Recent Research on Visual Mnemonics: Historical Roots and Educational Fruits

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A few empirical studies of mnemonics were conducted in the late 1800's and early 1900's. Then, very little research was done until the 1960's, when a revived research interest in mnemonics accompanied the return of cognitive processes as a legitimate area of research. Virtually all of the experimental research on mnemonics has been conducted since 1965, and most of that since 1970. Research on visual-imagery mnemonic techniques in the 1970's is compared with research in the late 1800's and early 1900's, showing that the roots of much "recent" research can be traced back at least a century. Finally, some of the fruits yielded by recent research on mnemonics, in terms of practical implications for education, are described.

The word mnemonic means "aiding the memory." Thus, a mnemonic system or technique is a system or technique which aids the memory, and mnemonics refers in general to methods of memory improvement. Typically, however, the term refers more specifically to rather unusual, artificial memory techniques, the kinds recommended in popular memory-training books (e.g., stories, rhymes, acronyms, verbal mediators, visual imagery). As contrasted with specific-purpose mnemonic techniques, a mnemonic system can be used over and over to learn different sets of material. Three mnemonic systems have received considerable research interest during the 1970's: the Loci System, the Peg System, and the Phonetic System. Descriptions of these systems and their historical roots, as well as research evidence on how well they work, are available elsewhere (see Higbee, 1977; Morris, 1977).

The emphasis in this article is on the use of visual imagery as a mnemonic technique, because it is probably the most unusual aspect of mnemonic systems, it is used by most mnemonic systems, and it is the mnemonic technique that has been of most research interest during the 1970's.

The first section of this article examines the legitimacy of mnemonics as a subject of scientific investigation. The next three sections compare recent research evidence with older evidence and statements on mnemonics. ("Older" means anywhere from 60 to 2,500 years ago, with the emphasis on the late 1800's and early 1900's.) These
three sections discuss old and new evidence on: the mnemonic effectiveness of visual imagery in general; three techniques for maximizing the effectiveness of imagery (interaction, vividness, and bizarreness); and the comparative effectiveness of using one's own mediators versus mediators supplied by someone else. The last, and longest, section suggests some implications that recent research may have for education.

This article emphasizes recent research, published since the mid-1970's (two-thirds of the references are dated from 1976-1978); relevant research to the mid-1970's has been discussed elsewhere (Higbee, 1977, Note 1). The discussion is not intended to be a comprehensive review of research on mnemonics or of the history of mnemonics. Such a feat would have been virtually impossible even a century ago: an 1813 book listed about 60 references on memory improvement (Feinaigle, 1813), an 1852 source mentioned some 140 works on mnemonics, and an 1888 book by Fellows listed a bibliography of 247 works on mnemonics and memory training (see Burnham, 1888).

Virtually all of these references were philosophical treatments of mnemonics, rather than empirical research evidence, which did not appear until the late 1800's. Even then, much of the early "research" on mnemonics may not really be considered to be research by today's standards. The studies used very small numbers of subjects, and relied almost entirely on introspection. Some were anecdotal (e.g., Talbot, 1896), and many were not well-controlled. For example, most current researchers who compare learning by different mnemonic instructions include a check to determine the extent to which the subjects followed the instructions. Contrast this with a study by Kirkpatrick published in 1894 comparing different learning strategies, in which it was reported, "how closely they followed these directions it is impossible to say, but their faces indicated that they were trying to do so" (p. 603). It should be noted, however, that some of the "quaint" research techniques, such as introspection and small-N designs, may be regaining some legitimacy (see McKellar, 1972; Robinson & Foster, in press).

The history of mnemonics from about 500 B. C. through the 17th century has been traced by Yates (1966), and several recent articles are available for the reader who is interested in aspects of the history of mnemonics that are not covered in this article (Brown & Deffenbacher, 1975; Hoffman & Senter, 1978; Laver, 1977; Marshall & Fryer, 1978; Murray, 1976; Wittrock, 1977; Rawles, Note 2).

The Legitimacy of Mnemonics

Even though mnemonic techniques and systems have been in use for more than 2,000 years, virtually all of the experimental research on mnemonics has been conducted in the last 15 years. Brown and Deffenbacher (1975) have suggested that a reading of contemporary works on mnemonics gives the impression that the study of mnemonics and mnemonists has been more limited than is the case historically. The topic was actually of considerable interest during the 1800's, and Brown and Deffenbacher review some research done on mnemonists during the 1800's and early 1900's by men such as Binet and Muller.

