Mnemonics at a glance

A collection of articles on mnemonic strategies from the Mempowered website

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What mnemonics are, and what they are for

Aids to memory such as acronyms, rhymes, linking information by creating visual images or making up a story, are called mnemonics. Mnemonic strategies have been recommended as appropriate for remembering the following types of information:

- shopping lists
- vocabulary
- appointments
- speeches
- facts
- names & faces
- dates
- phone numbers
- ideas
- jokes
- dramatic parts
- poems
- numbers

Mnemonics are undoubtedly effective for rote memorization, but they do require a lot of work to master.

Mnemonics can also help you learn basic facts and new vocabulary, which you need to acquire when learning a new subject. However, mastering a subject is not simply a matter of knowing a lot. An expert has a well-organized network of memory codes into which new information can be easily integrated. Mnemonic techniques on their own do not help you understand the meaning of facts, and do not therefore help you develop expertise in a subject.

Moreover, although mnemonics are usually the best strategies for memorizing by rote, for most tasks there are easier strategies which are sufficiently effective to be preferable for many people:

- written or electronic records
- rote repetition

The value of lists

For many tasks and for most people, a written list is far less effort, far more likely to be used, and far more reliable.

Many people discard the idea of lists because they have found they usually forget to use them. However, research has confirmed what many of us already know from experience — even if you forget to refer to your list, you are much more likely to recall items that you

have written down. The act of writing (and perhaps the opportunity to visualize your list) is sufficient to improve your memory.

Imagery in mnemonics

Visual imagery underlies most mnemonic strategies. The best known are the list-learning strategies — the method of loci, the pegword method, and the link method. While these are undoubtedly effective strategies, they perhaps have less value as general strategic tools than the transformational elaborative strategies — the keyword method, and face-name association.

The role of imagery in helping memory is largely misunderstood (see the myth of imagery). Methods that use words rather than images have been shown to be equally effective. Imagery has one major advantage, and that is the ease with which two items can be connected using imagery. Imagery also has one major disadvantage, and that is the difficulty many people have with creating images.

Verbal mnemonic strategies include the use of acronyms, rhymes, and the more complex coding method (for memorizing numbers) and the story method (the verbal equivalent of the linking mnemonic).

When it's best to use a mnemonic

- when information only need to be remembered for a short time
- as a reminder for well-learned information (to help overcome memory blocks; to remind you of the order of information)
- when written records are impossible, inconvenient, or inappropriate
- to anchor facts

When it's best to write something down

- when you need to remember the information for a long time
- when reliability and accuracy are important
- when memory load is to be avoided
- when information is coming at you too fast
- when the information is too complex

References

Using mnemonics

Let's look a little deeper into the value of mnemonics for knowledge acquisition. By "knowledge acquisition", I mean the sort of information you learn from textbooks — information that is not personal, that you need for the long-term.

In this context, I believe the chief value of mnemonic strategies is to help you recall information that needs to be remembered in a particular order. Thus we use mnemonics to help us remember the order of the planets, the order of musical notes on the stave, the order of the colors in a rainbow.

Sometimes we impose an order to make something easier to remember. Thus, HOMES is an established acronym to help people remember the Great Lakes of North America (**H**uron, **O**ntario, **M**ichigan, **E**rie, **S**uperior). The order of the lakes has no meaning, except that, ordered in such a way, the initial letters form a word.

Notice that, of course, the sole assistance this acronym offers is to serve as a reminder cue, by telling you the initial letters of the lakes (and how many there are). You have to already know the names of the lakes.

Other mnemonics for the Great Lakes provide slightly more information, by involving a meaningful order. Thus, "**S**am's **H**orse **M**ust **E**at **O**ats" orders the lakes according to size, and "**S**ergeant **M**ajor **H**ates **E**ating **O**nions" tells you the order of the lakes from west to east.

None of these help you remember the actual names of the lakes.

You could use words similar in sound to the lakes' names, to help in remembering the names. However, this may well result in a mnemonic that is harder to remember. For example, "Superior Mitch Again sees a Herons' Eyrie Entire" makes far less sense and is a much harder sentence to remember than "Sergeant Major Hates Eating Onions".

All this emphasizes the main point about mnemonics, a point that sometimes gets a little lost in the shuffle. Mnemonics are adjuncts to learning. They have their place, and they are extremely effective for their purpose, but you have to remember that their purpose is very limited. Thus, if you wished to learn the Periodic Table of Elements (a question about ways of memorizing the Periodic Table was actually what provoked this article), then you could simply devise a first-letter mnemonic for the table, such as:

He **He**lps **Li**mping **Be**ggars **B**orrow **C**rutches **N**icely **O**r **F**airly **N**ear. **N**aturally **M**a**g**azines **Al**low **Si**mple **P**unctuation **S**hould **Cl**ear **Ar**guments. (the first 18 elements, i.e., the first three rows of the Table).

And of course, this won't help you in any way if you are not already very familiar with the names of the elements. Nor will it tell you anything at all about the significance of the Periodic Table.

Why would you want to memorize the Periodic Table of Elements?

I don't mean this question to indicate contempt for the task, I actually believe deeply in the value of having core information tamped down, as it were, deep into your knowledge base. You cannot develop any expertise in a subject without knowing the core facts — really knowing, in the same way you know your name and birthdate and, maybe, the names of the players in your favorite sports team, or the words to a favorite song, or the names of the characters in your favorite TV show. (Mnemonics do not, in fact, play a role when you have that depth of knowledge. Once you know something at the level of instant accessibility, you don't need a mnemonic. But mnemonics can be of great help in the early stages of developing your knowledge.)

But let's return to the question. Why do I ask it? Because, whenever you want to learn something, you should ask yourself why. Not in the spirit of "does it really matter?", but with the purpose of establishing precisely your goal. Notice the word "precisely". It's not enough to simply say, "Well, I need to know the Periodic Table because I'm studying chemistry, and the teacher tells me I have to know it." Why does your teacher insist you learn the Periodic Table? How does it help your understanding of chemistry?

The Great Lakes of North America are simply several large bodies of water in geographical proximity. Knowing their names is of no deep significance, has no larger meaning. The Periodic Table, however, does have larger meaning. The order of elements is no arbitrary thing, and the placement of an element in a particular place in the Table is deeply significant.

The Periodic Table arranges the elements in such a way as to demonstrate the pattern underlying the physical and chemical similarities between elements. If you know where an element is in the Table, you know a great deal about the element.

To know that, however, you must understand a great deal more about the Periodic Table than simply the order of the elements. The order of the elements tells you nothing in itself.

So, what is it that you really need to know? Not the order, as such. Not simply: Hydrogen Helium Lithium Beryllium Boron Carbon Nitrogen Oxygen Fluorine Neon Sodium Magnesium Aluminum Silicon Phosphorus Sulfur Chlorine Argon Potassium Calcium Scandium Titanium Vanadium Chromium Manganese Iron Cobalt Nickel Copper Zinc Gallium Germanium Arsenic Selenium Bromine Krypton etc. The Periodic Table is a table for good reason, and you should never lose sight of that.

