HOW TO....UH... REMEMBER!

If we free the mind from rote learning, there's more time for thought. A Stanford psychologist spells out ways to cut the pain of memorization.

by Gordon H. Bower

I'll NEVER FORGET dear old what's his name.

The fact that we forget things important to us is a source of embarrassment and irritation, to say nothing of inefficiency. Forgetting has also been a source of some irritation to psychologists, who are only slowly beginning to understand it.

Hermann Ebbinghaus completed the first studies of forgetting just before the end of the 19th century. Using himself as a subject, Ebbinghaus investigated how much we forget over a period of time. In order to slow down the learning and to avoid unwanted associations with familiar language, Ebbinghaus would learn a series of nonsense syllables (meaningless consonant-vowel-consonant combinations), and then try to recall them after varying periods of time. His famous forgetting curve showed large amounts of forgetting over the first few hours after learning, followed by progressively less loss over ensuing days and weeks.

Ebbinghaus' classic research demonstrated that forgetting occurred in a reliable, orderly fashion. A practical question was how to prevent forgetting, or at least slow it down. Ebbinghaus also had some suggestions there. His main prescription, supported by his evidence, was that forgetting could be reduced by overlearning the material originally, beyond the point of mastery; he also prescribed reviving and rehearsing the material every now and then before its final use. These prescriptions are clearly well taken and underlie most school study guides, which cite the need for periodic reviews for refreshing one's memory.

A second practical question is whether memorizing is a skill that can be improved by special means. Research suggests that the ability to remember is indeed a skill, one on which individuals differ reliably and consistently, and that there are a few clearly specifiable components or subskills to this overall ability. People can be taught some of these skills. As an elementary example, one component of the skill of learning people's names during introductions is that we must first explicitly attend to and register the name clearly as it is told to us. Most of us fail at this initial and most elementary step because we are preoccupied with the other tasks demanded by the occasion—shaking hands, smiling, planning the conversation ahead, or anticipating the next person to be met. In our preoccupation, the name fails to register clearly. So a first prescription would be that if you want to learn names, then you've got to reshuffle your "cognitive priorities" at the time of introduction and attend clearly to the name and repeat it aloud or to yourself. That at least is a beginning. A second component in remembering names, as in remembering many other types of information, is to embellish or elaborate the material to be learned into meaningful terms and then to associate items. Some features suggested by the name would be elaborated into a bizarre association with a distinctive feature of the face or person to the name. Mr. *Carpenter* can be visualized hammering that long spiked nose of his into the wall; Miss *Lockhart* can be visualized with a huge *padlock* going through her *heart* and wrapped around her chest; and so on.

From Olympus to Oculomotor. This second component, of elaboration and visualization to aid in associating materials to be learned, has been investigated recently under the title of "mnemonic strategies" or simply "mnemonics." Most of us already use elementary forms of mnemonics. Our principal is spelled "pal" because he was our pal, but some of us remembered him as the man without princi*ple*. Similarly we spell "conceive" that way because we learned the rule "i before e except after c."

One problem people have is remembering the right *order* of a set of familiar items. Specially coined phrases or coined words are helpful here. Biology students learn the ordering of the 12 cranial nerves by memorizing the lines "On old Olympus' towering top, a fat-assed German vaults and hops." The first letter of each word is also the first letter of one of the major cranial nerves. The "coined-word" procedure consists of taking the first letter of words to be remembered and making a new word from them. Thus the ordering of colors of the spectrum is suggested by the name ROY G. BIV for red, orange, yellow, etc. If we can remember the coined word or phrase, we can order the items correctly. These particular mnemonics fail in the long run because they do not maintain the actual items in memory. Biology students may recall the limerick long after they have forgotten the names of the cranial nerves. A better mnemonic would contain hints for remembering the items themselves as well as their order. For example, using key words that sound like the names of the nerve, they could remember the following story: "At the *oil factory* (olfactory nerve) the *optician* (optic) looked for the *occupant* (oculomotor) of the *truck* (trochlear). He was searching because *three gems* (trigeminal) had been *abducted* (abducents) by a man who was hiding his *face* (facial) and *ears* (acoustic). A *glossy photograph* (glossopharyngeal) had been taken of him, but it was too *vague* (vagus) to use. He appeared to be *spineless* (spinal accessory) and *hypocritical* (hypoglossal)."