Brown and Deffenbacher considered several possible reasons for the lack of current awareness of this historical research by American psychologists, and concluded that the most likely reason was the behaviorist slant of American psychology during the first half of the 20th century. Likewise, a probable major reason why there was
virtually no research on mnemonics during the first half of the 20th century was that mental processes were not a very legitimate area for research, as psychologists concentrated on observable behavior in order to be scientific. A revived research interest in mnemonics in the mid-1960's accompanied the general acceptability of cognitive processes as a legitimate area for research.

A second possible reason why mnemonics may not have been viewed as a legitimate area for scientific inquiry for so many years is that they were associated with sensationalism, showmanship, and commercialism. Researchers may have thought that research on mnemonics would yield little useful knowledge about memory, or that such “gimmicks” were not worthy of serious scientific study.

In 1960, Miller, Galanter, and Pribram observed that “the antagonistic attitude of experimental psychologists toward mnemonic devices is even more violent than their attitude toward their subjects' word associations; mnemonic devices are immoral tricks suitable only for evil gypsies and stage magicians” (p. 134). According to Hoffman and Senter (1978), several researchers had carried out experiments on mnemonic systems in the late 1950's and early 1960's, but did not attempt immediate publication of their work due to the prevailing prejudices against the mentalism which mnemonics entailed.

Norman (1976) observed the following regarding mnemonic techniques:

In the past, psychologists tended to ignore these techniques because they were thought to be mere tricks and sophistry—the practitioners exhibited themselves as stage entertainers or advertised themselves and their methods in unrespectable classified advertisements. But the techniques work. In fact, we ought to examine procedures that simplify the job of memorizing with great care. Not only might they be useful in our lives, but the secrets of those who practice the art of memory ought to shed some light on the organization and operation of the mechanisms involved in memory. (p. 130)

Bower similarly commented in 1970 that people have always searched for various rituals, tricks, gimmicks, and methods to improve their memories. He noted that the search has produced a few reasonably successful methods, which are advertised in sensationalistic terms in newspapers and magazines by commercial memory courses, and wrote, “Although such hard-sell tactics are somewhat repugnant to respectable scholars (who view their grant proposals and fund-raising speeches in a different light), we should not be deterred by these commercial trappings from investigating scientifically some of the mnemonic devices” (p. 496).

Fortunately, these commercial trappings have not deterred many psychologists from investigating mnemonics during the 1970's. With reference to one best selling popular book on memory improvement by Lorayne and Lucas (1974), Peterson (1977) suggested that “rather than being an object of scorn for the academician . . . it is a source of information on what two memory experts have found effective in the way of subjective organization” (p. 393). There is a considerable amount of research evidence that mnemonics are worth taking seriously enough to study and use (see Higbee, Note 3). Bower (1973a) has observed that “like many things, mnemonic techniques are easy to parody and poke fun at,” but that makes them no less effective “and there is nothing like success to reinforce someone in a new method of learning” (p. 209). Bower also noted that critics rarely make explicit that the alternatives to
mnemonics in memorizing are either “dumb, blind repetition or simply outright failure, and no one seems to want to champion these alternatives” (p. 209).

Visual Imagery: Old and New

Old

The origin of mnemonics is usually traced to the early Greeks about 500 B.C. Imagery played a central role from the very beginning. Cicero, writing in De Oratore, described the procedure as follows:

Persons desiring to train this faculty (of memory) must select places and form mental images of the things they wish to remember and store these images in the places, so that the order of the places will preserve the order of the things, and the images of the things will denote themselves. (Yates, 1966, p. 2)

This emphasis on visual imagery continued through the centuries. A memory course published in the early 1900's emphasized visual associations: “Practically all mental action and development are based on the Association of Ideas and the use of the visual faculty,” and “You are going to learn association and to visualize your ideas” (Roth, 1918, pp. 5-6). The use of visual imagery is also emphasized in current memory-training books (e.g., Lorayne & Lucas, 1974).

Probably the earliest research study which actually provides some empirical support for the memorability of pictures versus verbal material is that of Kirkpatrick (1894). Kirkpatrick studied memory for objects versus the names of the objects in elementary school, high school, and college students. Some subjects were shown 10 objects, and others were shown the names of the objects. He found that there was a slight advantage for immediate recall memory of objects over memory of names of the objects. After three days, the difference in recall was more striking. People who were shown the objects recalled seven times as much as people given the names of the objects (means were 6.29 vs. .91). Calkins (1898) obtained similar results using pictures of objects rather than the objects themselves. Moore (1919) found similarly that objects were recalled better than pictures, and pictures better than words. All these studies suggest indirectly that visual imagery may be helpful, although they do not provide direct evidence. Fracker (1908) reported eight experiments on memory for different kinds of material, and concluded that “some elements concerned in improvement and transference have been enumerated. Of these the central or most essential element is individual imagery” (p. 101).