The rows have significance. The columns have significance. You don't want to be able to say, "Oh, Scandium. That's between Calcium and Titanium." So?

More to the point would be if you knew Scandium was in row 4 and column 3B — that would tell you something (if you knew the significance of the rows and columns).

I'm not knocking the use of mnemonics to learn this sort of information. Mnemonics, used wisely, can facilitate your learning in the beginning. But, if the information you want to memorize has any meaning, you need to combine the use of mnemonic strategies with

the use of strategies that are appropriate for meaningful learning. Never forget that the purpose of mnemonic strategies is to help with arbitrary information, facts that have no meaningful connection with each other.

Thus, to master the Periodic Table, you should look at the underlying principles and the meaningful clusters. Use mnemonics to memorize members of meaningful clusters, by all means. Just remember to clearly articulate precisely what you need to know (and then, redefine your goals at intervals as your knowledge grows), and organize the information in ways that support those precise goals. Then apply your mnemonics judiciously.

Visual Vs Verbal Mnemonic Techniques

> There is no special magic about visual images.
>
> Whether verbal or visual mnemonic techniques are better for learning depends partly on the learning material, partly on the nature of the learning task, and partly on the individual.
>
> Older adults in general are probably better advised to use verbal mnemonics.
>
> There is no particular advantage to using bizarre images.

Most mnemonic strategies use visual images. But as I say in The myth of imagery, while there is no doubt that imagery can be an effective tool, there is nothing particularly special about it. The advantage of imagery is that it provides an easy way of connecting information that is not otherwise readily connected. However, providing verbal links can be equally effective.

One study that compared verbal and visual imagery methods for remembering serial items (lists of words) found that using a verbal strategy resulted in equal performance on both lists of items rated as "high imagery" and "medium imagery". The two visual imagery techniques (method of loci, and pegword) resulted in higher performance than the verbal strategy for the high-imagery list, but poorer performance for the medium-imagery list [5].

A more recent study found that connecting three nouns by imagery was more beneficial for immediate unexpected recall than relating them by sentence, however, after a week, recall was the same for both techniques [3].

It is well-established that people differ in their abilities to visualize, and clearly the usefulness of visual imagery is partly dependent on whether you are a "high-imager" or a "low-imager" (but don't be fooled by these categorical labels - people will vary along a continuum rather than fall into an either-or category).

This talent also seems to change over the course of one's life. It has been suggested that older adults in particular might be better advised to use verbal mnemonics rather than

visual image techniques, as they apparently find it difficult to produce and remember visual images ([7]; [1]).

Not entirely independent of these individual differences, there is also a significant difference between the effectiveness of visual images presented to you and those you must generate for yourself.

There is also some evidence that imagery techniques are more effective in particular types of memory tasks compared to others. Herrmann [2] suggested that interactive imagery was the most effective strategy for paired associate learning (linking two items together), but a story mnemonic was most effective for free recall (remembering various items in any order).

On a related subject, a study that looked into the usefulness of bizarre imagery as a mnemonic aid found that bizarre images were remembered better in the immediate term but not the long term, and only if the images were experienced as part of a mixed list (bizarre and non-bizarre items), and the learner could control their pace of learning [4]. A number of studies have failed to find any particular benefit to constructing bizarre images, and indeed, have suggested that bizarre images take longer to construct and may result in poorer performance. Most recently, the bizarreness advantage in mixed lists was eliminated when alternative retrieval strategies were encouraged [6]. These researchers suggested that the advantage of bizarreness depends on your retrieval strategy (whether or not it is based on distinctiveness).

In sum, then, I would say that use of visual imagery is an entirely personal matter, that there is no clear superiority of visual over verbal techniques, and that (as always) it comes down to individual idiosyncrasy. Don't feel pressured into using imagery if you're not easy with it. And if you are comfortable with imagery, still restrict your use of the technique to situations where the images come easily - don't spend more time on constructing images than is warranted; be open to using other techniques. There's no magic to visual imagery. Meaningfulness, organization, depth of processing are the crucial elements in learning, not the precise tools you use to get there.

References

The myth of imagery

> Images are effective to the extent that they link information.
>
> Images are not inherently superior to words.
>
> Bizarre images are not necessarily recalled better than common images.
>
> Imagery is chiefly effective when used with an organizing structure.

Most mnemonic strategies are based on imagery. There is no doubt that imagery can be an effective tool, but there is nothing particularly special about imagery. The advantage of imagery is that it provides an easy way of connecting information that is not otherwise readily connected. However, providing verbal links can be equally effective.

The critical element is that words or images provide a context which links the information. Thus, imagery is only effective when it is an interactive image — one which ties together one bit of information with another.

Visual imagery on its own is of limited value without an organizing structure, such as the method of loci or the pegword method (see list-learning mnemonics).

It is usually emphasized that bizarre images are remembered much better, but there is no evidence for this. In many studies indeed, ordinary images are remembered slightly better. One of the problems is that people tend usually find it harder to create bizarre images. Unless you have a natural talent for thinking up bizarre images, it is probably not worth bothering about.

Further reading: for a long, scholarly article on mental imagery, you can see the entry in the Stanford Encyclopedia of Philosophy at:

http://plato.stanford.edu/entries/mental-imagery/

References

The Art of Memory

Frances Yates described the memory strategy valued by the ancient Greeks and Romans as the "Art of Memory" in her widely quoted and seminal book The Art of Memory. Today we know it as the method of loci. But the Art of Memory, as those of the ancient world and those of the medieval world practiced it, is far richer than is implied by that title.

It is known to us from three Roman sources – Cicero, an anonymous work Ad C. Herennium libri IV, and Quintilian's Institutio oratoria. The strategy itself, although developed by many in later centuries, has always been attributed to Simonides, a Greek of the 5th century B.C. Cicero emphasizes that Simonides is given the credit for the art of memory not simply because he discovered how important order is for memory, but also because of his emphasis on the importance of visualization.

The original concept of Simonides, as encapsulated in the much-quoted and memorable story associated with this discovery, was simple enough. As the story goes (abbreviated version), Simonides was called out of a banqueting hall and during his absence, there was an earthquake and the hall collapsed, killing everyone inside. The destruction was so great the bodies couldn't be identified, but Simonides visualized where everyone was sitting, and so enabled the bodies to be identified.

Order and imagery. The twin staples of mnemonics.

But the truly interesting aspect of this is how this simple idea was developed over the centuries. And the meaning (indeed, multiple meanings) it developed.

According to Mary J. Carruthers in her wonderful work The Book of Memory: A study of memory in medieval culture, medieval European scholasticism was fundamentally memorial. Now this is not particularly surprising - books were handwritten, and obviously far less available than now. But Carruthers points to something far more interesting - a trained memory was considered moral.

Following the Roman rhetorician Cicero (deeply admired by the medieval scholars), memory was considered to be one of the "virtues", and necessary to develop a moral character. Hence the rote learning so despised in our modern age: schoolchildren learned by heart the wise sayings of great men, so that they could also develop wisdom. Only by making moral arguments part of your character, known so well that the words are engraved in your heart, could you become moral.