One mnemonic technique is particularly useful whenever two or more things are to be associated. Examples include the principal products of a country, foreign-language vocabulary items, and definitions of new concepts. The method consists simply of searching for or elaborating some vivid connection between the two items. One way to establish a connection is to imagine the two elements interacting in some way. To remember the meaning of the word *porte*, one might picture a huge bottle of *port* wine dangling from a *door*. Thus the word's meaning—door—will be called forth by the image.

Consider learning a series of word pairs such as DOG-HAT, MAN-PENCIL, CLOCK-WOMAN, SOFA-FLOOR, and PIPE-CLOWN. People usually learn a list such as this by rapidly repeating each pair as often as possible in the allotted time. The method is reasonably satisfactory for short lists and

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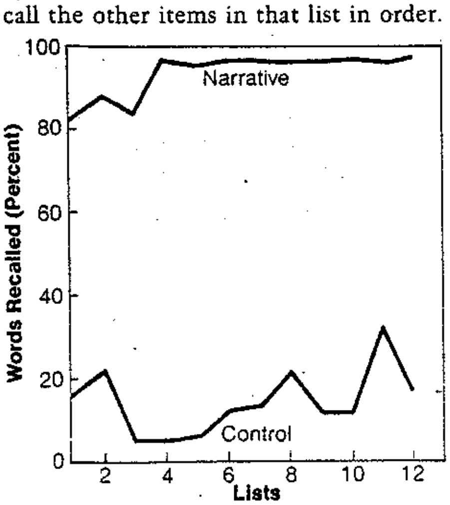
over short retention intervals. But extend either the length of the list or the retention interval, and the rehearsal method falters seriously. People who have learned to use mental imagery to relate the items of a pair perform much better. They visualize a dog wearing a hat, a man resting a large pencil on his shoulder like a rifle, a woman wearing a clock on a chain around her neck, a section of floor resting on a sofa, and a clown smoking a pipe. When provided with one word of each pair, they can call to mind the interactive image they had formed, and can name the other object in the image. This procedure can improve recall by as much as 100 to 150 percent.

Spinning Stories. The value of relating items to each other in a thematic way shows up clearly when one concocts narrative stories as an aid to serial learning. In one study of this "chaining method," Michal Clark and I instructed college students to make up a story around a list of 10 unrelated nouns which were to be remembered. It usually took a student about one or two minutes to construct his story. Each student studied 12 different lists of words in a period of 30 to 40 minutes. Our control subjects learned the lists using any method they chose; they were allowed to study for a time comparable to that taken by the students composing stories. Following presentation of the last list, we tested retention by giving the first word of each list and asking the student to recall the other items in that list in order.



Students who had constructed stories recalled about seven times as many correct items as the control subjects did.

The narrative chaining method is a good mnemonic because the person provides an overall theme by which to organize the critical words. A second mnemonic for learning lists of items is the method of loci ("locations"): it works not by relating the items to be remembered to one another but rather by relating them to a standard list of known locations. One of the first references to this mnemonic system was made by Cicero, who tells the story of a man named Simonides. While attending a large banquet, Simonides was called outside and during his absence the roof of the hall collapsed, killing all of the revelers. The bodies of the victims were so mangled that they could not be identified by their relatives. Simonides, however, was able to identify each of the corpses by recalling where each person sat before the tragedy. He did this by visualizing the room and mentally walking about, "seeing" who had been seated in each chair. This feat so impressed him that he came to believe that all memory worked by placing objects or ideas into definite locations. The mnemonic is known as the method of loci because it depends on pigeon-holing items to be remembered into a series of "locations."

To use the method of loci, you must first establish a list of "memory snapshots" of locations taken from along a familiar route, such as a walk through your house. (A building, campus, or city would serve as well.) You must be able to see clearly and to recite the different distinctive locations on your list. To learn any new list of items you simply take a "mental walk" through your list of loci, placing successive items in your imagination at successive locations along your familiar route. You should connect the items to their locations by visualizing some vivid interaction between the item and the things at a given location. When you need to recall the items, you simply take another mental walk along your familiar route and see what items have been deposited there. For example, suppose that you need to buy many items at the grocery, including milk, bread, bananas and cigarettes as the first four. The first-four snapshots of your pre-memorized list of locations might be your front hallway closet, the kitchen refrigerator, your favorite easy chair, and the living-room fireplace. To learn the first four items of your shopping list, you should visualize a vivid image of quarts of milk stacked up and bursting in your hallway closet, then