1 It is interesting to note that the skepticism of some researchers regarding the value of mnemonics is not limited to the 20th century. Nearly a century ago, Burnham (1888) quoted the following from a 17th century document referring to teachers of mnemonics: “Many there be that at this day profess the same, though they get more infamy and disrepute than gain thereby: being a sort of rascally fellows that do many times impose upon silly youth, only to draw some small piece of money from them for present subsistence” (p. 86). Burnham then went on to say, “There is at least this difference between the mnemonic teachers of Agrippa’s time and those of the present. The latter generally get, not a small piece of money, but a large piece, and they sometimes impose upon others as well as silly youth” (pp. 86-87).
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The saying that “one picture is worth a thousand words” is usually applied to the effectiveness of a picture in communicating an idea that would take many words to express; it may also apply to the effectiveness of a picture in remembering what was communicated. Several recent studies have replicated the older findings reported above that objects are more memorable than pictures, and that pictures of objects are more memorable than the names of the objects, both by young children and by adults (e.g., Levie & Levie, 1975; Westman & Delprato, 1974). In addition, pictures of objects have been found to be more memorable than verbal descriptions of the objects (Denis, 1973). In fact, there is evidence that recognition memory for pictures may be virtually unlimited (see Standing, 1973).

Research on visual imagery provides a specific example of the previous discussion of the legitimacy of mnemonics (see Bugelski, 1970). In fact, in an extensive survey of the field of human learning published in 1952 (McGeoch & Irion, 1952), mental imagery and visualization were not even mentioned. The number of references appearing under “Imagery” in Psychological Abstracts was 8 in 1960, 19 in 1965, 62 in 1970, and 98 in 1975. There is considerable current research interest in the nature of imagery, and how and why it helps memory for verbal material (e.g., Bugelski, 1977; Fleming, 1977; Kieras, 1978; Richardson, 1977; Shepard, 1978; Wicker, 1978).

Although there are various theories about why visual imagery can be such a powerful memory aid in learning verbal material, the important point for mnemonics is that it can help. As Ellis (1978) noted, “There is no doubt about the effectiveness of imagery as a factor in verbal learning and memory; the conflict lies rather in the interpretation of imagery effects in learning and memory” (pp. 66–67).

Most of the research on imagery has used paired-associate learning of nouns (see reviews by Higbee, 1977; Kieras, 1978; Levin, 1976; Paivio, 1976; Pressley, 1977b). However, imagery has also been found to aid memory for adjectives (e.g., DeVito & Olson, 1973), and for verbs and adverbs (Pate, Ward, & Harlan, 1974). Nor is the value of imagery limited to memory for single words. Visual imagery has been found to help in learning sentences (e.g., Davies & Proctor, 1976; Higbee, 1976; Holmes & Langford, 1976; Levin, Ghatala, Guttmann, Subkoviak, & Bender, 1978), and vocabulary and prose material (see reviews by Pressley, 1977b; and Wittrock & Lumsdaine, 1977); and even in abstract and conceptual learning (e.g., Katz & Paivio, 1975; Snodgrass & Asiaghi, 1977).

Using Visual Imagery

The following advice for the effective mnemonic use of visual imagery was given about 2,000 years ago in Ad Herennium (circa 86–82 B.C.):

Now nature herself teaches us what we should do. When we see in everyday life things that are petty, ordinary, and banal, we generally fail to remember them, because the mind is not being stirred by anything novel or marvellous. But if we see or hear something exceptionally base, dishonourable, unusual, great, unbelievable, or ridiculous, that we are likely to remember for a long time . . . . We ought, then, to set up images of a kind that can adhere longest in memory. And we shall do so if we establish similitudes as striking as possible; if we set up images that are not many or vague but active; if we assign to them exceptional beauty or singular ugliness; if we ornament some of them, as with
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crowns or purple cloaks, so that the similitude may be more distinct to use; or if we somehow disfigure them, as by introducing one stained with blood or soiled with mud or smeared with red paint, so that its form is more striking, or by assigning certain comic effects to our images, for that, too, will ensure our remembering them more readily. (Yates, 1966, pp. 9-10)

This advice carried through the centuries. It was advised by memory-training courses in the 1800's and early 1900's. Consider the following suggestions by Roth (1918):