I can see their point. Doubtless it is no coincidence that, today, this type of learning tends to occur only in fundamentalist religious education. Nor that its absence in education appears to have gone hand-in-hand with a disavowal of any sort of moral instruction. But the association of morality with memory is a fascinating and, to me at least, unexpected one.

Because of this association with morality, so fundamental to the medieval mind, mnemonic strategies were part of education, part of writing - books (according to Carruthers) were decorated for memorability. She even suggests that Dante's great work, his description of the circles of Hell, was actually a mnemonic device, to help people remember the places and attributes of Hell. This is not as weird as it sounds (well actually it is), because people used such descriptions as "memory places" (loci). The grotesque (to modern eyes) and shocking sculptuary in churches, paintings, drawings seen in the margins of books, all these, Carruthers suggests, were not so much because of some inexplicable twist of the medieval mind, as because they were intent on following the mnemonic principles they had been taught - provoking emotional reactions to enhance memorability.

Indeed, this is one of the (many) ideas I have found particularly intriguing: there is great emphasis from these pre-modern writers about memory, on the need to involve the emotions, to get yourself into a state as it were.

This is a particularly interesting point, because it is largely overlooked in modern memory advice (including my own!). I think the reason it is overlooked is simply because of modern sensibilities. Western culture, especially the scholastic, de-emphasizes emotion. It is therefore fascinating to read Carruthers' accounts of the emotional "states" which some pre-modern scholars seemed to find it necessary to work themselves into, when memorizing. Perhaps most interesting is that these scholars did not make the modern

distinction between memory for personal events and information, and memory for "facts" - they understood that, for more effective remembering, all information had to be made into a personal event.

> All mnemonic advice stresses the benefits to be gained from forming memories as "scenes" that include personal associations. Hugh of St Victor, for instance, stresses the need to impress the circumstances during which something was memorized as part of the associational web needed to recall it: the sort of day it is, how one feels, the gestures and appearance of one's teacher, the appearance of the manuscript page, and so on." (Mary Carruthers: The Book of Memory, p60)

Of course, the emotional component of memory also has an effect through its effect on motivation.

Another thing that struck me was how much ancient and medieval scholars understood about the practical aspects of memory - an understanding which seems to have got lost in the intervening centuries, buried beneath more arcane and complicated mnemonic strategies.

The mystique of these strategies seems to appeal to something in the human mind - the very complexity hints at something special, something magical. I am not decrying mnemonic strategies; they are certainly effective. But the more complex ones do require a great deal of training to be used effectively, and few people really want to put that degree of effort into something that, while potentially useful, is not, for most of us, as useful as all that.

But there are effective memory strategies that don't require so much effort to master, and the pre-modern scholars (at least in early times) understood the basic principles that underlie these:

- the need to break things up into manageable chunks
- the need for complete concentration (indeed it was suggested that night time was the best time to engage in memory work, because of the quiet and lack of distraction)
- the usefulness of reading aloud in a low murmur (if you ever saw the movie Yentl, you might recall the students learning the Talmud doing the same thing).

The need to break things up into manageable chunks is a piece of advice that doesn't seem to be emphasized much in the increasingly complex mnemonic schemes that developed much later, and yet it is probably the single most important principle.

As to exactly what people did to learn information, to make memorable associations, it was recognized that these were matters for the individual, that different methods suited different people (and of course, different materials and different purposes):

> "All ancient mnemonic advice [counsels] that any learned technique must be adapted to individual preferences and quirks. One cannot use a "canned" system, nor will every system work equally well for everyone." (ibid, p64)

When you're looking for a method of learning that will suit you, emotional affinity is as important as any other factor.

References and resources

Verbal mnemonics

> Coding mnemonics are the most effective means of memorizing numbers.
>
> Coding mnemonics can also be used to dramatically extend the value of the pegword method.
>
> First-letter mnemonics are most effective for learning the order of well-learned information.
>
> First-letter mnemonics can be useful for overcoming memory blocks.
>
> The story method is an effective means of learning lists.

Coding mnemonic

Coding mnemonics are used for encoding numbers. Because words are much easier for most of us to remember, a system that transforms numbers into letters is one of the best ways for remembering numbers — as seen in the modern innovation of encoding phone numbers into letters (0800-ANSETT).

A coding system is very useful for remembering numbers, but it must be said that few people have sufficient need to memorize long numbers to make the initial cost of learning the code acceptable.

The coding system's main value in fact is as a source of pegs for the pegword system. By allowing numbers to be encoded as easily remembered words, the number of pegs can be extended from ten into infinity. Lists of such pegwords are available in various memory improvement books.

Clearly of course, mastery of such a system requires a very large investment of time and effort, as well as a facility for image creation. But if you decide that the pegword strategy is for you, you should certainly increase its value by learning a coding system.

Such systems have been suggested for memorizing such information as appointments, and birthdays and anniversaries. There is no evidence that mnemonic strategies are particularly effective for tasks in the planning memory domain and most people find

external strategies — diaries, calendars, watch alarms — more dependable and easier to use.

First-letter mnemonics

First-letter mnemonics are probably the most widely used mnemonic. This reflects the popularity of specific mnemonics, rather than its wide use as a strategic tool.

There are two types of first-letter mnemonic: acronyms in which the initial letters form a meaningful word — such as FACE for the notes in the spaces of the treble staff — and acrostics in which the initial letters are used as the initial letters of other words to make a meaningful phrase — such as Every Good Boy Deserves Fruit for the notes on the lines of the treble staff.

First letter mnemonics are a very effective means of recalling the order of well-learned items. First letter mnemonics are a cueing strategy — they remind us of what we already know. They are therefore particularly effective as a means to overcome memory blocks — for example, for students whose minds 'go blank' in exams.

The story method

The story method is another list-learning strategy. It is the verbal equivalent of the link method. Items are chained together by linking them in a story. This method is as effective as the imagery methods for learning lists. Which one will be most effective for you depends on which type of information (words or images) you deal with most easily.

References

Singing for Memory

Song is a wonderful way to remember information, although some songs are better than others. Songs that help you remember need to have simple tunes, with a lot of repetition -- although a more complex tune can be used if it is very familiar. Most importantly, the words should be closely tied to the tune, so that it provides information about the text, such as line and syllable length. You can read more about this in my article on Music as a mnemonic aid, but here I simply want to mention a few specific songs designed for teaching facts.

I was always impressed by Flanders & Swann's song describing the First and Second Laws of Thermodynamics (you can read the lyrics at http://physics.about.com/cs/jokeoftheweek/a/flandersandswan.htm — though I'm not sure how well that works if you can't hear, as I can, the music and rhythms playing in your head as you read), and Tom Lehrer's song of the Periodic Table (you don't really need the lyrics for this, it's simply a list of the elements, but here they are: http://www.ahajokes.com/sci46.html .)

The Thermodynamics song, I think, is much easier to remember than the Periodic Table, but the latter is an interesting demonstration of how much you can improve memorability simply by setting the information to music.

You can find some more "science songs" at http://www.tranquility.net/~scimusic/lyrics.html (lyrics only), and http://www.haverford.edu/physics-astro/songs/links.html (this is actually designed for instruction: you can hear some of the songs, there are associated lesson plans, etc).

