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## **MNEMONICS: EDUCATIONAL APPLICATIONS**

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The purpose of this paper is to describe selected mnemonic techniques and to review research studies that validate the apparent benefits of these memory aids, with the primary focus on strategies and conditions that will facilitate the learning and retrieval of information and, thusly, improve comprehension in content classrooms. Through the use of memory systems, or mnemonics, spectacular displays of memory have been demonstrated with results that have specific applications to educational settings.

Unfortunately, some people think that the development of a good memory is like exercising a mental muscle by practicing

one rote exercise after another. Ebbinghaus (1964) showed the lack of any such analogous relationship when he found that the number of trials required to learn a list of twelve syllables by rote was fifteen times as great as that required to learn six syllables.

The importance of mnemonic devices for the facilitation of recall has been noted in recent surveys of the literature and related research (Ernest, 1977; Higbee, 1979; Hoffman & Senter, 1978). E.g., it has been found that the memory deficits of reading disabled children could be overcome by instruction in efficient mnemonic strategies (Torgesen, 1977) and that the problem solving ability of highly anxious subjects could be improved with memory aids (Gross & Mastenbrook, 1980). Further benefits from mnemonic training were demonstrated by Barclay (1979) when he reported that all his trained subjects maintained mnemonic strategies and showed transfer to new learning situations.

Only in recent years have mnemonics been considered serious and legitimate techniques in learning (Higbee, 1979). With the "knowledge explosion" adding an overwhelming amount of facts to our already vast mental store of data, more demands have been placed on the individual to learn, retain, and recall substantial amounts of this information. Bower (1973), concluding from his research that the basic facts must be learned before higher comprehension skills could be achieved, recommended that we teach mnemonic techniques just as we teach reading and writing.

## Methods, Research, and Educational Applications

### Peg-type Mnemonics

"Pegs," or schematically-organized concrete words, have been used to remember numerous items. Bower (1970; 1972) gave some guidelines on the use of peg-words, including these: (a) Both the peg-words and items to be remembered must be made to interact so as to form a single integrated image. (b) The peg-words must be generated easily by the subject or externally provided. (c) More than one item can be associated with a given peg-word, provided the items are elaborated into a unitary image. (d) Semantic similarity among peg-words impairs performance.

Wood (1967) reported the facilitation of recall when peg-words were used by subjects to learn response words and concluded that (a) recall is increased when a peg list is used, (b) there is a correct serial ordering with the peg, and (c) material in the middle of the list is not more difficult to learn than the items at the beginning or end. In addition, Hoffman and Senter (1978) found that with the use of a peg list, accuracy of recall did not decrease when subjects learned multiple lists of related items.

With the rhyming peg-word as described by Lorayne and Lucas (1974), each peg-word rhymed with the number indicating its position on the list such as "one is a bun, two is a shoe, three is a tree, four is a door, five is a hive, six are sticks, seven is heaven, eight is a gate, nine is a line, and ten is a hen." This scheme has been used by the author to remember lists such as the order of the presidents of the United States. Using the rhyming pegs, a visual image was made of each president and integrated with the peg-word. For example, George Washington was imagined wearing a bun in his hair (one is a bun). John Adams was pictured with a large *Adam's* apple and a *shoe* tied around his neck (two is a shoe). Thomas Jefferson was thought of as a *Jef-fer(fir)-son* tree (three is a tree), and so forth.

Logan (1955) proposed another peg system in which the peg-words sounded like their numbered positions: one is won, two is shoe, three is tee, four is gore, five is dive, six is kicks, seven is heaven, eight is bait, nine is dine, ten is hen, and so forth. Using the presidents again, the following sequence could be imagined: *Washington won* the Revolutionary War and the presidency; *Adams wore a shoe* in the Garden of Eden; *Jeff*

was teaching his *son* to play golf so he set up the *tee*. This system could be elaborated to include the dates the presidents took office.