MEMORY FREAKS I HAVE KNOWN

In the popular mind, mnemonic devices are associated with magic, memory tricks, chess wizardry, lightning-fast calculations, and other Olympiad feats of mental gymnastics. Being a naive scientist, I vigorously disbelieved such popular dogma. I pictured instead lawyers, doctors and engineers using mnemonics to lighten the memory load of their jobs. To unmask the poppycock, I went to meet some professional mnemonists in the flesh at the first and only convention of a national mnemonics association in the Spring of 1968 in Hollywood, where else. To my chagrin, I discovered that the popular notion is true. The mnemonists I met were usually entertainers doing shows of magic and trickery. Some were simply zany characters who got their kicks from performing spectacular mental gyrations that leave the rest of us dumfounded and awe-struck. Mnemonists love to entertain and dazzle one another even more than they do a naive audience. Like a reunion of comedians, each mnemonist loves to "top" the other one, with a new trick or new mental skill. They made a charming crowd for a convention: slightly pixilated, wild, madcap, and surprising in their unexpected mental skills.

Arriving at the convention, I saw some 30 people scattered in small conversation a dagger-like loaf of bread piercing the refrigerator door, then large bunches of bananas piled up in your easy chair, and in the fireplace a large pack of cigarettes with several of them sticking out of the pack and smoking. A long list of items to be learned would require a long list of familiar locations in memory. As each object to be learned is studied, it is placed in imagination at the next location on your list of familiar-loci. You should try to visualize a clear mental picture of the object "doing something interesting" at the location where it is placed. Later, in the grocery store, you can recall your shopping list by an imaginary walk through your house, pausing to "look at" what you've placed earlier at the standard locations in your route.

This system provides a series of memory hooks on which you can snag items and keep them from getting away. The number of loci can be expanded indefinitely according to one's needs. The system does more than just connect an item to something that is already known. It provides a series of permanent hooks or memory pegs to which you already have reliable access. Since the peg-list doesn't change, the pegs provide cues that can stimulate recall of the needed items.

A man who developed the method of loci to a fine art was the subject of Alexan-

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groups. My first surprise came when I registered and received a *name tag.* The small conversation groups turned out to be mnemonists comparing notes on how best to do some memory trick. One group was discussing several variants of the "perpetual-calendar" system, which enables the user to calculate rapidly, in his head, the day of the week on which any date fell. The system will tell you that February 12, 1809 was a Sunday and July 15, 1922 was a Saturday. Other groups were discussing schemes for fast memorization of the Morse code, or the order of cards in a shuffled deck, or ways to fool an audience into believing you'd memorized a thousand eight-digit numbers or the entire Los Angeles telephone directory. It was amazing guile but trickery nonetheless.

The convention program consisted principally of performances by these talented people. There was a 96-year-old man who memorized 50 three-digit numbers shouted out to him by the audience. Another participant had memorized the powers of 2 up to 2^{100}, which is a very large number indeed. He did it by recalling a key sentence associated with pegword N, the sentence composed of words which were a phonetically coded translation of successive digits in 2 . These coding techniques are explained in my article. The two most spectacular performances were turned in by John Stone, and Willis N. Dysart, whose stage name was Willie the Wizard.

At age 66, Stone had taught himself several complex skills allowing him to carry out nearly simultaneously several activities which, for most people, would interfere with one another. In one of these performances, he would begin with four six-letter words shouted out at random by the audience, from which he proceeded to write rapidly and upside-down a complexly transformed word salad. For instance, given the words GEORGE, STOLEN, MARKER, and ARMPIT, Stone would quickly write a sequence such as:

G N W T E Ǝ ∀ I O ꓕ ꓤ ꟼ R O K M G ⅃ E Я E S ꓤ A

The pattern of the sequence can be shown by selective erasure or by rearranging letters vertically as follows:

G E O R G E

N Ǝ ꓕ O ⅃ S

W ∀ ꓤ K E ꓤ

T I ꟼ M Я A

The four words appear on each line, either properly ordered, reversed, upside-down (turn page), or a combination.