Drug Discovery Today also has an article recounting the lyrics for various songs, by scientists, celebrating various science subjects, which you can read at www.mnstate.edu/malott/Molecular04/SingaSongofScience.pdf (it's in pdf format).

Songs are in fact such a popular means of learning science facts that in the U.S. there is a Science Songwriters' Association!

Songs are also a great way to learn poems or prose texts. Many well-known texts have been put to music (for example, The Lied and Art Song Texts site has 87 listed for Shakespeare), or you can of course (bearing in mind the need to find a melody that "fits" the text) match texts to music yourself.

Keyword method

> **Guide to Use**
>
> Very effective for learning the meanings of words
>
> Not particularly effective for remembering the words themselves
>
> Most effective when you are supplied with the keyword, but create your own image
>
> Particularly suited for learning:
>
> > vocabulary
> >
> > face-name associations
> >
> > core facts

How the keyword method works

The keyword method has been especially pushed as an effective strategy for learning foreign vocabulary. It is presumably equally valuable for extending your native-language vocabulary and learning technical jargon, and has also been used successfully to teach social studies facts (e.g., the products of a country; capital cities), science facts (e.g., chemical reactions, parts of the skeletal and nervous systems) and the names and faces of people.

There are two stages to the method:

- link the foreign word with an English word that sounds like some part of the foreign word (e.g., the Spanish *carta* sounds like the English cart). This (cart) is the keyword.
- link the keyword with the English meaning of the foreign word by forming an interactive image (e.g*., carta* means letter, so you could visualize a letter inside a cart).

When not to use the keyword method

If you want to understand what a word means when you come across it the keyword method is probably the best memory strategy. However if your goal is an ability to produce the word, rote repetition is better. In other words, your letter in the cart will help you remember what *carta* means when you come across it, but it won't necessarily help you recall the Spanish word for letter.

Similarly, if you learn that Canberra is the capital of Australia by visualizing a can on top of a map of Australia, you should find it easy to answer "What is Canberra the capital of?", but less easy to answer "What is the capital of Australia?".

Remembering backwards

Although the keyword component of the word is much more likely to be recalled (the cart part of *carta*; the can part of Canberra), any word with that component seems equally possible.

To remember that *carta* means letter you need to:

- Derive the keyword from the word (cart from *carta*).
- Derive the interactive image from the keyword (letter in cart from cart).
- Derive the meaning from the image (letter, from letter in cart).

Clearly, the more obvious your original encoding, the easier it will be to recreate the process (cart is an obvious keyword for *carta*; pet is not quite so obvious for *pequenos*).

However, to remember the Spanish word for letter, you must:

- Retrieve the interactive image (letter in cart, from letter).
- Use the image to derive the keyword (cart, from letter in cart).
- Use the keyword to derive the foreign word (*carta* from cart).

While *carta* might seem easily derived from cart, other associations are not likely to be so easy — imagine trying to derive *pequenos* from pet or peck.

The keyword method is very effective for linking a new fact to a well-learned fact, but is little help in recalling the new fact itself.

Learn faster not better

The main advantage of the keyword mnemonic over other strategies for remembering information of this type, is that you acquire the information faster. But not better. Learning new words in a meaningful context is an equally effective strategy for long-term recall.

[References](#)

Using the keyword method to learn vocabulary

> The keyword mnemonic is undoubtedly an effective means of learning the words of a foreign language
>
> How well you remember depends on how well you learned them, not on whether you have learned the words using a keyword mnemonic or rote repetition or some other method
>
> Even using a keyword mnemonic, you still need to rehearse the information to be learned
>
> The keyword mnemonic is not always the best method of learning particular words
>
> Skilled learners may be best to use the keyword mnemonic selectively, for particularly difficult words
>
> The keyword mnemonic requires individual instruction and practice, to use effectively
>
> Using a verbal (sentence) link is at least as effective as an image, and is easier for many people
>
> Whether using a sentence or an image, the critical factor is that the keyword interact with the definition or own-language word

In the mid-seventies, Raugh and Atkinson had remarkable results using the keyword method to teach Russian vocabulary to college students. While later studies have not tended to find such dramatic results, nevertheless, a large number of studies have demonstrated an advantage in using the keyword mnemonic to learn vocabulary.

Some researchers have become huge fans of the strategy. Others have suggested a number of limitations. Let's look at these.

Remembering for the long term

The keyword method is undeniably an effective method for accelerating learning of suitable material. Nor is there any doubt that it improves immediate recall. Which can be

useful in itself. However, what people want is long-term recall, and it is there that the advantages of the keyword method are most contentious1.

While many studies have found good remembering a week or two after learning using the keyword mnemonic, others have found that remembering is no better one or two weeks later whether people have used the keyword mnemonic or another strategy. Some have found it worse.

It has been suggested that, although the keyword may be a good retrieval cue initially, over time earlier associations may regain their strength and make it harder to retrieve the keyword image. This seems very reasonable to me — any keyword is, by its nature, an easily retrieved, familiar word; therefore, it will already have a host of associations. When you're tested immediately after learning the keyword, this new link will of course be fresh in your mind, and easily retrieved. But as time goes on, and the advantage of recency is lost, what is there to make the new link stronger than the other, existing, links? Absolutely nothing — unless you strengthen it. How? By repetition.

Note that it is not the keyword itself that fails to be remembered. It is the image. The weakness then, is in the link between keyword and image. (For example, the Tagalog word *araw*, meaning sun, is given the keyword arrow; when tested, *araw* easily recalls the keyword arrow, but the image connecting arrow with sun is gone). This is the link you must strengthen.

The question of the relative forgetting curves of the keyword mnemonic and other learning strategies is chiefly a matter of theoretical interest — I don't think any researcher would deny that repetition is always necessary. But the "magic" of the keyword mnemonic, as espoused by some mnemonic enthusiasts, downplays this necessity. For practical purposes, it is merely sufficient to remember that, for long-term learning, you must strengthen this link between keyword and image (or sentence) through repeated retrieval (but probably not nearly as often as the repetition needed to "fix" meaningless information that has no such mnemonic aid).

One final point should be made. If the material to be learned is mastered to the same standard, the durability of the memory — how long it is remembered for — will, it appears, be the same, regardless of the method used to learn it2.

Are some keyword mnemonics easier to remember than others?

A number of factors may affect the strength of a keyword mnemonic. One that's often suggested is whether or not the mnemonic is supplied to the student, or thought up by them. Intuitively, we feel that a mnemonic you've thought up yourself will be stronger than one that is given to you.

One study that compared the effectiveness of keywords provided versus keywords that are self-generated, found that participants who were required to make up their own keywords performed much worse than those who were given keywords3. This doesn't

answer the question of the relative durability, but it does point to how much more difficult the task of generating keywords is. This has been confirmed in other studies.

The quality of the keyword mnemonic may affect its durability. Mnemonics that emphasize distinctiveness, that increase the vividness and concreteness of the word to be learned, are remembered less well over time than mnemonics that emphasize relational and semantic information (which is why the emphasis in recent times is on making interactive images or sentences, in which the keyword and definition interact in some way). Having bizarre images seems to help remembering immediately after learning (when there is a mix of bizarre and less unusual images), but doesn't seem to help particularly over the long term.