Take advantage of the fact that things out of the ordinary impress us more than those that are commonplace. In order to retain your visual associations you must make them unusual. Some of us find it necessary to make these associations grotesque and ludicrous although I do not recommend the extreme use of this. (p. 9)
Your mind's eye should see every picture clearly. (p. 12)
You must have two objects in every picture. Do not make the mistake of forming a picture of only one object at a time. (p. 23)
[If recall fails] it may be because you have merely thought of the two ideas, but have failed to actually see in your mind's eye the picture combining them, or because you have failed to imagine motion, color, or exaggeration in your pictures. (p. 39)

Concerning the clarity of the images, Kirkpatrick (1894) felt that his research results gave some ground for saying “Make the impressions vivid and the associations will take care of themselves” (p. 605).
These suggestions are still emphasized in current memory-training books, as the following examples show (Lorayne & Lucas, 1974):

You need a ridiculous—impossible, crazy, illogical, absurd—picture or image to associate the two items. What you don't want is a logical or sensible picture. (p. 9)
You needn't labor over seeing that picture. All is takes is a fraction of a second. It's the clarity of the picture that's important, not how long you see it. (p. 11)
The one problem you may have in Linking, only at first, is in making your pictures ridiculous. There are four simple rules to help you do this right from the start. The easiest rule to apply is the rule of Substitution. . . . Another rule is Out of Proportion. . . . Another rule is Exaggeration. . . . And, try to get Action into your pictures. (pp. 15-16)

The above advice from the past and present suggests at least three strategies that may be used to make visual associations effective. First, form a visual image of the two items interacting with each other. Second, picture the image as clearly and vividly as possible. Third, use bizarre associations. Each of these suggestions has received recent research interest. The evidence provides strong support for interaction, some support for vividness, and no support for bizarreness.

Interaction

Visual imagery by itself may not be too effective. Evidence indicates that to make visual association effective, imagery must both be “visual” and involve “association.”
It is necessary that the two items you are associating be pictured as interacting in some way with each other, rather than merely sitting next to each other. For example, if you were associating “dog” and “broom,” it would be better to picture a dog sweeping with a broom than to picture a dog standing by a broom.

Research in which pictures are shown to people, rather than having the people make up their own mental pictures, has found that when the items in the picture are interacting, they are remembered better than when they are not interacting (e.g., Kee & White, 1977; Odom & Nesbitt, 1974; Wollen & Lowrey, 1974). Numerous studies in which people make up their own mental pictures to remember words have also found that interacting imagery is more effective than separated images in paired-associate learning (e.g., Begg & Anderson, 1976; Kerst, 1976; Nelson, Greene, Ronk, Hatchett, & Igl, 1978; Reese, 1977a, 1977b; Richardson, 1976). The advantage of interacting imagery over separate images has been well-supported, and future efforts may more beneficially be aimed at theoretical explanations for the effect (e.g., Begg, 1978; Reese, 1977b) than at piling up additional evidence in support of the effect.

**Vividness**

A vivid visual image is one that is clear, distinct, and strong. For example, if you are associating “dog” and “broom,” you should not just think about the words “dog” and “broom” together, or think about a dog sweeping with a broom, but should actually try to see the dog sweeping with the broom in your mind. It may help to make the picture detailed. What kind of dog is it? What kind of broom? Where is he sweeping? What is he sweeping? Picture a dachshund sweeping mud off your porch with a pushbroom; or a bulldog sweeping food off the kitchen floor with a straw broom.

Several different kinds of studies suggest that visual associations should be vivid to be remembered. In a correlational study of imagery in paired-associate learning, people rated the vividness of their images as they constructed them. For every person, the more vivid the images were rated, the better they were recalled (Bower, 1972). This positive correlation between recall and vividness of imagery has also been found for sentences (Anderson & Hidde, 1971). In an experimental study Delin (1969) found that students instructed to make vivid mental images tended to remember a list of words better than students told only to make mental images; students instructed to make vivid, active images tended to perform even better.

In other experimental studies people learned concrete sentences or paragraphs that described events with either high or low vividness. (The vivid descriptions were more emotional, colorful, and forceful, and yielded more graphic imagery.) The vivid sentences and paragraphs were recalled better than the nonvivid ones (Anderson & Hidde, 1971; Holmes & Murray, 1974). Similarly, vivid pictures, like a crashed airplane, are remembered better than normal pictures, like a flying airplane (Standing, 1973).

