to explore whether mnemonics enhance recall at longer retention intervals (especially longer than 1-week).

### Additional Perspectives on Using Mnemonics in Education

Watch a memory competitor memorize a deck of cards in under a minute, and it is easy to imagine students effortlessly memorizing pages of text before a test. However, as reviewed above, mnemonics are not the panacea for education that some claim them to be (Levin, 1993; Lorayne, 1990). Mnemonics require practice and training, may not lead to long-term retention without support from other techniques, and may not work with complex materials. Yet, when the conditions are right (the materials fit with the mnemonic, users are trained appropriately etc.), mnemonics can still be effective learning tools. Here are a few additional points to keep in mind when evaluating mnemonics for educational use or for designing future research.

First, is the time spent learning a mnemonic justified? (In other words, “is the juice worth the squeeze?”) As noted earlier, learning a mnemonic only to use it once is a waste of time. But learning a mnemonic and using it repeatedly in the future is a worthwhile investment. A student who learns mnemonics in high school can use keywords and the peg

system in college to remember chemistry terms or Maslow’s hierarchy of needs. This hypothesis could be explored in a study where students take a freshman seminar focused on learning and practicing mnemonic techniques (see Shimamura, 1984 for a sample syllabus). At graduation students who completed the course could be surveyed about what study strategies they continue to use, and their GPAs could be compared to students who took a different seminar. This study would not only shed light on whether students continue to use mnemonics years after training, but whether mnemonic training has any real impact on academic performance.

Second, mnemonics should be used primarily as an aid for recall once students have already mastered the material. To provide a concrete example, Stalder (2005) provided introductory psychology students with acronyms on a review sheet 1 week before a test. The review sheet listed the acronyms along with the general topic (e.g., The Big Five = OCEAN), but not what each letter stood for; students had to either recall the exact terms or go look them up (e.g., openness, conscientiousness, agreeableness, neuroticism). Stalder also provided a linking sentence that connected the acronym to the content (e.g., *The Big Five* categories cover most traits as the OCEAN covers most of the earth). On the exam a week later, students who reported using the acronyms (64% of the class) averaged 70% correct on the acronym-related questions compared with 56% for students who did not report using acronyms (the two groups did not differ on the nonacronym questions). Thus, students had to understand the content, but could use the acronyms to help retrieve that knowledge on the test. As well, by looking up or recalling the exact definitions, students were engaging in spaced study or retrieval practice.

In general, mnemonics should be used in conjunction with other learning strategies. Bellezza (1983) suggested that in using a mnemonic to remember a prose passage, a user must first *understand* the passage, identify which information is critical, create a code or keyword for the critical information, and then store the keywords in a system such as the method of loci. In practice, to prepare for a final exam, a student might review her reading and lecture notes before creating an

outline of the big ideas from each unit. Then she can take a few minutes to create an image to represent each idea and store them in a mental palace she learned specifically for final exams. As she walks to class the next morning, she can mentally walk through her palace, referring to her outline whenever she needs feedback. Thus, the mnemonic is not the only learning tool, but is used in conjunction with other strategies.

Which brings us to a third point: some of the disadvantages of mnemonics can be ameliorated by combining them with other learning strategies such as retrieval practice and spacing. Of course, this raises the question of whether students should just be using those alternative techniques, which are highly favored by psychologists (Dunlosky et al., 2013). Fritz et al. (2007) had students learn German vocabulary with the keyword method, retrieval practice, or a combination of the two. In general, the keyword method and retrieval practice led to similar benefits at both immediate and delayed tests. Critically, however, the combined condition led to better recall after a 1-week delay than either individual technique, suggesting that there may be additive benefits of combining retrieval practice with the keyword method. In a classroom, this could be as simple as teaching students a peg list to learn the 50 U.S. presidents and immediately giving them a recall quiz. The immediate quiz should help prevent any forgetting before a chapter test at the end of the week. Fritz et al. (2007) is one of the few papers to directly compare mnemonic performance to other validated learning strategies (see also Snowman et al., 1980). Future research should continue to use spacing and retrieval practice as control conditions (instead of rote rehearsal), and continue to explore how mnemonics and retrieval practice can be used together.

Finally, mnemonics may have some positive nonmemory side effects, such as increasing motivation to study. In one study students reported on a survey that having acronyms on a review-sheet made it easier for them to remember course content and made them start studying earlier (Stalder, 2005). Other studies show that students think that some mnemonics are easier, faster, more enjoyable, and more useful than rote rehearsal (Fritz et al., 2007), and that mnemonics can reduce test anxiety (Stalder & Ol-

son, 2011). Although preliminary (and certainly worthy of future research) these results mesh with anecdotal reports about students enjoying the use of mnemonics (e.g., VanVoorhis, 2002), and suggest that mnemonics may have some additional motivational benefits that could increase their utility in educational contexts.