The amazing feature was the rapidity with which Stone could reel off these letters, writing them upside-down, all the while reciting "The Shooting of Dan McGrew." He was like a one-man band of mental instruments, a walking counterexample to the "limited channel capacity" hypothesis of cognitive psychologists. Seeking to unlock the secrets of the cognitive universe, I asked Stone what went on in his mind as he did this trick. His answer was totally unrevealing: "I practiced it so long that my hand just automatically knows what to do as my eye looks at successive letters of the key words." Such answers, to the dismay of cognitive psychologists, are also about what we get if we ask a pianist or one-man band to explain how he does his "trick." It's like asking the common man how he can understand rapid speech. He doesn't know; he just can do it.

Willie the Wizard was a lightning-fast mental calculator who could multiply and divide very long numbers at a startling speed. He was led through his paces by his manager, a sort of carnival barker who would announce Willie's next feats, solicit problems from the audience, keep track of problems on a blackboard, and call for applause. The general class of problems Willie liked to work on were freaks of the following form: "If a flea jumps two feet, three inches every hop, how many hops must it take to go around the world, the circumference being 25,020 miles? Also, how long would it require for the journey if the flea takes one hop per second?" Almost before such questions were finished, Willie would have started rattling off the answer, "It would take 58,713,600 hops, requiring one year, 314 days, 13 hours, and 20 minutes." Like most mental calculators, Willie had memorized a vast array of arithmetic facts (e.g., products of all three-digit numbers); he also used many shortcuts which speed up mental calculations. Such skills are poorly understood. As a person, Willie was shy, with few interests beside arithmetic; higher math like calculus held no interest for him. He was somewhat of an innocent pixie regarding human relations. His business manager helped shield him from people who would exploit that innocence.

The evening following the conference a banquet was held in a private club for magicians, with haunted-house decor straight out of the Addams family. Throughout dinner we were entertained by conferees doing card tricks and memory tricks. I recall one stunt in which the mnemonist looked briefly through a shuffled deck of cards, then recited from memory the order of the 52 cards. As another trick, after shuffling and dealing you one or more cards, he could inspect the remaining deck and tell you which cards you'd taken. For these stunts, he used a prememorized code word (and image) for each of the 52 cards in conjunction with the pegword system explained in my article.

Such tricks kept us entertained throughout the evening. The only memory failures I noticed in the crowd were some late arrivals who had mistaken the time and place of the banquet and two conferees who forgot where they'd parked their cars. As the evening ended, one stage mnemonist shook my hand with that direct, sincere look and said, "It's been a pleasure meeting you, Dr. Flowers."

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der R. Luria's book, *The Mind of a Mnemonist.* Known simply as *S*, this man performed remarkable feats of memory, recalling long lists of words without effort, and often retaining material many years.

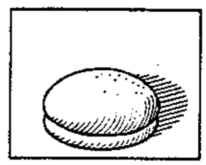
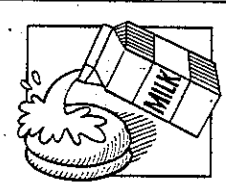
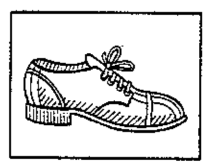
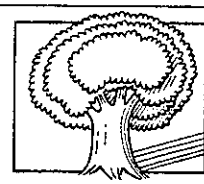
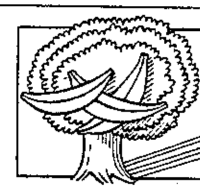
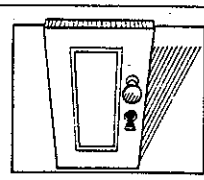
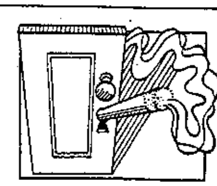
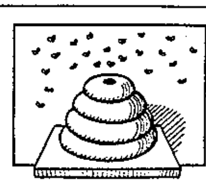
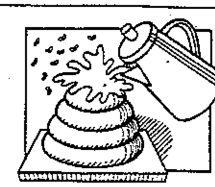
There is also experimental evidence that the method of loci improves memory. Sometimes subjects who use this system are able to recall two to four times as much material as control subjects. In a study by John Ross and Kerry A. Lawrence, students studied a list of 40 nouns using the loci method. Immediately after each student studied the list, he tried to recall it in correct order. The next day the subject returned and again recalled the list before learning a new list of 40 items. Each student learned several lists this way. The average number of words recalled immediately after presentation of the list was 38 out of 40 in correct order. The average recall of words studied a day before was 34 out of 40 in correct order. This performance is vastly superior to that of students who use rote learning techniques.