Studies comparing people who have a high ability for visual imagery with people with low ability have found a positive relationship between measures of vividness of imagery and retention, suggesting that the ability to experience vivid visual imagery indeed facilitates memory (Ernest, 1977), although this conclusion is not clear-cut due to the many different ways of measuring imagery ability (see Hiscock, 1978; Richardson, 1977; White, Sheehan, & Ashton, 1977). That interaction may be more critical than vividness is suggested by the finding that people high in imagery ability
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do not benefit by this ability when they use separate images (Richardson, 1976, 1978).

_Bizarreness_

Another recommendation that has come down through the ages is that visual associations must be bizarre (unusual, weird, implausible, incongruous, or ludicrous). The opposite of bizarre would be plausible—a picture that makes sense, and could really occur. For example, in associating “dog-broom,” a picture of a dog being chased out of a house by a person with a broom is plausible; a dog sweeping with a broom would be somewhat bizarre; and a dog riding a broom like a witch, or a person sweeping the floor with a dog tied to the end of a broomstick would be bizarre.

Most recent research has found that bizarre imagery is not more effective than plausible imagery (e.g., Bevan & Feuer, 1977; Hauck, Walsh, & Kroll, 1976; Senter & Hoffman, 1976), although one study found bizarre imagery to be more effective in delayed recall (Andreoff & Yarmey, 1976).

Hock, Romanski, Galie, and Williams (1978) found that novel visual associations between objects helped memory for the objects more than did common associations, as long as the novel associations were plausible. However, implausible novel associations were no more effective than common plausible associations. (A man playing a harp is an example of a common plausible association; a man sitting on a harp is a novel plausible association; a harp playing a man is an implausible novel association.)

Senter and Hoffman (1976) compared the importance of bizarreness versus interaction. People saw pictures of two objects, which varied in whether the objects were bizarre or common and whether they were interacting or separate. Interacting pictures were recalled better than noninteracting pictures, but bizarreness did not affect recall.

Thus, there is considerable evidence that bizarre visual associations are not more effective than plausible ones. When bizarreness does help, it is likely because bizarre images incorporate other factors which help memory. Thus, some interacting images may almost have to be bizarre in order to involve interaction (for example, it is hard to think of a plausible picture showing a whale and a piano interacting). Bizarre images may be more vivid than plausible images. Bizarre images tend to be unique, and the uniqueness of an image helps memory (Andreoff & Yarmey, 1976). Bizarre images take more time to form than do plausible images (e.g., Hauck et al., 1976), and extra time spent on an image may increase its memorability.

However, all of these factors (interaction, vividness, uniqueness, extra time) can also be used in images which are not bizarre. It is not necessary that an image be bizarre to incorporate these factors. One popular memory-training book (Lorayne & Lucas, 1974) illustrated the advantages of bizarre associations by the following examples for associating _airplane_ and _tree_: A logical picture would be an airplane parked near a tree. Since that is possible, the book said, it probably will not work; better pictures would be airplanes growing on trees, or trees boarding an airplane. It is true that the latter examples would be more memorable than a plane parked near a tree. However, it is also true that plausible pictures involving interaction, vividness, and uniqueness would also be more memorable; for example, a low-flying airplane shearing the tops off trees, or an airplane crashing into a tree.
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One reason why bizarreness may be ineffective for some people is that some people find it difficult to make up bizarre images (Gruneberg, Monks, Sykes, & Oborne, 1974). The person who finds it difficult to make up bizarre images, or who feels uncomfortable doing so, can concentrate on making the images interacting and vivid, and not worry about making them bizarre. On the other hand, the person who does not have any trouble imagining bizarre associations, and who feels comfortable with them, can go ahead and use them.

Own-Versus Other-supplied Mediators

In ancient times it was considered advisable for learners to construct their own associations, rather than have them given to them by someone else. Yates (1966) reported that though the ancient memory treatise would always give the rules, it rarely gave any concrete application of the rules. She reports that this tradition was started by the author of *Ad Herennium*, who said that the duty of an instructor in mnemonics is to teach the method of making images, give a few examples, and then encourage students to form their own. This suggestion has carried to modern memory books, as Lorayne and Lucas (1974) advise, "You're much better off, incidentally, thinking up your own pictures" (p. 11).

The recent research evidence tends to support this claim, although the evidence is not unequivocal. Some studies have found that both visual and verbal mediators tend to be more effective if subjects think them up themselves than if they are given by the experimenter (e.g., Griffith, 1976; Ley & Locascio, 1977; Ley & Hubba, Note 4). Research by Wittrock (e.g., Doctorow, Wittrock, & Marks, 1978; Wittrock & Lumsdaine, 1977; Wittrock, Note 5) on the generative model of reading comprehension is also supportive of the facilitative effect of readers generating their own elaborations.