## Conclusion

At the Extreme Memory Tournament another competitor was James Paterson, a high school teacher from England. He recently described how he teaches the method of loci to his students to help them prepare for a national college placement exam in psychology (Brown, Roediger, & McDaniel, 2014, Chapter 7). After mastering the content from each chapter, the class visits a coffee shop and learns the layout of the café to serve as a memory palace. They then create keywords for the important ideas from each chapter, and store those keywords in the mental version of the café, which becomes the outline for their essay. Paterson insists that mnemonics are not a replacement for learning the material. Rather, the mnemonics provide a retrieval plan that students can use to access what they already know. Students experience less test anxiety, because they can spend the first five minutes jotting down ideas from their memory palace and complete the rest of the exam with what is essentially a legal “cheat sheet.”

When deciding to use any learning technique, educators and students should know why they are using the technique and why it is appropriate to use it in that particular context. Mnemonics have often been touted as a revolutionary learning device, and by watching the memory competitors it is easy to see why. However, memory competitors train for thousands of hours and perform in an environment very different from a classroom. Mnemonics will not revolutionize education, but given the variety of techniques, their compatibility with other learning strategies, and effectiveness with certain materials, it seems that students would benefit from being familiar with them and knowing when and how to use them.

## References

- Atkinson, R. C. (1975). Mnemotechnics in second-language learning. *American Psychologist*, *30*, 821–828. <http://dx.doi.org/10.1037/h0077029>



