

The Ancient Art of Memory

Usefulness in Treatment

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Four patients with verbal memory defects associated with dominant hemisphere lesions were taught how to use an ancient mnemonic system. By the strategy of encoding memory items in a vivid, visual way, patients were able to use a pre-arranged peg list of images as labels to facilitate recall of the to-be-remembered items. Using this system, verbal memory performance was enormously increased. These data indicate that the mnemonic systems known to be effective in increasing the recall of professional mnemonists and normal college students are also of benefit to some patients with organic diseases of the nervous system.

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THE ANCIENT art of memory was invented by Simonides in 477 BC. According to Cicero in *De Oratoria*, Simonides had chanted a lyric poem at a banquet given by Scopas, a nobleman of Thessaly. Subsequently, while the poet was out of the room, the ceiling collapsed crushing Scopas and his guests. The corpses were mangled beyond identification. But Simonides, noting that it was through his memory of the places at which the guests had been seated, that he identified the bodies, realized that orderly arrangement is essential for good memory

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and that a visual image of the to-be-remembered item is easy to recall. The Parian chronicle, a marble tablet of about 264 BC which was found at Paros in the 17th century, records legendary dates for discoveries like the invention of the flute, the introduction of corn, and the recitation of Orpheus' poetry. In historic times the tablet's emphasis is on the prizes awarded at festivals. The entry which confirms Cicero's attestation is as follows: "From the time when Simonides son of Leoprepes, the inventor of the system of memory-aids, won the chorus prize at Athens, and the statues were set up to Harmodius and Aristogeiton, 213 years (ie. 477 BC)."

This ancient art of memory, well known to the Greeks, will be unfamiliar to most readers. Very few physicians realize that the ancients, lacking the books, papers, file cabinets, tape recorders, photographs, and other aids of modern man, had to rely heavily on their memories and used a system of mnemotechnics to augment the recall of specific information. This art, whose history is recorded in an excellent book by Yates,¹ seeks to memorize by impressing images on places to facilitate recall. The methods are adequately described by Cicero and Quintillian but specific examples of its practical application can only be inferred from our present knowledge of similar systems used by contemporary mnemonists such as Furst² and Lorayne.³ The extravagant claims made by commercial schools of memory run by these men and others have only recently been subject to objective testing and analysis. The conclusions are that, when normal col-

lege students are used as subjects, recall of specific information can be increased enormously by use of such systems.^{4,5} It has been demonstrated, for instance, that capacity for serial learning and paired associate tasks can be increased at least an order of magnitude.

When a list of items is memorized, the items from the beginning and end of the list are more often correctly recalled than those in the list's middle. This peculiar finding that the probability of correct recall depends on the position of the item in the list is well known to psychologists, and is called the serial position effect. Unlike the usual results in list learning, serial position effects are completely absent when the ancient mnemonic system is used.

When two lists are memorized one after the other, the first list tends to interfere with correct recall of the second and the second tends to interfere with the correct recall of the first list. The adverse effect that list one has on the recall of list two is called proactive inhibition, and the adverse effect that list two has on recall of list one is called retroactive inhibition. Proactive and retroactive inhibition effects are notably absent when encoding in the memory is done with the ancient art.

The more concrete the item to be recalled, the more vivid and ridiculous the mental image associated with the item, the easier the subject remembers. Prior memorization of a set of memory peg words is not necessary for the proper working of the system, as such lists can be supplied to the subject on a piece of paper.⁶

The author has studied most of the memory systems available at the present time and reviewed the history of this ancient art. His own memory has been increased enormously and his memory, like that of Shereskevskii, the Russian mnemonist who used such systems, appears to have no clearly defined limits.⁷ Easily picturable concrete items can be recalled 90% to 100% correctly days after encoding and the author has, as a demonstration, memorized many lists of 50 unrelated items with excellent recall. Practice in making absurd visual associations has enabled him to encode items at the rate of one per eight to ten seconds. Less visual items and more abstract terms require mental con-

