Chapter: Remembering

Remembering

WHAT'S THE ANSWER?

Said Juanita, "Let's invite that new kid who was talking to Patsy to the party this weekend."

Responded Debbie, "Good idea. Give me the phone book and I'll give him a call. Let's see . . . yes, here it is, 739-9267. Where's the phone?"

"Under your bedspread."

"I've got it. All right, here we go . . . seven . . . three . . . nine . . . nine . . . two . . . six . . . seven . . . It's ringing!. . Wow! Six rings, I hope he's home! Uh, what's this?. . . The phone's been disconnected? Try it again?. . . Juanita, what number was I calling? . . . Was it, uh, six . . . two . . . uh . . . " *What happened? Why did Debbie forget the number she'd just dialed?*

"Both Maria and I had dates Saturday night and Sunday afternoon. We're twins, you know, and we do a lot together. Our grades have been identical in every course we've ever taken together. Well, anyway, I know neither of us had studied for either our English test on poetry or our math test on equations until we sat down Sunday evening. We both had six hours to study and the two tests to get ready for. I spent three hours on English and then three on math. Maria alternated all evening, spending an hour at a time on each participant. And you know what? She beat me! She did better on both tests!" *How do you explain this?*

Do people who learn things faster tend to learn things better?

It is generally believed that there are at least two, possibly three types of memory processes by which humans retain information. The sensory store retains information for a very brief interval of time. Rehearsal allows information to be held in short-term memory and helps determine if it will enter long-term memory. Retrieval of information from long-term memory requires some trace of the event and a retrieval cue. Another theoretical analysis of memory bases its organization on the use to which stored knowledge is put. This model views memory as composed of three types of material: episodic (time-related), semantic (language-related), and procedural (physical activity).

Three basic methods for measuring the amount that has been learned and remembered have been developed: Re-learning is one measure; recognition is another. Recall is the most difficult measure of retention. Although psychologists often say they are studying learning or memory, it is more likely that they are studying different aspects of the same complex process. Moreover, if fast and slow learners learn the same amount of material, there will be no difference in their ability to remember that material.

The first process in learning and remembering something is to put the information into memory. Certain attributes of the learner affect that input process. These include the learner's level of motivation, level of attention, and intelligence. Aspects of the material being learned influence the ease of putting it in memory. The most powerful variable influencing ease of learning material is its meaningfulness which includes the association value of the words being learned, the imagery value of the materials, and the relative frequency of usage of the terms being mastered. A variety of task variables including the complexity and organization of the material, as well as the manner in which the material can be structured, also impact ease of learning.

There are a number of different procedures that will have an impact on the ease with which information can be put into memory. These procedures involve (1) how one's time is spent; (2) what activities are used while learning; (3) how accurate the knowledge of results that can be gained; and, finally, (4) the use of mnemonics in recall. Mnemonics are helpful in structuring material for input.

The three important processes in learning and remembering are (1) the putting of information into memory; (2) its storage (including strategies for studying to store information; and (3) its later successful retrieval if you have successfully studied for retrieval. It is no longer thought that decay takes place during storage because of our failure to use or rehearse information. Forgetting is more likely to be a result of proactive or retroactive interference, or lack of a consolidation period. Retrieving information is based on using a correct cue to locate a memory.

Any situation in which two tasks are to be learned offers the possibility of positive or negative transfer. If you want to predict which will occur, you can analyze tasks in terms of the stimuli and responses involved.

Memory

In the Learning Chapter we analyze in detail the most basic learning processes, classical and operant conditioning, as well as observational learning. However, we ignore another significant process -- remembering -- our subject here. What is the relation of memory to learning?

Obviously, once we have learned something, we have to keep it in "storage" so that we can retrieve it when we need it. How does this work? According to one theory of human associative memory, psychologists believe that there are at least two types of memory, possibly three -- representing different intervals of storage between input and use. This time-of-storage theory argues for the existence of a very short-term sensory store, short-term memory (up to about 2 min.), and a long-term memory involving up to permanent storage. According to another proposed model of memory, there are three types of memory, stored in terms of how the information is used. This theory assumes the existence of episodic memory storing time-relevant information, semantic memory storing word meanings and language rules, and procedural memory for retention of mechanical and repetitive acts. These theories are based on studies using the same techniques for studying memory.