The advantage of a semantic connection may be seen in the following example, taken from an experimental study3. Students in a free control condition (those told to use their own methods to remember), almost all used a keyword-type technique to learn some items. Unlike those in the keyword group, the keywords chosen by these subjects typically had some semantic connection as well. (The use of somewhat arbitrary keywords is characteristic of the strategy as originally conceived by Atkinson). Thus, for the Spanish word *pestana*, meaning eyelash, several people used the phrase paste on as a link, reflecting an existing association (pasting on false eyelashes). The keyword supplied to the keyword group, on the other hand, was pest, which has no obvious connection to eyelash. (It is also worth noting that verbal links were more commonly used by control subjects, rather than mental images.)

It has been suggested that keywords that are semantically as well as acoustically related to the word to be learned might prove more durable.

Controlled presentation

For experimental reasons, the information to be learned is usually presented at a fixed rate, item by item. There is some suggestion that an unpaced situation, where people are simply presented with all the information to be learned and given a set time to study it, allows better learning, most particularly for the repetition strategy. The performance of rote repetition may have been made poorer by constraining it in this way in some experimental studies.

An unpaced study time is of course the more normal situation.

The importance of one-to-one instruction and the need for practice

What is clear from the research is that instruction in the technique is vitally important. Most particularly, the superiority of the keyword mnemonic tends to be found only when the students have been treated individually, not when they have been instructed as a group. At least, this is true for adults and adolescents, but not, interestingly, for children. Children can benefit from group instruction in the technique. Why this is, is not clear. However, I would speculate that it may have something to do with older students having

already developed their own strategies and ideas. More individually-oriented instruction might be needed to counteract this depository of knowledge.

It might also be that children are given more direction in the using of the technique. That is, they are given the keywords; the images may be described to them, and even drawn. Clearly this is much simpler than being required to think up your own keywords, create your own links.

It does seem clear that durable keyword images require quite a lot of practice to create. It has been suggested that initially people tend to simply focus on creating distinctive images. It may only be with extensive practice that you become able to reliably create images that effectively integrate the relational qualities of the bits of information.

Some words benefit more from the keyword mnemonic

It has been suggested that the keyword mnemonic works effectively only on concrete words. For the most part, researchers only use concrete words (which are easily imageable). Studies which have compared the two are rare. The weight of the evidence is probably against the view that the mnemonic should be restricted to concrete words, but it may well be more difficult to come up with good, concrete images for abstract words. However, verbal mnemonics (a sentence can link the keyword with the definition) don't suffer the same drawback.

In experimental studies, the words are usually vetted to make sure they're not "easy" to learn because of obvious acoustic or graphic similarities with familiar words. The implication of this for real world learning, is that there is no reason to think that such words require a keyword mnemonic.

How important is the image?

Most research has focused on using an image to link the keyword with the definition. One study which compared the using of an image with the use of a sentence (in a study of children's learning of Spanish words) found no difference (the sentence mnemonic in fact scored higher, but the difference was not significant)4.

Is the keyword mnemonic of greater benefit to less able students?

Several researchers have suggested that the keyword mnemonic might be of greater benefit to less able students, that the keyword mnemonic may be a means by which differences in learning ability might be equalised. One study that failed to find any superiority in the keyword mnemonic among college students, pointed to the high SAT scores of their students. They suggested that those studies which have found a keyword superiority using college students, have used students who were less verbally able5.

What seems likely, is that teaching the keyword mnemonic to more able students has less impact than teaching it to less able students, because the more able students already have a variety of effective strategies that they use. It is worth noting that, just because students are instructed to use a particular strategy, that doesn't mean that they will. In one

experimental study, for example, when subjects were asked about the strategies they used, 17 out of the 40 control subjects (instructed to use their own methods) used the keyword method for at least some items, while every keyword subject used the keyword method for at least seven items (implying they didn't always). In that study, it was found that, for the control subjects, the probability of recalling keyword-elaborated items was .81 vs .45 for other items; while for the keyword group, the probability of recall for keyword-elaborated items was .80 vs .16 for those items for which they didn't use a keyword mnemonic[6].

Comparing the keyword mnemonic to other strategies

As a general rule, experimental studies into the effectiveness of the keyword mnemonic have compared it to, most often, rote repetition, or, less often, "trying your hardest to remember" (i.e., your own methods). It is not overwhelmingly surprising that the keyword mnemonic should be superior to rote repetition, and the study quoted just above reveals why comparisons with "free" controls might show inconsistent (and uninformative) results.

Studies which have directly compared the keyword method to other elaborative strategies are more helpful.

A number of studies have compared the keyword strategy against the context method of learning vocabulary (much loved by teachers; students experience the word to be learned in several different meaningful contexts). Theory suggests that the context method should encourage multiple connections to the target word, and is thus expected to be a highly effective strategy. However, the studies have found that the keyword method produces better learning than the context method.

It has been suggested that students might benefit more from the context method if they had to work out the meaning of the word themselves, from the context. However, a study which explored this possibility, found that participants using the context method performed significantly worse than those using the keyword mnemonic[5]. This was true even when subjects were given a test that would be thought to give an advantage to the context method — namely, subjects being required to produce meaningful sentences with the target words.

The same researchers later pursued the possibility that the context method might, nevertheless, prove superior in long-term recall — benefiting from the multiple connections / retrieval paths to the target word. In an experiment where both keyword and context groups learned the words until they had mastered them, recall was no better for the context group than it was for the keyword group, when tested one week later (on the other hand, it was no worse either)[2].

Two more recent studies have confirmed the superiority of the keyword mnemonic over the context method[7].

Another study looked at the question of whether a combined keyword – repetition strategy (in which subjects were told to use repetition as well as imagery when linking the

keyword to the English translation of the word to be learned) was better than the keyword strategy on its own. They failed to find any benefit to using repetition on top of the imagery8.

Given the procedures used, I can see why this might occur. Imagine you're trying to learn that *carta* is Spanish for letter. The obvious keyword is cart. Accordingly, you form an image of a cart full of letters. However, having constructed this image, you are now told to repeat the salient words "carta - letter" over and over to yourself. It's not hard to see that many people might completely lose track of the image while they are doing this. Thus the repetition component of the strategy would not be so much augmenting the imagery link, as replacing it. Repetition of the link you are supposed to be augmenting (a cart full of letters) might be more useful (in fact, I personally would repeat to myself: "carta – letter; a cart full of letters").

Backward recall

The value of the keyword mnemonic is of course, in forward recall — that is, in the above example, you learned that *carta* meant letter. When you see the word carta, the keyword mnemonic will help you remember that it means letter. But if you are asked for the Spanish for letter, how helpful will the keyword mnemonic be then?

A study that looked at this question found that the keyword mnemonic was no worse for backward recall than the other strategies they employed8. On the other hand, it was no better, either — and this despite being superior for forward recall (remembering the English when given the Spanish). The failure of the method was not due to any difficulty in recalling the keyword itself. Remember, the English meaning and the keyword are tied together in the mnemonic image, so it is not surprising that remembering the keyword given the English was as high as remembering the English given the keyword. But the problem is, of course, that generating the (unfamiliar) Spanish word from the keyword is much harder than remembering the (familiar) keyword from the Spanish.