Sample List of Memory Pegs and Images

Number	Peg Word	Peg Picture
1	Tea	Tea cup
2	Noah	Old man in ark
3	Ma	My mother
4	Rye	A bottle of rye
5	Law	Policeman
6	Shoe	A shoe
7	Cow	Someone milking a cow
8	Ivy	College wall covered with ivy
9	Pea	Giant pod filled with peas
10	Toes	A foot with toes on it

version into visual items and therefore need more time for encoding. Using a special phonetic system in which numbers are converted to sounds, sounds to words, and words to images, it is possible to remember any number. On repeated occasions the author has as a demonstration and also as an aid in his everyday life, memorized 12 and 15 digit numbers quickly. Usually a 12 digit number will take 1½ minutes to encode, a 20 digit number takes three to four minutes. Since the number is actually stored as a meaningful concrete visual image and not as the intangible, meaningless item it really is, subsequent recall is easy. The extra effort needed to encode the item in this manner is amply repaid by the benefits of increased recall. It is not true, as Cicero correctly points out, that memory is crushed beneath a weight of images.

The crucial question raised by this investigation was whether or not such mnemonic systems could be utilized to augment the failing memories of patients suffering from organic diseases of the nervous system.

This paper discusses the methods which can be used to increase a patient's recall, gives some case illustrations, and outlines criteria for predicting which patients are likely to benefit the most from such treatment. The suggestion is that such mnemonic techniques may be the foundation of a new branch of rehabilitation therapy helping patients recover their memories and partially filling the therapeutic vacuum which now exists in this part of medicine.

Method

Patient Testing.—After the patient's orientation, reading, writing, speaking, and language

abilities were appraised, a short test of their memory was given. Each patient was asked to memorize three verbal items, three visual items (faces from the *New York Times*), as well as a set of smells and tastes. The attention was then distracted by asking the patient his address, telephone number, age, year of birth, and fifth grade teacher's name. Memory of impersonal distant events was estimated by asking the patient to describe World Wars I and II. After the patient's forward and backward digit span were measured, recall and/or recognition of the previously encoded items was tested. Confabulations and falsifications of memory were noted and tests of sequencing historical events, and ability to estimate time intervals were also given. The results constituted a set of measurements by which different facets of the patient's memory functioning could be compared before and after therapy.

Mnemonic Techniques.—Systems outlined by Cicero, Quintillian, Furst, and Lorayne were adapted for patient use. Each patient was trained in forming vivid, visual images in his mind's eye and connecting these with the to-be-remembered items. The patient was told that all memory consists of associating what we want to remember with what we already know and that vivid, visual, ridiculous associations are remembered best. For instance, suppose one wants to remember the following shopping list: bread, carrots, eggs, dog food, newspaper, bacon, and deodorant. If we know *bread* and want to remember *carrots* we picture a giant loaf of bread breaking open and carrots falling out. The instructor would pause briefly to enable the patient to form the association picture and to "see it" in his mind's eye. Similarly, eggs are connected with carrots by picturing a chicken hatching a carrot. Dog food is connected with eggs by picturing a dozen eggs running around the street on a leash. Newspaper was connected to dog food by seeing a dog reading a paper; bacon connected with newspaper by visualizing someone reading a bacon instead of a newspaper; and deodorant was connected with bacon by picturing someone putting bacon under their arms instead of deodorant. Care must be taken that at each step the patient forms his own visual image and sees it momentarily in his own mind's eye.

The patient was then distracted by some unrelated conversation and then retested some time later by supplying the word *bread*. The recall of bread would bring to mind the carrots, the carrots, the eggs, and so on; each item was easily linked to the subsequent item via the ridiculous image. Recall was remarkably fast, easy, and enjoyable.

The same system was then applied to a 15 item list so that patients, encouraged by their seeming spectacular progress, would continue in treatment. Then patients were given a peg list of visual items to attach to the numbers one to ten and asked to memorize the peg list (Table) for the next session. Little mnemonics were given to facilitate memory but these are trivial and will be left to the reader's imagination.