However, other studies have yielded mixed results. Treat and Reese (1976) found a slight advantage of self-generated imagery for elderly people but not for young adults. For verbal associations, Ley and Dean (1976) found that people high in associative ability showed better recall than those low in associative ability, when associations were supplied by the experimenter, but not when the associations were self-generated. In addition, people who may not be able to construct good mediators, such as young children (see Reese, 1977a) and mental retardates (see Campione & Brown, 1977), benefit by having associations suggested to them.

So far we have examined historical and recent aspects of the scientific legitimacy of mnemonics, the effectiveness of visual imagery as a mnemonic technique, factors affecting the effectiveness of visual imagery, and own- versus other-supplied mediators. At this point, the concluding remarks from a review of memory published nearly a century ago seem appropriate, because the conclusion applies as well today as it did then:

In recent years the subject of memory has broadened. It is now connected with some of the most profound questions of psychology and biology. As the knowledge of these sciences has advanced, the importance of the study of memory has increased. Yet it is noteworthy that the beginning of the newer views is found in the doctrines of the older writers studied in this article. (Burnham, 1888, p. 90)
Educational Implications of Mnemonics

In 1883, Galton published a survey in which he investigated the vividness of visual imagery in 100 adult men. He asked them to imagine given objects, then asked them questions about the nature of their images and found considerable individual differences (see Galton, 1907). Even though he felt that "the visualizing faculty is a natural gift" (p. 69), he suggested that "there is abundant evidence that the visualizing faculty admits of being developed by education" (p. 73). He further suggested that the faculty is worth developing:

There can, however, be no doubt as to the utility of the visualizing faculty when it is duly subordinate to the higher intellectual operations. . . . I believe that a serious study of the best methods of developing and utilizing this faculty, without prejudice to the practice of abstract thought in symbols, is one of the many pressing desiderata in the yet unformed science of education. (p. 79)

Similarly, Kirkpatrick suggested in 1894,

The fact that mental images of objects are remembered better than their names is of great pedagogical significance, indicating that if objects are shown children, or when that is impracticable, if they are led to form mental images of them, they can obtain a genuine knowledge of things more readily than they can be crammed with the verbal appearance of knowledge. (p. 605)

Sully (1899) noted that "the training of the memory, though it is not the whole of intellectual education, is certainly an important part of it" (p. 294). In a 1909 book discussing experimental research on memory, Watt concluded a chapter on mental imagery in memory with the statement: "The need for visual and pictorial demonstration is being recognized more and more in our higher education" (p. 108).

In the early 1970's, several researchers likewise suggested the potential for mnemonics in education. Paivio (1971) suggested that the most important practical outcome of research on imagery and verbal processes may be in relation to problems of education. Cermak (1972) predicted that mnemonic methods of organizing will someday be taught as a high school subject. Bower (1973a) suggested a number of educational uses of mnemonics, and gave examples of how different mnemonics can be used in schoolwork.

More recently, Hilgard and Bower (1975) wrote, "It now seems reasonably certain that all efforts at audio-visual instruction, plus teaching the pupil techniques of mnemonic elaboration and imagery of materials to be learned are likely to maximize the amount of learning obtainable within the least time, and with the least repetitive drill and difficulty" (p. 589). Wittrock (in press) has noted that "memory, imagery, and other cognitive processes are being resurrected in the study of instruction because they are important to the explanation and understanding of human and humane learning."

Is research on mnemonics having an effect on education? Pressley (1977b) noted Paivio's lamenting in 1971 that imagery researchers could only offer speculation to educators about the effects of imagery on learning. He then wrote,
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Six years later there are a lot more data that allow better guesses as to the effect of pictures and imagery on children’s learning, especially learning in naturalistic situations, such as prose learning. Researchers can give the educator reasonable estimates of the age at which imagery strategies effectively mediate various tasks. The researcher can suggest a gross diagnostic to separate good picture learners from bad ones. However, more information is needed if imagery is to have a significant impact on the education of children. The promise is great, but as yet unfilled. (pp. 615–616)

It should be noted that even if, as Pressley suggested above, the promise of mnemonics in educational applications is unfilled, that does not necessarily mean that mnemonics are not useful in education. The problem of applying research findings in educational settings is not limited to mnemonics, but seems to be characteristic of much research on learning and memory (see Entwistle, 1977; Hilgard, 1977; Jackson & Kiesler, 1977; Kemmis & Grotelueschen, 1977; Kerlinger, 1977; Rohwer & Dempster 1977; Jenkins, Note 6). The incorporation of mnemonics in education may be a slow process (as are most changes in education).