Shopping With Mnemonics. In a direct comparison of the methods, David Winzenz and I had college students study five successive "shopping lists" of 20 unrelated words. They were allowed five seconds to study each word; they tried to recall each list immediately after studying it, and at the end of the session they tried to recall all five lists (100 items). Some subjects learned using the mnemonic or slight variations on it, while our control subjects were left to learn by their own devices (which typically consisted of rote rehearsal). The subjects using the mnemonic recalled the words far better than the controls on both the immediate test and the end-of-session test. At this end-of-session test, the mnemonic subjects remembered an average of 72 items out of 100, whereas the controls remembered only 28. Furthermore, the items recalled by subjects using the mnemonic were usually assigned to the right position on the right list, whereas the control subjects were very poor at remembering the position and list of the few scattered items they did recall.

A second mnemonic, called the "pegword system," seems in most respects to be entirely equivalent to the method of loci. Where the method of loci uses mental snapshots of locations as memory pegs, the pegword system uses a familiar list of names of simple, concrete objects. A typical pegword list is one composed of rhymes of the first 20 or so integers. For instance, the pegwords for the first five integers might be 1-bun, 2-shoe, 3-tree, 4-door and 5-hive. The pegs should be names of concrete objects which you can visualize. This pegword list should be well learned so that it can be recited readily (the rhymes help at this stage) before it can be put to use in learning any new set of items.

To memorize a new set of items, you then use the pegwords during study much as you used the locations. You associate each item to be learned with a peg by imagining the two objects interacting in some way. For example, for our earlier grocery list, you would imagine pouring *milk* all over a soggy hamburger *bun*, then a *shoe* kicking and breaking a large stick of French *bread*, then bunches of bananas hanging from a *tree*, then a *door* puffing on a *cigarette* stuck in its keyhole. You can make up any bizarre image you like in order to link the pegword to the item to be learned. When recall is desired, you simply run through your familiar list of pegs and try to call to mind the image you formed earlier associated with each peg.

This system helps whenever the ma-

Item Number	Pegword	Peg Image	Item to Be Recalled	Connecting Image
1	bun		milk	
2	shoe		bread	
3	tree		bananas	
4	door		cigarette	
5	hive		coffee	

Connecting Images:
1 *Milk* pouring onto a soggy hamburger *bun*
2 A *shoe* kicking and breaking a brittle loaf of French *bread*
3 Several bunches of *bananas* hanging from a *tree*
4 Keyhole of a *door* smoking a *cigarette*
5 Pouring *coffee* into top of a bee *hive*

Both methods, of course, produced recall far superior to that of control subjects who were not using either mnemonic.

terial to be learned is already familiar, but when the items are relatively unrelated, so that the problem is one of reminding yourself of all of them. Typical applications are to memorizing lists of errands, shopping items, geographical facts (e.g., the principal products of Brazil), unrelated sets of scientific laws, the sequence of points in a speech or sets of arguments you are to deliver, of main events in a play or history or novel you want to remember, and so on.

Since each pegword is attached to a number, you can recall a particular item without running through the entire list as you must do with the method of loci. If asked to recall the ninth item, you simply call to mind your pegword for number nine ("nine is wine") and this will cue recall of the ninth item. Going in the reverse direction, you can also identify the serial position of any item; from knowledge that an *orange* was last visualized drinking a bottle of *wine*, you know that *orange* was the ninth item on your list.

The numerical mnemonic is obviously very similar to the method of loci; the difference is that images of concrete objects rather than images of familiar locations are used as pegs, and that the pegs are numbered. Judith S. Reitman and I compared recall by students using the two mnemonics, and found them to be entirely equivalent so long as the student was asked only to recall the test items in the order he'd studied them. Both methods, of course, produced recall far superior to that of control subjects who were not using either mnemonic. The equivalence of the two methods is understandable if one notes that a "location" (such as my chair, my fireplace) is really nothing more than a coherent collection of "objects," like those prescribed for the numerical pegword system.

The same pegs or loci can be used over and over again to learn new lists of items. No particular difficulty is created by such multiple usages so long as you're interested only in remembering the most recent set of items you've stuck on your peg. Typically we can forget about arbitrary lists once we've used them: shopping lists are used but once, legal arguments before a jury are gone through but once, and a waitress has to remember only once that the current customer sitting on the left in the third booth gets the ham sandwich on rye. In such cases, the person has no need or desire to retain earlier lists.