Once the peg words were memorized, the patient was shown how the list could serve as a memory label when any item is attached in a visual way with the peg item. The practical utility in memorizing shopping lists and organizing one's daily activities, was emphasized and illustrated. The patient also practiced the use of the system by memorizing a list of ten unrelated items. The reader is urged to follow along now and form the visual associations suggested. The peg images and words will be supplied later, so don't worry about them. Here is your chance to prove to yourself whether or not this system has any usefulness in augmenting recall. The to-be-remembered list is as follows: 1, radio; 2, airplane; 3, lamp; 4, cigarette; 5, picture; 6, telephone; 7, chair; 8, horse; 9, diamond and; 10, watch.

Make the following visual associations, and most important try to see them for an instant in your mind's eye.

1. Connect teacup with radio by seeing yourself drinking tea from a radio instead of a cup.
2. Connect Noah with an airplane by seeing an old man and some animals in the pilot's cabin of the airplane.
3. Connect ma with lamp by seeing your mother holding a bulb in her mouth and the bulb is lighting up.
4. Connect rye with cigarette by seeing someone smoking a bottle of rye instead of a cigarette.
5. Connect policeman with picture by seeing a picture directing traffic.
6. Connect shoe with telephone using an absurd visual image you made up yourself. In the same way make the following connections. Be sure you make a visual image and be sure it is ridiculous, and be sure you "see" it for an instant in your own mind's eye.
7. Cow to chair.
8. Ivy to horse.
9. Pea to diamond.
10. Toes to watch.

Do not review the original list or your associations. That is not needed. In fact, focus your attention on something else for five minutes and dismiss the list from your mind. Then return to the peg words in the Table to see how many items can be recalled. What did you associate with teacup? With Noah? With ma?

The average patient gets all items correct in or out of sequence. Usually the recall sequence starts with the number, the number is linked to the peg word, and the peg word to the peg image. As soon as the peg image flashes before the slate of consciousness the ridiculous visual image is thought of and the item to be recalled is retrieved eg, the patient would think 3 was Ma. He would see a picture of his mother and then the burning bulb in her mouth would recall the test item associated with 3 was lamp. Errors of omission are usually due to poor visualization of the original association and failures of recall are due to failure to make the visualization ridiculous enough. False recall is seen only when patients try to bypass the visual system and recall the item from their natural memories. Evidently, from the success and facility of this system, we may conclude with certainty that thoughts or mental activity, once having formed the same total thought, tend ever after immediately to suggest each other.

At this point in the patient's progress he is taught how to connect numbers into words and words into numbers, and additional peg words from 11 to 100 are logically derived from the conversion principles. An assignment to memorize the US presidents is easily carried out and the successful patients are usually showing off their memory skill before friends and family.

Report of Cases

CASE 1.—This pharmacist was well until age 60 when he developed a transient attack of drooping of the right side of the face and decreased vision in the left eye. He was admitted to another hospital and observed for ten days. Subsequently, he was well until age 62, when he awoke with severe substernal pressing chest pain and mild nausea. Physical examination was normal but electrocardiogram showed Q waves in V_1 to V_5 . Chest x-ray film demonstrated an enlarged heart and serial enzyme elevation confirmed the clinical diagnosis of myocardial infarction. On the fifth hospital day, the patient became aphasic and hemiplegic on the right. Neurological examination showed a right field cut, expressive aphasia, right hemiplegia, right-sided areflexia, and a right Babinski sign. Over the ensuing two months the patient's aphasia cleared somewhat, and he was able to say simple words. Complex words could not be pronounced, and he frequently could not name objects even though he correctly picked the names from a list. The Wechsler Adult Intelligence Scale indicated a verbal intelligence quotient of 102 and performance IQ of

99. Bender-Gestalt, in the opinion of the psychologist, showed no perceptual problems but did indicate confused recall. The psychologist felt the patient was incapable of learning since he demonstrated no recall of any recent information.