Using the keyword mnemonic to remember gender

One other aspect of vocabulary learning for many languages is that of gender. The keyword mnemonic has successfully been used to remember the gender of nouns, by incorporating a gender tag in the image9. This may be as simple as including a man or a woman (or some particular object, when the language also contains a neutral gender), or you could use some other code — for example, if learning German, you could use the image of a deer for the masculine gender.

Why should the keyword mnemonic be an effective strategy?

Let's think about the basic principles of how memory works.

The strength of memory codes, and thus the ease with which they can be found, is a function largely of repetition. Quite simply, the more often you experience something (a

word, an event, a person, whatever), the stronger and more easily recalled your memory for that thing will be.

This is why the most basic memory strategy — the simplest, and the first learned — is rote repetition.

Repetition is how we hold items in working memory, that is, "in mind". When we are told a phone number and have to remember it long enough to either dial it or write it down, most of us repeat it frantically.

Spaced repetition — repetition at intervals of time — is how we cement most of our memory codes in our long-term memory store. If you make no deliberate attempt to learn a phone number, yet use it often, you will inevitably come to know it (how many repetitions that will take is a matter of individual variability).

But most of us come to realize that repetition is not, on its own, the most effective strategy, and when we deliberately wish to learn something, we generally incorporate other, more elaborative, strategies.

Why do we do that? If memory codes are strengthened by repetition, why isn't it enough to simply repeat?

Well, it is. Repetition IS enough. But it's boring. That's point one.

Point two is that making memory codes more easily found (which is after all the point of the exercise) is not solely achieved by making the memory codes stronger. Also important is making lots of connections. Memory codes are held in a network. We find a particular one by following a trail of linked codes. Clearly, the more trails lead to the code you're looking for, the more likely you are to find it.

Elaborative strategies — mnemonic strategies, organizational strategies — work on this aspect. They are designed to increase the number of links (connections) a memory code has. Thus, when we note that lamprey is an "eel-like aquatic vertebrate with sucker mouth", we will probably make links with eels, with fish, with the sea. If we recall that Henry I was said to have died from a surfeit of lampreys, we have made another link. Which in turn might bring in yet another link, that Ngaio Marsh once wrote a mystery entitled "A surfeit of lampreys". And if you've read the book, this will be a good link, being itself rich in links. (As the earlier link would be if you happen to be knowledgeable about Henry I).

On the other hand, in the absence of any knowledge about lampreys, you could have made a mnemonic link with the word "lamp", and imagined an eel-like fish with lamps in its eyes, or balanced on its head.

So, both types of elaborative strategy have the same goal — to increase the number of connections. But mnemonic links are weaker in the sense that they are arbitrary. Their value comes in those circumstances when either you lack the knowledge to make meaningful connections, or there is in fact no meaningful connection to be made (this is

why mnemonics are so popular for vocabulary learning, and for the learning of lists and other ordered information).

Where does that leave us?

> Memory codes are made stronger by repetition
>
> Repetition is enough on it's own to make a strong memory code
>
> Achieving enough repetitions, however, is a lengthy and often boring process
>
> Memory codes are also made easier to find by increasing the number of links they have to other memory codes
>
> Elaborative strategies work on this principle of making connections with existing codes
>
> Some elaborative strategies make meaningful connections between memory codes — these are stronger
>
> Mnemonic strategies make connections that are not meaningful
>
> Mnemonic strategies are most useful in situations where there are no meaningful connections to be made, or you lack the knowledge to make meaningful connections

Mnemonic strategies have therefore had particular success in the learning of other languages. However, if you can make a meaningful connection, that will be more effective. For example, in Spanish the word *surgir* means to appear, spout, arise. If you connect this to the word surge, from the Latin *surgere*, to rise, then you have a meaningful connection, and you won't, it is clear, have much trouble when you come across the word. However, if your English vocabulary does not include the word surge, you might make instead a mnemonic connection, such as *surgir* sounds like sugar, so you make a mental image involving spouting sugar. Now, imagine each of these situations. Imagine you don't come across the word again for a month. When you do, which of these connections is more likely to bring forth the correct meaning?

But of course, it is not always possible to make meaningful connections.

The thing to remember however, is that you haven't overcome the need for repetition. These strategies are adjuncts. The basic principle must always be remembered: Memory codes are made stronger by repetition. Links are made stronger by repetition. If you don't practice the mnemonic, it won't be remembered. The same is true for any connection, but meaningful connections are inherently stronger, so they don't need as many repetitions.

I would also note that the experimental research invariably involves very limited numbers of words to be learned. While this is entirely understandable, it does raise the question of the extent to which these findings are applicable to real world learning situations. If you are learning a new language, you are going to have to learn at least 2000

new words. Does the keyword mnemonic hold up in those circumstances? The keyword mnemonic has been used in real world situations (intensive language courses), but these are not experimental situations, and we must be wary of the conclusions we draw from them. The keyword strategy does take time and effort to implement, and may well have disadvantages if used to excess. Some words lend themselves to other techniques. At least for more experienced students (who will have a number of effective strategies, and are capable of applying them appropriately) the keyword strategy is probably best used selectively, perhaps for particularly difficult items.

References

Face-name association

> **Creating a face-name association**
>
> Select a distinctive feature of the face (nose).
>
> Select a word or phrase that sounds like the name (con rat for Conrad).
>
> Create an interactive image linking the distinctive feature with the keyword(s) (a man in a prisoner's uniform — con — rides a rat that slides down the nose).

To remember the name on seeing the face again, you must:

- Identify the distinctive feature that you used when encoding (**nose**).
- Use that feature to help you retrieve the interactive image (a **con** riding a **rat** sliding down a **nose**).
- Derive the keyword(s) from the image (**con rat**).
- Use the keyword to help you retrieve the name (**Conrad**).

Drawbacks to the face-name association method

To use the face-name association method in a social situation requires a great deal of practice.

The other drawback to this method is that it requires you to select a distinctive feature. This is not always easy, particularly when you're distracted and time is short (which is usually the case when you're being introduced to someone). But finding a distinctive feature is absolutely crucial to the strategy's effectiveness.

Face-name association only works well to the extent that the selected distinctive feature is an effective cue.

References

List-learning strategies

Guide to Use

To be used effectively, you need to be able to create images quickly

To be used effectively, all steps need to be properly implemented

They help you learn faster, not better

They are useful for:

> learning the right order

> memorizing retrieval cues

> anchoring many details

The method of loci or place method

This is the classic mnemonic strategy, dating back to the ancient Greeks, and is (as evident from its continued use over 2500 years) an extremely effective strategy for remembering lists.

First of all, you choose a place you know very very well. Perhaps a familiar route, your house, or a particular room in it. Any place that you know well enough to easily call to mind various 'landmarks' (different fixed objects in a room, for example). You must train yourself to go around your landmarks in a particular order. With a route of course, that is easy.