For long-digit number encoding, a system was described by Paivio (1971) which decoded the numbers into words by translating each number into a predetermined consonant sound, e.g.: One was equivalent to the sounds of *t*, *d*, and *th*; two was the *n* sound; three was *m*; four was *r*; five was *l*; six was *j*, *sh*, *ch*, and soft *g*; seven was *k*, hard *c*, and hard *g*; eight was *f*, *v*, and *ph*; nine was *p* and *b*; zero was *z*, *s*, and soft *c*. The vowels and *w*, *h*, *y*, had no value, but were added to the consonant sounds to create words or sentences. This system could be used to remember telephone numbers, dates, statistics, measurements, and so forth. When using this system to remember the dates the presidents took office, the author simply transposed the last two digits of the date to the appropriate consonant sounds, added vowels to make a concrete word, and associated the image with the president. Washington took office in 1789, so *8* and *9* became *f* and *b* respectively, from which the word *job* was developed and used to imagine Washington with a bright watch *job* and a bun in his hair. Adams was pictured with his shoe tied around his neck reading a *book* in the Garden of Eden as a cue for 1797, and so forth. Bower (1978) suggested the following sentence in aiding the recall of the consonant phonetic alphabet for digits from 0 to 9: *Satan may relish coffee pie*.

To visualize each letter of the alphabet, Lorayne and Lucas (1974) assigned highly visual words to the letters of the alphabet: A was ape, B was bean, C was sea, etc. With each assigned cue word sounding like its corresponding letter, recall was enhanced. This system was used to remember anything that contained letters, such as formulas and equations, style numbers, stock numbers, license plates, and difficult spelling words.

The literature has shown that peg-word mnemonics did not greatly increase recall performance when items to be learned were low imagery abstract words (Bellezza, 1981). However, by creating tangible words and sentences from abstractions, and then applying the peg-word system for retention, the learner was always "originally aware" of the number, formula, or list of vague facts to be remembered.

### Keyword Method

When using a mnemonic device on a list of abstract words, either a semantic or phonetic encoding procedure might have to be applied to the list of items before they can be successfully associated with the mnemonic cue (Bugelski, 1970). The phonetic encoding technique, called the keyword of substitute word method, has been used effectively in teaching a second language (Atkinson, 1975; Atkinson & Raugh, 1975; Levin et al, 1979; Raugh & Atkinson, 1975). In using the keyword, a foreign word was presented and its English translation was to be remembered. An English word, the keyword, was found within the foreign word to be learned forming an interactive image between the keyword and the English translation of the foreign word. For example, the Spanish word *perro* (pronounced pear-oh) which means *dog*, could be remembered by associating the keyword *pear* with *dog* such as having a visual picture of a dog eating a pear (Bellezza, 1981).

Pressley and Dennis-Rounds (1980) found the keyword strategy effective with 18 year-olds who learned a list of cities paired with their products and showed transfer of the technique to a follow-up Latin learning task. Atkinson (1975) summarized the effectiveness of the keyword method when he reported gains in learning sentences, vocabulary, prose, and abstract concepts.

### The Link

Another method described as an aid in remembering a list was the link mnemonic. The procedure was to form a visual picture associating the first and second words of the list, then forming a completely different image connecting the second and the third, third and fourth, and so forth. The overlapping series acted as chains, and have been shown to improve recall

in a serial learning task (Delin, 1969).

With the story mnemonic (Bower & Clark, 1969), a linking device in serial learning, the user incorporated each successive word on a list into a story that was created as the items were presented. There was little difficulty in distinguishing the items from the words in the story and little interference from other previously formed stories.

Lorayne and Lucas (1974) described the story link procedure after the following news item was read by students for factual recall: "In the history of railroading, few tracks have been laid faster than those of the Tanzam Railway in Zambia. At this moment, it is moving from the Port of Dar es Salaam to Zambia's copper belt" (p. 180). This news item described Zambia and its railway, so a link should be started with a "heading" picture, a substitute thought that would be a reminder of Zambia. The authors used *zombie* as a start of the link for Zambia. They pictured a *zombie walking very fast along a railroad track*; the sun was so hot that it *tans 'im*. This ridiculous picture was a vivid reminder that in Zambia, the railroad tracks were being laid very quickly, and the railway was the Tanzam Railway. In continuing the link, *There is salami* (Dar es Salaam) falling on the *zombie's copper belt*. Millions of pieces of salami were imagined falling, and if a more detailed cue was needed to remember Dar es Salaam, a person could be visualized pointing to a huge salami and saying, "There is salami!"