One and one half years later, the patient was referred for memory evaluation. At that time the patient did not know the day, date, or month. He gave the year and place correctly. His distant memory for personal events was normal but recall of distant impersonal events was defective because he could remember only four drugs of the thousands he once knew as a pharmacist, and he could not remember any events of World War II. He did seven digits forward, but only two backwards, and he recalled none of three unrelated verbal items after distraction. Clues, cues, and lists did not improve his verbal performance. Visual recognition memory, by contrast, was good, and he recognized three of three face pictures after distraction. Recognition memory for smells was normal. Taste memory could not be tested because the patient had been unable to taste since his stroke. It was reasoned that this patient's selective verbal memory impairment with preserved visual memory was due to dysfunction of the dominant hemisphere, a finding noted by others.^{8,9} If a system could be devised whereby the visual memory could be used to augment verbal recall then his performance might be increased enormously. Six months later, the author ran across such a system when he read a course on memory by Furst. The patient was then brought back and retested. His verbal memory, orientation, and dysphasia were the same.

Memory Therapy.—This patient was taught how to make vivid, visual, ridiculous associations. He quickly realized that he was able to enormously augment his verbal recall. After one week of practice he was able to recall the days of the week and two of three unrelated verbal items after distraction. He did four digits backwards instead of the previous two. The second week of therapy he could recall correctly four of five unrelated items after distraction and had memorized the peg list from 1 to 10. His digit span was now 7 forward and five digits backward. The third week of therapy his performance was markedly worse. Although completely oriented, he was now unable to recall any of seven unrelated items. The reason for the poor performance was that, having become over confident about his memory, he had failed to make any visual associations. After the realization that the ridiculous pictures are essential, he returned the next week and successfully recalled 15 of 15 unrelated items after

ten minutes of distraction. At this time he had noticed that his natural memory was also improving so that he now easily recalled his social security number. For some unknown reason, his expressive dysphasia was improved. He was now able to clearly say words like zipper, respectable, and Kennedy which he had not been able to say before. As an exercise, he memorized the presidents of the United States from 1 to 37 by attaching visual images to the peg words supplied. For instance, the peg for 14 is *tire*. If the patient was asked who was the 14th President, a visual image of a tire with an arrow in it would flash before his mind. "Seeing" the arrow would recall Pierce. The peg word for 19 is *tub*. If the patient was asked who the 19th President was, he would see a tub filled with hay which would, of course, recall Rutherford Hayes, our 19th President. This man was taught peg words to 100 and how to use such combinations of peg words to recall numbers. His wife now uses his memory to recall shopping lists and appointments, and he is showing off his memory skills to friends and relatives.

CASE 2.—At age 5, this patient had grand mal seizures when he had high fevers. He was otherwise well until age 17 when, after diving from a boat, he surfaced with a severe frontal headache and stiff neck. He was admitted to another hospital and found to have a bloody cerebrospinal fluid. An arteriogram showed a left frontal arteriovenous malformation. No medicines were given.

At age 23 he developed grand mal seizures characterized by an aura of being isolated from the world, accompanied by a nauseated feeling, followed by a loss of consciousness, tonic-clonic convulsive movements lasting one to two minutes, without incontinence of urine or stool, and usually followed by postictal weakness, muscle soreness, and lethargy. The patient received diphenylhydantoin three times daily and phenobarbital 30 mg four times daily, with control of his major motor attacks, but the aura and nausea continued to occur. His neurological examination was normal.

Skull films showed an abnormal oval calcification in the left cranial cavity. Electroencephalogram had bilateral theta waves. On iodinated I 131 serum albumin (RISA) brain scans there was a left frontal-temporal and midline uptake greatest at zero hour. Left carotid angiogram demonstrated a large mid and inferior frontal arteriovenous malformation fed by both internal carotid arteries. The extent and location of the lesion precluded operative removal so the patient was continued on the anticonvulsants and followed in clinic. At about this time he

noted a decrease of his thinking and concentrating abilities. His recent memory for important details of his everyday life and his work performance became progressively worse. At age 29, four years later, the memory defect had become so bad that he was unable to recall things just said to him minutes before. He wrote down everything he wanted to recall and came to clinic asking for some treatment for his memory defect.