Thus, to remember a shopping list, you simply imagine each item in turn at these landmarks. A loaf of bread sticking out of the letterbox; a giant apple in place of the door; the hall full of beans; a giant banana in the bath, etc.

Because the place method uses cues that are already well-known to you, it is probably the easiest of the imagery mnemonics to master.

Disadvantages

- difficult to recall a particular item without going through the list in order until you reach the item you want.
- most effective as a relatively short-term strategy (By using the landmarks again and again, you can only readily recall the last list. Earlier lists are much less easily recalled.)
- difficult to use if the information is presented too fast

The pegword mnemonic

uses numbers instead of places. These numbers are transformed into visual images by means of the following simple rhyme:

one is a bun

two is a shoe

three is a tree

four is a door

five is a hive

six is sticks

seven is heaven

eight is a gate

nine is a line

ten is a hen

The rhyme must be learned by rote until it is over-learned. Accordingly, there is a higher 'cost' to the pegword method than to the place method, where cues already over-learned are used.

Disadvantages

- most effective as a relatively short-term strategy (By using the landmarks again and again, you can only readily recall the last list. Earlier lists are much less easily recalled.)
- difficult to use if the information is presented to you too fast
- difficult to use effectively without extensive training.

The link method

like the others, uses visual images to link items together. However, instead of linking items to a well-learned structure, items are linked to each other. For example, to remember our shopping list of bread, apples, beans, bananas, you would form an image of the bread interacting with apples in some way, then another image of apples and beans, then another image bringing beans and bananas together.

The story method

is the verbal equivalent of the link method. Items are chained together by linking them in a story. For example, A VEGETABLE can be a useful INSTRUMENT for a COLLEGE student. A carrot can be a NAIL for your FENCE or BASIN. But a MERCHANT of the QUEEN would SCALE that fence and feed the carrot to a GOAT.

Disadvantages of both link & story methods

- difficult to recall a particular item without going through the list in order until you reach the item you want.
- difficult to use if the information is presented too fast.
- difficult to use effectively without extensive training.

References

References

What mnemonics are

Belleza, F.S. 1983. Mnemonic-device instruction with adults. In Pressley, M. & Levin, J.R. (eds.) Cognitive strategy research: Psychological foundations. New York: Springer-Verlag.

Bransford, J.D., Stein, B.S., Vye, N.J., Franks, J.J., Auble, P.M., Mezynski, K.J. & Perfetto, G.A. 1982. Differences in approaches to learning: an overview. Journal of Experimental Psychology: General, 111, 390-398.

Intons-Peterson, M.J. & Newsome, G.L. III. 1992. External memory aids: effects and effectiveness. In D. Herrmann, H. Weingartner, A. Searleman & C. McEvoy (eds.) Memory Improvement: Implications for Memory Theory. New York: Springer-Verlag.

Visual Vs Verbal Mnemonic Techniques

[1] Baltes, P. B., & Kliegl, R. (1992). Further testing of limits of cognitive plasticity: Negative age differences in a mnemonic skill are robust. Developmental Psychology, 28, 121-125.

[2] Herrmann, D.J. 1987. Task appropriateness of mnemonic techniques. Perceptual and Motor Skills, 64, 171-178.

[3] Hishitani, S. 1985. Coding strategies and imagery differences in memory. Japanese Psychological Research,27(3),154-162.

[4] Iaccino, J. F., & Sowa, S. J. 1989. Bizarre imagery in paired-associate learning: An effective mnemonic aid with mixed context, delayed testing and self-paced conditions. Perceptual and Motor Skills, 68, 307-316.

[5] Marston, P.T. & Young, R.K. 1974. Multiple Serial List Learning with Two Mnemonic Techniques.

[6] McDaniel, M.A., DeLosh, E.L. & Merritt, P.S. 2000. Order information and retrieval distinctiveness: Recall of common versus bizarre material. Journal of Experimental Psychology: Learning, Memory, and Cognition, 26(4), 1045-1056.

[7] Poon, L. W., Walsh-Sweeney, L., & Fozard, J. L. (1980). Memory skill training for the elderly: Salient issues on the use of imagery mnemonics. In L. W. Poon, J. L. Fozard, L. S. Cermak, D. Arenberg, & L. W. Thompson, (Eds.), New directions in memory and aging: Proceedings of the George A Talland Memorial Conference (pp. 461-484). Hillsdale, NJ: Lawrence Erlbaum Assoc.

The myth of imagery

Belleza, F.S. 1983. Mnemonic-device instruction with adults. In Pressley, M. & Levin, J.R. (eds.) Cognitive strategy research: Psychological foundations. New York: Springer-Verlag.

Bower, G.H. 1972. Mental imagery and associative learning. In L.W. Gregg (ed.) Cognition in learning and memory. New York: Wiley.

Morris, P.E. 1978. Sense and nonsense in traditional mnemonics. In M.M. Gruneberg, P.E. Morris & R.N. Sykes (eds.) Practical aspects of memory. London: Academic Press.

The art of memory

Yates, Frances A. 1966. The Art of Memory.

a starting point into the art of memory, with a long article on Yates' book:

http://www.silcom.com/~dlp/mnem3.html

Carruthers, Mary. 1990. The Book of Memory: A Study of Memory in Medieval Culture. New York: Cambridge University Press.

long article from Fathom: http://www.fathom.com/feature/122190

Carruthers, Mary. 1998. The Craft of Thought: Meditation, Rhetoric. and the Making of Images. 400-1200. Cambridge: Cambridge University Press.

review: http://www.film-philosophy.com/vol3-1999/n22cameron

reply by Carruthers: http://www.film-philosophy.com/vol3-1999/n38carruthers

A word of warning. Carruthers' books are not really aimed at the lay audience. Carruthers is clearly writing for her peers, those familiar with Latin and Greek, and the classic and medieval cultures.

Verbal mnemonics

Bower, G.H. & Clark, M.C. 1969. Narrative stories as mediators for serial learning. Psychonomic Science, 14, 181-182.

Gruneberg, Michael M. 1992. The practical application of memory aids. In M.M. Gruneberg, & P. Morris (eds). Aspects of memory. Vol.1: The practical aspects. 2nd ed. London: Routledge.

Morris, P.E. 1978. Sense and nonsense in traditional mnemonics. In M.M. Gruneberg, P.E. Morris & R.N. Sykes (eds.) Practical aspects of memory. London: Academic Press.

Morris, P.E. 1979. Strategies for learning and recall. In M.M. Gruneberg & P. Morris (eds.) Applied problems in memory. London: Academic Press.

Keyword method

Belleza, F.S. 1983. Mnemonic-device instruction with adults. In Pressley, M. & Levin, J.R. (eds.) Cognitive strategy research: Psychological foundations. New York: Springer-Verlag.

Pressley, M., Levin, J.R., Hall, J.W., Miller, G.E. & Berry, J.K. 1980. The keyword method and foreign word acquisition. Journal of Experimental Psychology: Human Learning and Memory, 6, 163-173.

Wang, A.Y. & Thomas, M.H. 1995. Effect of keywords on long-term retention: help or hindrance? Journal of Educational Psychology, 87, 468-475.