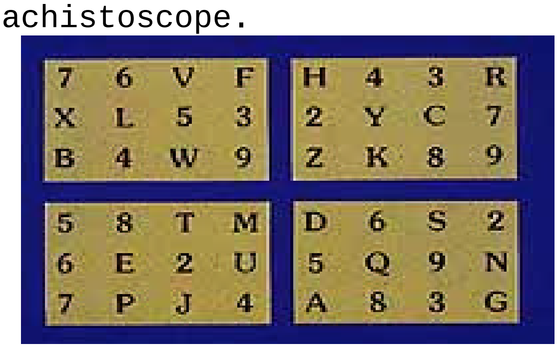
Is remembering the same as learning? Is it possible to demonstrate the existence of memory without using learning? We doubt it. People who study human learning and those who study memory may differ only in the processes they use and the events they study. They are really both studying the same thing. Psychologists studying human learning are most often concerned with stimuli and responses and with the input and retrieval stages we discussed earlier. Those who study memory tend to be more concerned with storage problems and the internal processing of information. But, both learning and memory are always present in any situation where either is being studied.

Does the speed of learning have an impact on the amount remembered? Does someone who learns material very rapidly remember it any better than someone who takes a long time to learn the same amount of material? The key phrase in that question is "same amount of material." And the answer is no. Even if the time people take to learn the same amount of material differs widely, there will not be a difference in their abilities to remember it. Whether you are a fast learner or a slow learner, if you learn an equal amount of material, your retention will be equal.

However, there is one difference: a fast learner will have more time than a slow learner to devote to "overlearning" the same material. It is important to assure that all learners have mastered the same amount of material. Otherwise, rapid learners could overlearn material and demonstrate "better" learning only because they spent more time with the same material.

Sensory Store

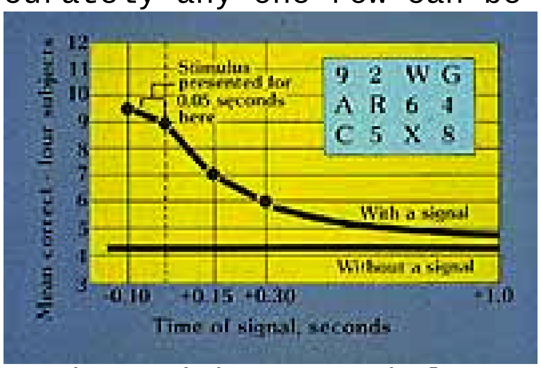
Look at the illustration, which is a picture of a tachistoscope.



This is an apparatus that allows a psychologist to present images for very short intervals of time, as brief as a few hundredths of a second.

Let's suppose we ask a participant to focus on a cross in the center of the screen. In this way we will be assured that our participant is attending to the stimulus we are presenting. As we discuss in the Sensation and Perception Chapter, when you focus attention on something, you tend to ignore other parts of the environment. Then we flash on twelve letters and numbers, arranged -- as seen in the Figure -- in three rows around the cross, for 1/20 second. Even if the participant pays close attention, he or she will be able to recite correctly only about 4.3 of the letters and numbers shown. That's a little better than one-third.

However, we can provide our participant with some help in retrieval. Suppose we say beforehand that we will sound a high, medium, or low tone to identify which of the three rows we want recited. If that tone sounds within a second after the letters and numbers have been flashed on the screen, it is amazing how accurately any one row can be recalled.