Memory Examination.—Patient was awake, alert, happy, and cooperative. He read and wrote well and was completely oriented. Distant personal and impersonal items were easily and correctly recalled. He knew his address, telephone number, age, year of birth, fifth grade teacher, and adequately outlined the events of World War II and the Korean War. His forward digit span was seven but backward digit span was four. He could recall only one of three unrelated verbal items after distraction and identified only two of three pictures. Olfactory and gustatory immediate memory, tested as described under "Methods," were normal. The data correlated with the patient's complaint of having more trouble recalling names than faces.

Memory Therapy.—The patient was taught the system outlined above. He quickly realized that his verbal memory defects could be overcome by encoding the items in a visual way. Using this system he was easily able to memorize and correctly recall after one half hour of distraction, a list of 20 unrelated items in or out of sequence. He also had no difficulty memorizing all of the presidents of the United States in or out of sequence. His digit span backwards has not changed and without this system his verbal memory is still markedly defective. His job as a clerk is no longer in jeopardy, and he has found that making visual images of associations is a more effective memory aid for him than writing things down. He has shown off his skill to his wife and friends and has increased his self-esteem and self confidence.

CASE 3.—This taxi driver was well until age 64 when, because of severe angina and congestive heart failure, his aortic valve was replaced with a Starr-Edwards prosthesis. He did well until April 1970 when, just after visiting the doctor, he suddenly felt weak, confused, and disoriented. He could not remember where the parking lot was in relation to the hospital but somehow he managed to get to his car. He drove for several hours in an effort to find his way home and was very chagrined to find out later that night, when he stopped for information, that he had ended up many miles away. As a

taxi driver he had had no previous difficulty traveling around New York City. Neurological examination three weeks later showed a mild right facial droop and a right Babinski sign, findings which were unchanged from an examination one year before. He knew the day, month, and year but not the day of the month. Reading and writing skills were preserved. Aphasia and apraxia testing was negative.

Memory Testing.—Distant personal and impersonal memories were normal. He did seven digits forward and four backwards. He recalled none of three unrelated verbal items after distraction. Cues, clues, and lists were of no aid. In fact, when given a list containing the correct item, he misidentified another item as the one he was supposed to recall. By contrast, he made no mistakes on the visual recognition memory tests. After distraction he couldn't pick previously given tastes from a group. Testing olfactory recent memory was precluded because he couldn't smell. The electroencephalogram was normal, and the patient did not want to receive anticoagulants or come into the hospital for evaluation. One month later his memory was unchanged, and it was decided to start memory therapy. In spite of an initial reluctance to form vivid, visual images, the patient was able, with the aid of the system, to recall four of five unrelated items after one half hour's distraction. He also memorized a list of five tasks to do. Like the mnemonist of Luria's book,⁷ once a vivid image was formed, he had trouble forgetting it. Week after week, as he practiced memorizing new lists, the old lists, previously encoded, would intrude into his consciousness. In spite of this difficulty, the patient was usually able to clearly distinguish which image belonged to the most recent list. He was easily able to recall seven of ten verbal items when using the system but without the system he recalled none of ten unrelated items after distraction. While sitting at home, one night, practicing his peg lists, he suddenly developed substernal pressing chest pain and soon thereafter was admitted to the hospital for treatment of a myocardial infarction. Memory therapy was then discontinued. In retrospect, he had probably had an embolism from his artificial valve to the brain, and subsequently, another embolism to the coronary artery.

CASE 4.—This 37-year-old movie executive was admitted for evaluation of 18 hours of headache, confused speech, poor comprehension, and weakness of the right side of his body. Except for a temperature of 102 F (38.9 C), results of his general physical examination were normal. On neurological examination, he had a Wernicke type aphasia and confusion.

The patient ignored the right side of his body. There was a right homonymous hemianopsia, weakness of right lateral gaze, right central facial paresis, and right hemiparesis. Sensation to all modalities was absent to markedly decreased on the right side. Routine blood studies were normal except for a white blood cell count of 13,700/cu mm, with 85% neutrophils. Echoencephalogram showed a 4 to 5 mm left to right shift, brain scan had a left temporal uptake, EEG demonstrated a left fronto-temporal slow wave focus, and left carotid arteriogram was read as showing an avascular mass. At craniotomy, a large mass consisting of edematous brain was removed. Pathological diagnosis was herpes simplex encephalitis and idoxuridine therapy was begun. The postoperative course was complicated by continuous fever for 12 days, a subgaleal infection, and hepatitis. Subsequently, the patient slowly improved and was discharged with a marked speech deficit mild hemiparesis, and a right homonymous hemianopsia.