Using the keyword method to learn vocabulary

Atkinson, R. C., & Raugh, M. R. 1975. An application of the mnemonic keyword method to the acquisition of Russian vocabulary. Journal of Experimental Psychology: Human Learning and Memory, 104, 126-133.

Desrochers, A., Gélinas & Wieland, L.D. 1989. An application of the mnemonic keyword method to the acquisition of German nouns and their grammatical gender. Journal of Educational Psychology, 81, 25-32.

Gruneberg, M.M.1998. A commentary on criticism of the keyword method of learning foreign languages. Applied Cognitive Psychology , 12, 529-532.

Hall, J.W., Owens, W.L. & Wilson, K.P. 1987. Presentation rates and keywords in vocabulary learning. Bulletin of the Psychonomic Society, 25, 179-81.

Hall, J.W., Wilson, K.P. & Patterson, R.J. 1981. Mnemotechnics: Some limitations of the mnemonic keyword method for the study of foreign language vocabulary. Journal of Educational Psychology, 73, 345-57.

Hall, J.W., Wilson, K.P. & Patterson, R.J. 1981. Mnemotechnics: Some limitations of the mnemonic keyword method for the study of foreign language vocabulary. Journal of Educational Psychology, 73, 345-57.

Jones, M.S., Levin, M.E., Levin, J.R. & Beitzel, B.D. 2000. Can vocabulary-learning strategies and pair-learning formats be profitably combined? Journal of Educational Psychology, 92, 256-62.

McDaniel, M.A. & Pressley, M. 1984. Putting the keyword method in context. Journal of Educational Psychology, 76, 598-609.

McDaniel, M.A., Pressley, M. & Dunay, P.K. 1987. Long-term retention of vocabulary after keyword and context learning. Journal of Educational Psychology, 79, 87-9.

Pressley, M. & Levin, J.R. 1985. Keywords and vocabulary acquisition: Some words of caution about Johnson, Adams, and Bruning (1985). ECTJ, 33, 277-84.

Pressley, M., Levin, J.R. & Miller, G.E. 1981. The keyword method and children's learning of foreign vocabulary with abstract meanings. Canadian Journal of Psychology, 34, 283-87.

Pressley, M., Levin, J.R., Digdon, N., Bryant, S.L. & Ray, K. 1983. Does method of item presentation affect keyword method effectiveness? Journal of Educational Psychology, 75, 686-91.

Pressley, M., Levin, J.R., Hall, J.W., Miller, G.E. & Berry, J.K. 1980. The keyword method and foreign word acquisition. Journal of Experimental Psychology: Human Learning and Memory, 6, 163-73.

Raugh, M. R., & Atkinson, R. C. 1975. A mnemonic method for learning a second-language vocabulary. Journal of Educational Psychology, 67, 1-16.

Shing, Y.S. & Heyworth, R.M. 1992. Teaching English Vocabulary to Cantonese-speaking Students with the Keyword Method. Education Journal, 20, 113-129.

Wang, A.Y. & Thomas, M.H. 1992. The Effect of Imagery-Based Mnemonics on the Long-Term Retention of Chinese Characters.

Wang, A.Y. & Thomas, M.H. 1995. Effect of keywords on long-term retention: help or hindrance? Journal of Educational Psychology, 87, 468-75.

Wang, A.Y. & Thomas, M.H. 1999. In defence of keyword experiments: a reply to Gruneberg's commentary

Wang, A.Y. et al. 1989. Do Mnemonic Devices Lessen Forgetting? Paper presented at the Annual Meeting of the American Psychological Association (97th, New Orleans, LA, August 11-15, 1989).

Wang, A.Y. et al. 1992. Keyword Mnemonic and Retention of Second-Language Vocabulary Words.

1. Wang, A.Y. & Thomas, M.H. 1992. The Effect of Imagery-Based Mnemonics on the Long-Term Retention of Chinese Characters.

Wang, A.Y. et al. 1989. Do Mnemonic Devices Lessen Forgetting? Paper presented at the Annual Meeting of the American Psychological Association (97th, New Orleans, LA, August 11-15, 1989).

Wang, A.Y. et al. 1992. Keyword Mnemonic and Retention of Second-Language Vocabulary Words.

Wang, A.Y. & Thomas, M.H. 1995. Effect of keywords on long-term retention: help or hindrance? Journal of Educational Psychology, 87, 468-75.

Gruneberg, M.M.1998. A commentary on criticism of the keyword method of learning foreign languages. Applied Cognitive Psychology , 12, 529-532.

Wang, A.Y. & Thomas, M.H. 1999. In defence of keyword experiments: a reply to Gruneberg's commentary

2. McDaniel, M.A., Pressley, M. & Dunay, P.K. 1987. Long-term retention of vocabulary after keyword and context learning. Journal of Educational Psychology, 79, 87-9.

3. Hall, J.W., Wilson, K.P. & Patterson, R.J. 1981. Mnemotechnics: Some limitations of the mnemonic keyword method for the study of foreign language vocabulary. Journal of Educational Psychology, 73, 345-57.

4. Pressley, M., Levin, J.R. & Miller, G.E. 1981. The keyword method and children's learning of foreign vocabulary with abstract meanings. Canadian Journal of Psychology, 34, 283-87.

5. McDaniel, M.A. & Pressley, M. 1984. Putting the keyword method in context. Journal of Educational Psychology, 76, 598-609.

6. Pressley, M., Levin, J.R., Digdon, N., Bryant, S.L. & Ray, K. 1983. Does method of item presentation affect keyword method effectiveness? Journal of Educational Psychology, 75, 686-91.

7. Jones, M.S., Levin, M.E., Levin, J.R. & Beitzel, B.D. 2000. Can vocabulary-learning strategies and pair-learning formats be profitably combined? Journal of Educational Psychology, 92, 256-62.

Shing, Y.S. & Heyworth, R.M. 1992. Teaching English Vocabulary to Cantonese-speaking Students with the Keyword Method. Education Journal, 20, 113-129.

8. Pressley, M., Levin, J.R., Hall, J.W., Miller, G.E. & Berry, J.K. 1980. The keyword method and foreign word acquisition. Journal of Experimental Psychology: Human Learning and Memory, 6, 163-73.

9. Desrochers, A., Gélinas & Wieland, L.D. 1989. An application of the mnemonic keyword method to the acquisition of German nouns and their grammatical gender. Journal of Educational Psychology, 81, 25-32.

Face-name association

McCarty, D.L. 1980. Investigation of a visual imagery mnemonic device for acquiring face-name associations. Journal of Experimental Psychology: Human Learning and Memory, 6, 145-155.

List-learning strategies

Belleza, F.S. 1983. Mnemonic-device instruction with adults. In Pressley, M. & Levin, J.R. (eds.) Cognitive strategy research: Psychological foundations. New York: Springer-Verlag.

Bower, G.H. & Reitman, J.S. 1972. Mnemonic elaboration in multilist learning. Journal of Verbal Learning and Verbal Behavior, 11, 478-485.

Morris, P.E. 1979. Strategies for learning and recall. In M.M. Gruneberg & P. Morris (eds.) Applied problems in memory. London: Academic Press.