Some attempts have been made to use mnemonics for instruction. One project has used research on mnemonic elaboration as a basis for developing a training program to give children a basic understanding of fundamental words and concepts concerning money, measurement, and time (see Turnure & Thurlow, 1976). Programs for teaching reading that are based on mnemonics have been developed (Michael, King, & Moorhead, 1978; Wendon, 1972). Imagery mediation has also been applied in developing programs for training effective learning strategies (e.g., Dansereau, Long, McDonald, Atkinson, Collins, Evans, Ellis, & Williams, 1976; Weinstein, Note 7). Visual imagery has been found to facilitate performance of kindergarten children on difficult addition problems (Grunau, 1978), and visual rehearsal has been found to help preschool children in problem-solving (Gross, Note 8; but see Wicker, Weinstein, Yelich, & Brooks, 1978).

Carlson, Kincaid, Lance, and Hodgson (1976) found a positive correlation between grade point average and the spontaneous use of mnemonics by college students, which they suggested as evidence that mnemonics may help in academic studies (although they did not determine the direction of causality, it is also possible that being a good student may help in using mnemonics). Gruneberg (1978) presents additional evidence that the use of mnemonics (in this case, the first-letter mnemonic) may aid college students in their schoolwork.

Some college students in my memory class have reported benefits from mnemonic systems in their schoolwork. For example, one student reported using a mnemonic system to complete a self-paced physics course. The course employed a 24-chapter textbook, a six-unit study guide, a series of films on the major units, and optional filmed lectures. He completed the one-semester course in two weeks, and obtained A’s on all four exams. He said, “The class was a first of its kind for me, so I was a little leary of how I would perform,” and he reported (rather surprised) that “the results were quite amazing.” Another student reported that one teacher warned his class “there is no way to memorize this information other than rote repetition. You must face that fact, and resign yourself to repeating it over and over. Plan 3–4 hours to do it”; the student used a mnemonic system to memorize the information in less than 2 hours, and got a perfect score on the exam. A third student used a variety of
mnemonic systems to learn a mass of material for an examination well enough to get 98% on the test. She reported, "The test was timed (40 minutes) and the majority of the class did not finish in this amount of time. I had no difficulty in finishing; in fact, I even had time to look over the test to make sure I did not want to change any of the answers."

The feasibility of using mnemonic training in education is supported by findings of visual-imagery effects on material other than serial and paired-associate learning of concrete word lists. As has been noted, visual imagery has been found to help in learning sentences, vocabulary and prose material, and concepts. In addition, imagery has been found to be effective in learning foreign languages (Atkinson, 1975; Delaney, 1978; Ott, Blake, & Butler, 1976; Pressley, 1977a; Webber, 1978). There is even evidence that imagery can help in understanding verbal material as well as remembering it (see Higbee, in press, Note 9).

Additional implications for the educational uses of mnemonics come from research on the role of memory in reading. Morrison, Giordani, and Nagy (1977) found that reading disabilities may be due to deficiencies in memory skills rather than in perception. Morrison said that he expects dramatic changes in the next few years that will put more emphasis in education on memory, including activities that train the memory and ways to diagnose memory problems ("Remembering to Read," 1977). Reading-disabled children have been found to perform worse than normal children on memory tasks (see Berger & Perfetti, 1977; Pelham & Ross, 1977; Prawat & Kerasotes, 1978; Tarver, Hallahan, Kauffman, & Ball, 1976; Torgesen, 1977; Wong, Wong, & Foth, 1977), although not necessarily on incidental memory tasks (Pelham & Ross, 1977; Tarver et al., 1976); and Torgesen (1977) found that memory deficits of reading-disabled children can be overcome by instruction in efficient mnemonic strategies.

Other research on reading has demonstrated the feasibility of teaching a basic reading vocabulary to retarded children and adults, using mnemonic associative strategies (Martin, in press); has found that a story mnemonic can aid kindergarten children's long-term retention of geometric shapes used in pre-letter-learning preparation (Gallimore, Lam, Speidel, & Tharp, 1977); and has used imagery mediation in teaching sight-sound associations for reading (Ackerman, Note 10). The possible role of imagery in reading ability is also suggested by the finding that high-imagery words are easier for poor readers to read than are low-imagery words (Jorm, 1977).