Over the ensuing months his aphasia cleared, but the patient continued to complain of major difficulty remembering verbal material especially names, telephone numbers, and the things people said to him. He also noted that, if distracted, he would quickly forget the trend of his own thoughts. Because of these problems, seven months after operation, he was referred for memory evaluation. At that time he was completely oriented and was able to read and write. He named objects well, repeated words and phrases, obeyed commands, and seemingly had little aphasia or apraxia. He knew the details of his own biography including his birthday, home address, telephone number, fifth grade teacher's name, etc. The events and leaders of World War II were quickly and reliably recalled. He could do seven digits forward but only four backward. He recalled only one of three unrelated verbal items after distraction. Lists but not cues or clues helped to facilitate recall. Visual, olfactory, and gustatory memory were normal. Of interest, this patient had noted an increase in his ability to remember faces and other visual material since his operation. He also reported a new power to mentally revisualize in his mind's eye things he had seen before, a skill not present prior to his illness. The remarkable preservation of his visual memory was used as therapy to increase his verbal recall. The verbal to-be-remembered items were simply converted into images and stored in the visual modality and then subsequently revisualized and converted into words. For instance, if he wanted to remember the five principal industries of Venezuela, he pictured in his mind's

eye a miner, driving a tractor. In one hand the miner had a fishing pole, in the other a lamb. The whole tractor was being pushed upward by a gusher of oil. When recall was needed he merely pictured the scene. The miner reminded him of mining, the lamb of animal husbandry, the fishing pole of fishing, the tractor of farming, the oil of petroleum production. Similarly, he was able to augment his English language vocabulary by visualizing the meaning of the word or associating in some way the meaning of the word to a visual image. For instance, his disease had erased the meaning of the word piebald. Endless efforts to memorize the meaning verbally were ineffective but by seeing in his mind's eye a bald pie with black and white patterns the meaning of the word would quickly flash before his stream of consciousness. Using this technique he was able to add 10 to 25 words to his English language vocabulary each day.

Comment

The ancient art of memory has been taught to 7 patients so far, with good results in the 4 reported here. Of the three patients who did not benefit significantly, one had Alzheimer's disease, one had a third ventricular tumor which was causing clinical deterioration, and the other had a defect in recent memory observed soon after operative clipping of an anterior communicating artery aneurysm. None of these patients could form vivid visual images, none had any recent memory modality preserved, none were aware of their memory defect or interested in improving it. All were considered to have lesions in the midline structures of the brain. The main reason for their failure to respond to therapy was the inability to attach modality specific memories on to a preserved, or relatively preserved, memory

modality. Each of the cases in which memory therapy was successful was able to overcome a verbal memory defect by the strategy of encoding in the preserved, or relatively preserved visual modality. Naturally, low intelligence, poor motivation, and poor imagination interfere with the application of the mnemonic system. The patients responding to therapy benefit in proportion to their skill in using the system. In general, benefits are easily perceived by patient and doctor in the first lesson. The practical application of these systems to the patient's everyday life is not proved. But, the patients reported here have found that they are now relying on their own memory skills rather than on those of others. The benefit from a marked increase in self-esteem that comes from being able to show off memory skills to relatives and friends should not be underestimated. Self-esteem is important in altering the mental set of these usually depressed patients, and substantial progress in memory has caused a change in the patient's outlook on life. The improvement in the first patient's expressive dysphasia was unexpected and is unexplained, but could have been a side effect of the treatment. All the patients have reported a feeling of increased mental power induced by the sheer work of practicing the systems. Such subjective feelings should be objectively studied in future work on memory therapy.

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Nonproprietary and Trade Names of Drug

Idoxuridine—*Dendrid, Herplex, Stoxil.*

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