- Atkinson, R. C., & Raugh, M. R. (1975). An application of the mnemonic keyword method to the acquisition of a Russian vocabulary. *Journal of Experimental Psychology: Human Learning and Memory*, *1*, 126–133. <http://dx.doi.org/10.1037/0278-7393.1.2.126>
- Bellezza, F. (1981). Mnemonic devices: Classification, characteristics, and criteria. *Review of Educational Research*, *51*, 247–275. <http://dx.doi.org/10.3102/00346543051002247>
- Bellezza, F. (1983). Mnemonic-device instruction with adults. In G. M. Pressley & J. R. Levin (Eds.), *Cognitive strategy research: Psychological foundations* (pp. 51–73). New York, NY: Springer-Verlag. [http://dx.doi.org/10.1007/978-1-4612-5522-2\\_3](http://dx.doi.org/10.1007/978-1-4612-5522-2_3)
- Bloom, C. M., & Lamkin, D. M. (2006). The Olympian struggle to remember the cranial nerves. *Teaching of Psychology*, *33*, 128–129.
- Bower, G. H. (1970). Analysis of a mnemonic device: Modern psychology uncovers the powerful components of an ancient system for improving memory. *American Scientist*, *58*, 496–510.
- Bower, G. H. (1973). How to uh remember! *Psychology Today*, *7*, 63–70.
- Brown, P. C., Roediger, H. L., & McDaniel, M. A. (2014). *Make it stick: The science of successful learning*. Cambridge, MA: Harvard University Press.
- Bugelski, B. R., Kidd, E., & Segmen, J. (1968). Image as a mediator in one-trial paired-associate learning. *Journal of Experimental Psychology*, *76*, 69–73. <http://dx.doi.org/10.1037/h0025280>
- Carlson, L., Zimmer, J. W., & Glover, J. A. (1981). First-letter mnemonics: DAM (don't aid memory). *Journal of General Psychology*, *104*, 287–292. <http://dx.doi.org/10.1080/00221309.1981.9921047>
- Carlson, R. F., Kincaid, J. P., Lance, S., & Hodgson, T. (1976). Spontaneous use of mnemonics and grade point average. *The Journal of Psychology: Interdisciplinary and Applied*, *92*, 117–122. <http://dx.doi.org/10.1080/00223980.1976.9921344>
- Carney, R. N., & Levin, J. R. (1998). Do mnemonic memories fade as time goes by? Here's looking anew! *Contemporary Educational Psychology*, *23*, 276–297. <http://dx.doi.org/10.1006/ceps.1998.0970>
- Carney, R. N., & Levin, J. R. (2000a). Fading mnemonic memories: Here's looking anew, again! *Contemporary Educational Psychology*, *25*, 499–508. <http://dx.doi.org/10.1006/ceps.1999.1035>
- Carney, R. N., & Levin, J. R. (2000b). Mnemonic instruction, with a focus on transfer. *Journal of Educational Psychology*, *92*, 783–790. <http://dx.doi.org/10.1037/0022-0663.92.4.783>
- Carney, R. N., & Levin, J. R. (2003). Promoting higher-order learning benefits by building lower-order mnemonic connections. *Applied Cognitive Psychology*, *17*, 563–575. <http://dx.doi.org/10.1002/acp.889>
- Carney, R. N., & Levin, J. R. (2011). Delayed mnemonic benefits for a combined pegword-keyword strategy, time after time, rhyme after rhyme. *Applied Cognitive Psychology*, *25*, 204–211. <http://dx.doi.org/10.1002/acp.1663>
- Carney, R. N., Levin, J. R., & Levin, M. E. (1994). Enhancing the psychology of memory by enhancing memory of psychology. *Teaching of Psychology*, *21*, 171–174. [http://dx.doi.org/10.1207/s15328023top2103\\_12](http://dx.doi.org/10.1207/s15328023top2103_12)
- Cornoldi, C., & De Beni, R. (1991). Memory for discourse: Loci mnemonics and the oral presentation effect. *Applied Cognitive Psychology*, *5*, 511–518. <http://dx.doi.org/10.1002/acp.2350050606>
- Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, *14*, 4–58. <http://dx.doi.org/10.1177/1529100612453266>
- Elliott, J. L., & Gentile, J. R. (1986). The efficacy of a mnemonic technique for learning disabled and nondisabled adolescents. *Journal of Learning Disabilities*, *19*, 237–241. <http://dx.doi.org/10.1177/002221948601900411>
- Fritz, C. O., Morris, P. E., Acton, M., Voelkel, A. R., & Etkind, R. (2007). Comparing and combining retrieval practice and the keyword mnemonic for foreign vocabulary learning. *Applied Cognitive Psychology*, *21*, 499–526. <http://dx.doi.org/10.1002/acp.1287>
- Gruneberg, M. M. (1973). The role of memorization techniques in finals examination preparation: A study of psychology students. *Educational Research*, *15*, 134–139. <http://dx.doi.org/10.1080/0013188730150209>
- Hall, J. W. (1988). On the utility of the keyword mnemonic for vocabulary learning. *Journal of Educational Psychology*, *80*, 554–562. <http://dx.doi.org/10.1037/0022-0663.80.4.554>
- Higbee, K. L. (2001). *Your memory: How it works and how to improve it*. New York, NY: Marlowe & Company.
- Karpicke, J. D., Butler, A. C., & Roediger, H. L., III. (2009). Metacognitive strategies in student learning: Do students practise retrieval when they study on their own? *Memory*, *17*, 471–479. <http://dx.doi.org/10.1080/09658210802647009>
- Krinsky, R., & Krinsky, S. G. (1994). The peg-word mnemonic facilitates immediate but not long-term memory in fifth-grade children. *Contemporary Educational Psychology*, *19*, 217–229. <http://dx.doi.org/10.1006/ceps.1994.1018>
- Levin, J. R. (1993). Mnemonic strategies and classroom learning: A twenty-year report card. *The*