A common argument against teaching and using mnemonics in education is that they help only with memorization of meaningless, unrelated facts, but not with the higher educational goals of understanding, reasoning, and creative thinking. However, much of schoolwork does involve straight memory. In their discussion of why educators may not appreciate the central importance of memory in education, Rohwer and Dempster (1977) wrote the following (see also, Howe & Ceci, in press):

Indeed, some give the impression that they regard memory proficiency as antithetical to academic excellence, feeling that memorization interferes with the operation of more laudable, higher mental processes. Such misconceptions about psychological perspectives on memory must be dispelled if work on memory development is to constitute a positive contribution to educational practice. (p. 407)
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Bower (1973b) has suggested that schools should teach memory skills just as they teach the skills of reading and writing, and he offered the following insightful analysis of the role of memory in education:

Although teachers typically describe educational goals in such lofty terms as teaching their students to be critical, insightful, curious, and deeply appreciative of the subject matter, these are usually only extra requirements beyond the learning of basic facts that is demanded as a minimum. Any geography student who thinks Istanbul is in France, or any art-history student who thinks Salvador Dali painted the Sistine Chapel, is going to flunk his exams if he pulls such boners often enough.

The point is that we do demand that students learn a lot of facts just as we are constantly required to do in our daily life. You can get a feel for this if you try to carry out an intelligent conversation about some current event . . . without having learned some facts about the topic.

But the solution to the problem is probably at hand. By systematically applying the knowledge that we now have about learning, we should be able to improve our skills so that we spend less time memorizing facts. By the strategic use of mnemonics, we might free ourselves for those tasks we consider more important than memorization. (p. 70)

Thus, even if mnemonics did help only remembering and not understanding, many people might still have enough to remember in school and elsewhere to make the use of memory aids worthwhile. Actually, the assumption that mnemonics do not aid understanding may not be completely valid; as has been noted, there is some evidence that mnemonics can help in understanding material as well as in remembering it. The value of mnemonics in understanding (as well as additional considerations in the practical applications of mnemonics) has been discussed further elsewhere (Higbee, in press, Note 9).

The applicability of mnemonics beyond the research laboratory and mnemonists' demonstrations is also suggested by the wide range of people who have been found to use mnemonics effectively. Mnemonic elaboration has been found to improve memory in young children (see Levin, 1976) and in the elderly (e.g., Robertson-Tchabo, Hausman, & Arenberg, 1976; Treat, Poon, Fozard, & Popkin, Note 11). It has been used effectively by mentally retarded children (Campione & Brown, 1977; Martin, in press), and by brain-damaged patients (e.g., Crovitz, in press; Lewinsohn, Danaher, & Kikel, 1977). However, it should be noted that not much success has been achieved in effecting a permanent increase in self-activated elaboration in young children (Rohwer & Dempster, 1977); even though very young and mentally retarded children can be taught to use mnemonics effectively for a given task, they may often fail to use them spontaneously on subsequent tasks, and fail to generalize to other tasks (Campione & Brown, 1977).

As a final note on mnemonics and education, let us consider Wittrock's (Note 5) suggestion of additional reasons why mnemonics may have practical implications for education:

The mnemonic has several advantages as a teaching tool. The imagery mnemonic does not require literacy among the learners. The mnemonic is easy to learn and difficult to forget. It is useful with large numbers of people, and it is
cost effective because images are inexpensive to construct, easy to transport, and impossible to consume. They also never wear out, and they never rust or need paint. (pp. 6–7)

In summary, the use of visual imagery may have implications for school instruction in at least two general ways: first, the ways in which instruction and instructional material can best present information to students to help learning and retention (e.g., concrete vs. abstract [concrete stories, examples, analogies, etc.], pictorial vs. verbal [pictures, diagrams, paintings, demonstrations, etc.], interacting vs. separate images), and second, the kinds of activities students can be taught to increase their learning power (e.g., visual associations, verbal elaboration, drawing pictures and diagrams).

Conclusion

Watt, a psychologist commenting on mnemonic systems in 1909, observed, “In principle such systems of memory training are all out of date, although in some cases their contents have not yet been tested or out-reached in psychological experiments” (pp. 9–10). Although the first part of this statement did not prove prophetic, the last part did. More than half a century later, psychologists began to seriously study systems of memory training and we can now say that many of their contents have been tested in psychological experiments. In this article we have seen the historical roots of much of this recent research on mnemonics, and have gotten a glimpse of the potential practical implications that this research can have for education.

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