Multiple Learning. But problems do crop up whenever the pegword system is used to learn many similar lists in succession, and the person needs to remember all of them later. One example might be learning on Sunday all of your hourly appointments for the coming week; another would be learning multiple shopping lists of things to buy at the grocery, the hardware store, the garden shop, and the drug store. In the experiment Reitman and I did, we simulated this kind of memorizing task by having some subjects use a pegword system and others a loci system to study five lists of 20 words presented once each. They were tested for ordered recall of each list immediately after they'd studied it. They were also tested unexpectedly for recall of all five lists at the end of the hour's session and again seven days later. We told some subjects to learn the items on each new list by calling to mind a separate, distinctly different version (and vision) of the pegword and to link that to the appropriate item. Thus, if the first pegword was 1-*bun*, they should visualize a small cloverleaf dinner roll for associating to the first item in the first list, a large hamburger roll for the first item on the second list, and so on. They were also told not to call to mind earlier images associated to the peg, but to study each list as a distinctly separate set. Other subjects received just the opposite instructions—to use exactly the same image for the pegword and to progressively elaborate grand imaginal scenes in which the peg was interacting in some way with all the prior objects to-be-remembered at that list position. Suppose, for example, that the second words in the first four lists were *dog*, *hat*, *bicycle*, and *cigar*. Then the peg 2-*shoe* would be elaborated successively over lists as follows: a *dog* wearing *shoes*, that *dog* wearing a *top hat* and those *shoes*, that *dog* riding a *bicycle* while wearing that *top hat* and those *shoes*, and finally that *dog* smoking a *cigar* while riding that *bicycle* and wearing that *top hat* and those *shoes*. Our college students had no difficulty concocting such progressive elaborations, even though they had no more time than those doing the "separate" imagery method.

Although these two conditions gave the same high level of immediate recall after studying each list (86 percent vs. 87 percent), a huge advantage for the progressive-elaboration procedure appeared at the later tests. On the end-of-session test, the progressive elaborators recalled about 70 percent compared to 38 percent for the separate imagers. At the one-week test, the scores were 54 percent versus 12 percent, a fourfold difference.

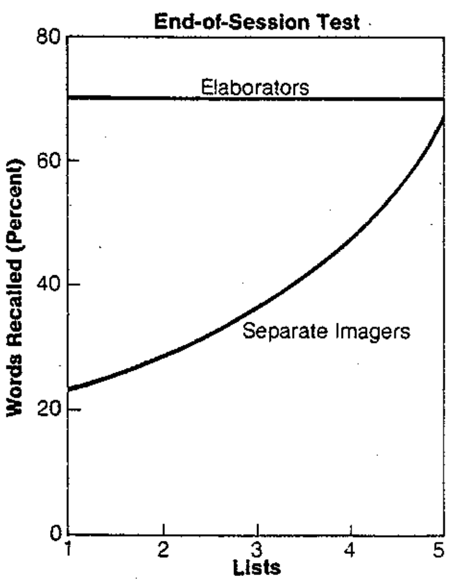
The problem seemed to be that as the separate imagers learned each new peg-to-item association they tended to *unlearn* the prior associations from that peg. Consequently, on the end-of-session test, these subjects were good at recalling the last list they'd learned, but did progressively worse at recalling the earlier lists of the session. The progressive elaborators, on the other hand, learned each new item by first recalling and rehearsing their "peg scene" containing the prior items and then adding a new elaboration of that scene. By this means, later uses of a peg caused revival and strengthening rather than unlearning of earlier items attached to the peg. As a result, at the one-week test, these subjects did best on the first list they'd learned and worst on their final list.