According to Lorayne and Lucas (1974), applications of the story link were found to slow down reading until proficiency was established, but once expertise was acquired, subjects remembered what they read or what they chose to remember. The link system could be used with all types of reading materials.

#### Single-use Mnemonics

Information that should be remembered permanently may have been learned with distinct organizational mnemonics. These mnemonics have sometimes been referred to as "ad hoc" mnemonics (Hunter, 1977). A variety of these mnemonics has been used by both children and adults.

Rhymes have been good at establishing order relations because any mistake in recall destroys the rhyme. Easy to learn and apply, the following rhymes have been commonly used: Use *i* before *e* except after *c*, and, Thirty days hath September, April, June, and November. Baddeley (1976) wrote a rhyme that would allow math enthusiasts to reproduce the value of Pi to the first twenty decimal places by counting the number of letters in each word:

Pie.

I wish I could remember Pi.

Eureka, cried the great inventor.

Christmas pudding! Christmas pie!

Is the problem's very center.

Reduction coding was developed to eliminate irrelevant information, thus reducing the amount that has to be stored. First-letter mnemonics are examples: (a) ROY G. BIV helps recall the colors of the spectrum—red, orange, yellow, green, blue, indigo, and violet. (b) HOMES cues the names of the Great Lakes—Huron, Ontario, Michigan, Erie, and Superior.

Adding information beyond what was strictly necessary has been characteristic in elaboration coding. For example, (a) Richard of York gains battles in vain is another way of recalling colors of the spectrum. (b) Every good boy does fine tells the lines on a music staff. (c) Men very easily make jugs serve useful nocturnal purposes. This sentence codes the nine planets in their order from the sun—Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto.

Little research has been done on single-use mnemonics as a method of learning to be compared with other alternative instructional systems. It was found, however, that through the continued use of information learned by a mediating mnemonic, the information became more spontaneous and the use of

the mnemonic aid declined (Atkinson & Raugh, 1975).

#### Method of Loci

The method of loci, used by Roman orators to remember speeches, was one of the oldest and most influential mnemonic devices described in Roman books on rhetoric (Yates, 1966). A large number of places in some public building or home were memorized in strict serial order, such that each locus (location) could be clearly visualized from memory. The sections of the speech were reduced to visual images where each image represented an important idea. Each image was placed in the corresponding locus, and the locus was a cue for recall of the image which in turn suggested the idea to be incorporated into the speech.

Snowman, Krebs, and Lockhart (1980) demonstrated the advantages of teaching the method of loci to high-risk college freshmen. The mnemonics group significantly increased their ability to retrieve factual information from prose while a similar group trained in notetaking, main ideas, and vocabulary development showed negligible improvement. Another group of college students trained in the method of loci had significant better recall and higher grade point averages than those students who did not use any mnemonic system (Carlson et al, 1976).

#### Conclusions

Although there has been an interest in recent years on the use of mnemonic systems in improving the memory, such interest has been expressed more by the layperson than the educator. Some researchers may think that research on mnemonics is an "unscientific venture," a meaningless pastime of observing gimmicks by entertainers. Several researchers who experimented with mnemonics in the 1950's and early 1960's did not publish their results due to the prejudices against mnemonics at the time (Hoffman & Senter, 1978). Pauk (1974) advised that "Such systems are fun at parties, but hardly applicable for serious studying and learning" (p. 77).

It has been demonstrated that mnemonic systems used in laboratory settings and classroom contexts have had a significant influence on memory performance. Now that attitudes have become more positive toward the study of mnemonics, research should be continued to extend the apparent benefits of mnemonic systems into the classroom. It is becoming increasingly evident that mnemonics are effective aids to recall and should be taught to students as a legitimate part of the school curriculum.