- Elementary School Journal*, 94, 235–244. <http://dx.doi.org/10.1086/461763>
- Levin, J. R., Shriberg, L. K., Miller, G. E., McCormick, C. B., & Levin, B. B. (1980). The keyword method in the classroom: How to remember the states and their capitals. *The Elementary School Journal*, 80, 185–191. <http://dx.doi.org/10.1086/461188>
- Levin, M. E., & Levin, J. R. (1990). Scientific mnemonics: Methods for maximizing more than memory. *American Educational Research Journal*, 27, 301–321. <http://dx.doi.org/10.3102/00028312027002301>
- Lorayne, H. (1990). *How to develop a super power memory*. Toronto, Canada: Prentice Hall Canada.
- Manalo, E. (2002). Uses of mnemonics in educational settings: A brief review of selected research. *Psychologia: An International Journal of Psychology in the Orient*, 45, 69–79.
- McCabe, J. A., Osha, K. L., Roche, J. A., & Susser, J. A. (2013). Psychology students' knowledge and use of mnemonics. *Teaching of Psychology*, 40, 183–192. <http://dx.doi.org/10.1177/0098628313487460>
- McGivern, J. E., & Levin, J. R. (1983). The keyword method and children's vocabulary learning: An interaction with vocabulary knowledge. *Contemporary Educational Psychology*, 8, 46–54. [http://dx.doi.org/10.1016/0361-476X\(83\)90033-4](http://dx.doi.org/10.1016/0361-476X(83)90033-4)
- Moè, A., & De Beni, R. (2005). Stressing the efficacy of the Loci method: Oral presentation and the subject-generation of the Loci pathway with expository passages. *Applied Cognitive Psychology*, 19, 95–106. <http://dx.doi.org/10.1002/acp.1051>
- Nelson, D. L., & Archer, C. S. (1972). The first letter mnemonic. *Journal of Educational Psychology*, 63, 482–486. <http://dx.doi.org/10.1037/h0033131>
- Pressley, G. M., Levin, J. R., & Delaney, H. D. (1982). The mnemonic keyword method. *Review of Educational Research*, 52, 61–91. <http://dx.doi.org/10.3102/00346543052001061>
- Roediger, H. L. (1980). The effectiveness of four mnemonics in ordering recall. *Journal of Experimental Psychology: Human Learning and Memory*, 6, 558–567. <http://dx.doi.org/10.1037/0278-7393.6.5.558>
- Roediger, H. L., III, & Karpicke, J. D. (2006). The power of testing memory: Basic research and implications for educational practice. *Perspectives on Psychological Science*, 1, 181–210. <http://dx.doi.org/10.1111/j.1745-6916.2006.00012.x>
- Rosenheck, M. B., Levin, M. E., & Levin, J. R. (1989). Learning botany concepts mnemonically: Seeing the forest and the trees. *Journal of Educational Psychology*, 81, 196–203. <http://dx.doi.org/10.1037/0022-0663.81.2.196>
- Shimamura, A. P. (1984). A guide for teaching mnemonic skills. *Teaching of Psychology*, 11, 162–166.
- Snowman, J. (1987). Explorations in mnemonic training. In M. A. McDaniel & M. Pressley (Eds.), *Imagery and related mnemonic processes* (pp. 377–391). New York, NY: Springer. [http://dx.doi.org/10.1007/978-1-4612-4676-3\\_17](http://dx.doi.org/10.1007/978-1-4612-4676-3_17)
- Snowman, J., Krebs, E. W., & Lockhart, L. (1980). Improving recall of information from prose in high-risk students through learning strategy training. *Journal of Instructional Psychology*, 7, 35–40.
- Soler, M. J., & Ruiz, J. C. (1996). The spontaneous use of memory aids at different educational levels. *Applied Cognitive Psychology*, 10, 41–51. [http://dx.doi.org/10.1002/\(SICI\)1099-0720\(199602\)10:1<41::AID-ACP361>3.0.CO;2-1](http://dx.doi.org/10.1002/(SICI)1099-0720(199602)10:1<41::AID-ACP361>3.0.CO;2-1)
- Stalder, D. R. (2005). Learning and motivational benefits of acronym use in introductory psychology. *Teaching of Psychology*, 32, 222–228. [http://dx.doi.org/10.1207/s15328023top3204\\_3](http://dx.doi.org/10.1207/s15328023top3204_3)
- Stalder, D. R., & Olson, E. A. (2011). t for two: Using mnemonics to teach statistics. *Teaching of Psychology*, 38, 247–250. <http://dx.doi.org/10.1177/0098628311421321>
- van Hell, J. G., & Mahn, A. C. (1997). Keyword mnemonics versus rote rehearsal: Learning concrete and abstract foreign words by experienced and inexperienced learners. *Language Learning*, 47, 507–546. <http://dx.doi.org/10.1111/0023-8333.00018>
- VanVoorhis, C. R. W. (2002). Stat jingles: To sing or not to sing. *Teaching of Psychology*, 29, 249–250.
- Waite, C. J., Blick, K. A., & Boltwood, C. E. (1971). Prior usage of the first-letter technique. *Psychological Reports*, 29, 630. <http://dx.doi.org/10.2466/pr0.1971.29.2.630>
- Wang, A. Y., & Thomas, M. H. (2000). Looking for long-term mnemonic effects on serial recall: The legacy of Simonides. *The American Journal of Psychology*, 113, 331–340. <http://dx.doi.org/10.2307/1423362>
- Wang, A. Y., Thomas, M. H., & Ouellette, J. A. (1992). Keyword mnemonic and retention of second-language vocabulary words. *Journal of Educational Psychology*, 84, 520–528. <http://dx.doi.org/10.1037/0022-0663.84.4.520>
- Worthen, J. B., & Hunt, R. R. (2011). *Mnemonology: Mnemonics for the 21st century*. New York, NY: Taylor & Francis.
- Yates, F. (1966). *The art of memory*. Chicago, IL: The University of Chicago Press.

Received April 30, 2014

Revision received November 12, 2014

Accepted January 23, 2015 ■