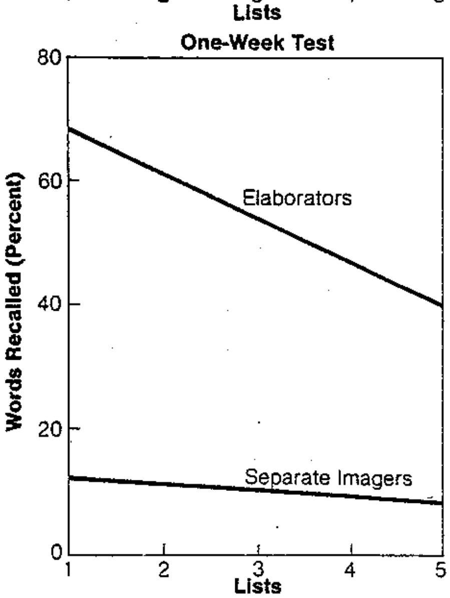
Overloading the Pegs. The practical prescription is obvious: if many similar lists are to be retained simultaneously using the same pegword list, then you frequently have to revive and rehearse earlier lists as you learn new lists. There are two other obvious ways to avoid the interference and forgetting caused by learning multiple lists. One way is to use a very long list of pegs (say, 100) and segregate items so that List-1 items (e.g., Monday's appointments) go onto pegs 1-20, List-2 items (Tuesday's appointments) go onto pegs 21-40, and so on. A second way to learn multiple lists but still avoid overloading a peg is to have multiple pegword lists at your command. Along with your rhyming pegwords, you might have three lists of 20 loci corresponding to locations along a familiar route inside your house, down the street outside your house, and through the place where you work. Then you can use different peg lists to learn the several similar lists you have to keep in mind. With a little ingenuity, you can

I once knew a 96-year-old man who could memorize a new list of 50 three-digit numbers shouted out to him by an audience one at a time every five or 10 seconds.

even work out a higher-order peg system to remember which class of items have been associated to which set of pegwords. Man's memory (or mind) seems quite at ease dealing with such superordinate hierarchies of units, since each hierarchy is built up according to a basic principle—namely, that a symbol can stand for an entire set of units but that symbol itself can enter into further associations.

As effective as such pegword systems can be, they are of no value in learning meaningless materials like numbers, which cause one of the biggest memory nuisances. We would like to remember telephone numbers, social-security numbers, license plates, room or locker numbers; we need to recall birth dates, anniversaries, addresses and ages; students must remember historical dates and the populations of countries; businessmen need to know production figures and budget allotments. A mnemonic system that is particularly helpful with this kind of material is a number-to-sound coding system.





Meet in HAVOK. One first assigns consonant sounds to the numbers zero through nine. For example, the numbers zero through nine might be assigned the letters b, c, n, v, r, h, s, k, l, and t. (More elaborate codings can be used.) Once the code has been learned, then a number can be replaced by its assigned letters. Thus the number 537 becomes HVK. These letters can then be made into a word by adding vowels wherever they are needed, as in HAVOK. And so we recall that we are to meet in HAVOK—that is, in room 537.

Dates, appointment times, and other numbers can be coded and learned in the same fashion. Very long numbers typically have to be broken up into a series of words, to make a phrase. Of course, like learning to play a piano (which requires coding or "translation" from visual score to finger movements), the code needs to be practiced if it is to be effective. You have to become very proficient at rapidly replacing digits by code letters and these by words. However, once the code has been learned, it takes little effort to maintain, much less than the time we ordinarly spend in trying to remember—or look up—important numbers.

Two or more mnemonics can be combined to produce a spectacular performance. I once knew a 96-year-old man who could memorize a new list of 50 three-digit numbers shouted out to him by an audience one at a time every five or 10 seconds. Not only could he recall the list without error, but he could tell you what the 37th item was and that the number 259 was the 18th item. Since he was partly deaf, his main trouble wasn't in remembering the numbers, but in hearing them correctly in the first place. He achieved his mnemonic feat by combining the pegword system and the number coding system. He had concrete images as pegs for the first 50 numbers. He also had a coded conversion word with a concrete image for each of the first 1,000 numbers. When given a number, he converted it to its code word and formed an image to connect that code word to the pegword for the first item. For instance, if the third number to be learned was 546, he would convert that to its code word, say, for example, HORSE. If his pegword for the third item was tree, then all he had to do was form an image of a horse leaning up against a tree, or kicking a tree.

Teaching Memory Skills. Most of us feel no compelling urge to learn long lists of three-digit numbers. Such feats make for interesting conversation and may prove entertaining at parties, but are themselves useless. However, the methods underlying such feats can be put to many practical uses. Whether we like it or not, we all have a great many things to remember. We ought then to acquire those skills that would make memorization less painful and more efficient. Our schools should teach memory skills, just as they teach the skills of reading and writing. 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 on an intelligent conversation about some current event, say, the Nixon Administration's war on inflation, 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.

We ought to take advantage of what we know about memory, forgetting, and mnemonics, and we ought to do it soon. You are already beginning to forget the material you just read.

To obtain reprints of this article, see page 142.