#### REFERENCES

- Atkinson, R. C. Mnemotechnics in second-language learning. *American Psychologist*, 1975, 30, 821-828.
- Atkinson, R. C., & Raugh, M. R. An application of the mnemonic keyword method to the acquisition of a Russian vocabulary. *Journal of Experimental Psychology: Human Learning and Memory*, 1975, 104, 126-133.
- Baddeley, A. D. *The psychology of memory*. New York: Basic Books, Inc., 1976.
- Barelay, C. R. The executive control of mnemonic activity. *Journal of Experimental Child Psychology*, 1979, 27, 262-276.
- Bellezza, F. S. Mnemonic devices: Classification, characteristics, and criteria. *Review of Educational Research*, Summer 1981, 51 (2), 247-275.
- Bower, G. H. Imagery as a relational organizer in associative learning. *Journal of Verbal Learning and Verbal Behavior*, 1970, 9, 529-533.
- Bower, G. H. Mental imagery and associative learning. In L. W. Gregg (Ed.), *Cognitive learning and memory*. New York: Wiley, 1972.
- Bower, G. H. How to . . . uh . . . remember. *Psychology Today*, 1973, 7 (5), 63-70.
- Bower, G. H. Improving memory. *Human Nature*, February 1978, 65-72.
- Bower, G. H., & Clark, M. C. Narrative stories as mediators for serial learning. *Psychonomic Science*, 1969, 14, 181-182.
- Bugelski, B. R. Words and things and images. *American Psychologist*, 1970, 25, 1002-1012.

- Carlson, R. F., Kincaid, P., Lance, S., & Hodgson, T. Spontaneous use of mnemonics and grade point average. *The Journal of Psychology*, 1976, 92, 117-122.
- Delin, P. S. The learning to criterion of a serial list with and without mnemonic instructions. *Psychonomic Science*, 1969, 16, 169-170.
- Ebbinghaus, H. *Memory: A contribution to experimental psychology*. (H. A. Ruger & C. E. Busenius, Eds. and trans.) New York: Dover, 1964.
- Ernest, C. H. Imagery ability and cognition: A critical review. *Journal of Mental Imagery*, 1977, 2, 181-216.
- Gross, T. F., & Mastenbrook, M. Examination of the effects of state anxiety on problem-solving efficiency under high and low memory conditions. *Journal of Educational Psychology*, October 1980, 72, 605-609.
- Higbee, K. L. Recent research on visual mnemonics: Historical roots and educational fruits. *Review of Educational Research*, Fall 1979, 49 (4), 611-629.
- Hoffman, R. E. & Senter, R. J. Recent history of psychology: Mnemonic techniques and the psycholinguistic revolution. *The Psychological Record*, 1978, 28, 3-15.
- Hunter, I. M. L. Imagery, comprehension, and mnemonics. *Journal of Mental Imagery*, 1977, 1, 65-72.
- Levin, J. R., Pressley, M., McCormick, C. B., Miller, G. E., & Shriberg, L. K. Assessing the classroom potential of the keyword method. *Journal of Educational Psychology*, October 1979, 71, 583-594.
- Logan, A. L. *Remembering made easy*. New York: Arco Publishing Company, 1955.
- Lorayne, H., & Lucas, J. *The memory book*. New York: Random House, 1974.
- Paivio, A. *Imagery and verbal processes*. New York: Holt, 1971.
- Pressley, M., & Dennis-Rounds, J. Transfer of a mnemonic keyword strategy at two age levels. *Journal of Educational Psychology*, 1980, 72, 575-582.
- Raugh, M. R., & Atkinson, R. C. A mnemonic method for learning a second-language vocabulary. *Journal of Educational Psychology*, 1975, 67, 1-16.
- Snowman, J., Krebs, E., & Lockhart, L. Improving recall of information from prose in high-risk students through learning strategy training. *Journal of Instructional Psychology*, Winter 1980, 7 (1), 35-40.
- Torgesen, J. K. Memorization processes in reading-disabled children. *Journal of Educational Psychology*, 1977, 69, 571-578.
- Wood, G. Mnemonic systems in recall. *Journal of Educational Psychology*, December 1967, 58, (6), 1-27, (pt. 2).
- Yates, F. A. *The art of memory*. London: Rutledge & Kegan Paul, 1966.