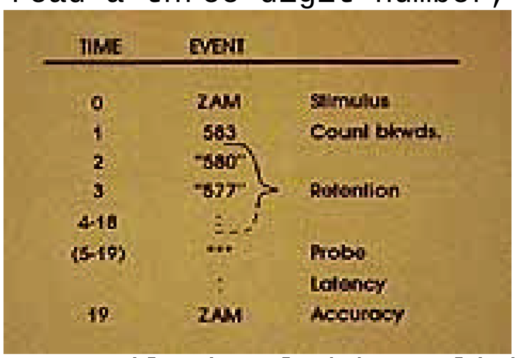
For example, if we show the stimuli and then immediately sound the tone, the participant can recall about 82 percent of any one row. However, if the tone signal is delayed by a full second, accuracy drops to about 38 percent -- not much better than he or she would have done without any help at all!

What do we learn from this experiment? (1) We learn that there is a type of memory, sensory store, in which information is stored very, very briefly when it is first received. (2) We learn that the information is forgotten if it is not attended to within the first second or so. (3) We find that nothing a person can do will prevent this loss of unused information.

Short-term Memory

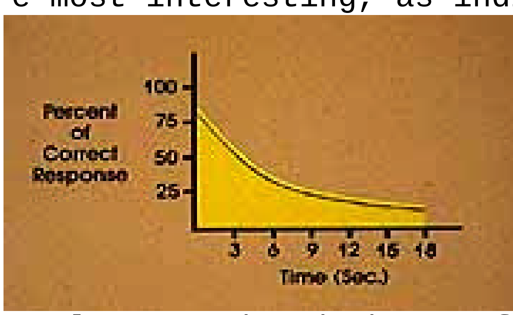
Let's assume that you are the participant being tested at a tachistoscope as described in our discussion of sensory storage. We play a middle level tone a short time after three rows of 4 letters and numbers are displayed. We'll assume you are paying attention and that you call the letters and numbers out to us correctly, X - L - 5 - 3. What would you do if you knew we were going to ask you to recite those same letters and numbers again after a minute or so without showing them to you again? Of course, you'd rehearse them, or repeat them to yourself. When we asked you for them again, you'd find you could recall the letters and numbers without difficulty. On the other hand, if we asked you for them several weeks later without any warning, it is very unlikely you would remember them. Why? Because you didn't continue to rehearse them, or because you rehearsed only for the purpose of the original test of memory.

The items you were asked to remember after a minute were stored during the retention interval in a second kind of memory, called short-term memory. Two researchers named Peterson in 1959 conducted what became a very famous piece of research on this short-term memory. They asked participants in their experiment to read a three-letter nonsense syllable (any meaningless sequence of three letters) and then right after that to read a three-digit number, as shown in the Figure.



The participants were instructed to remember the nonsense syllable. However, in the meantime they were to subtract three repeatedly from the number and report out loud each result once a second in time with a beating metronome. They were to keep subtracting three until signaled by a light to recall the letters they had originally read.

What was going on here? If you think about it, what the Petersons did was give the participants something to remember, but then prevent rehearsal of that information. The results were most interesting, as indicated in the Figure.



After as little as 18 seconds, people's ability to recall correctly the original three-letter nonsense syllable had dropped to less than 10 percent accuracy. Imagine, only ten percent of the time could participants correctly recall three letters they had seen for a second only 18 seconds earlier!

What do we learn from this? (1) We learn that there is a second kind of storage mechanism, short-term memory, in which information can be held for longer intervals of time. (2) We learn that the information disappears if the person is prevented from rehearsing it or fails to rehearse it. These are the characteristics of short-term memory. It is considered an active memory since, to retain information, it requires specific activity on the part of the organism.

Think About It

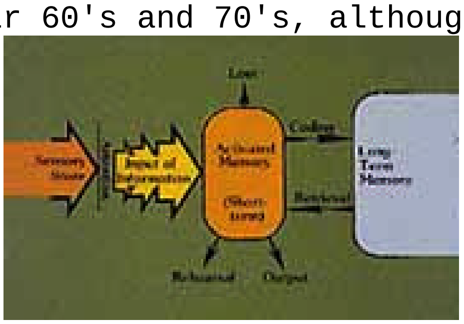
The question: In the story at the beginning of the chapter Debbie and Juanita continued talking after Debbie had looked up a telephone number and dialed it. When the recording came on informing Debbie the phone had been disconnected but to try dialing the number again, Debbie could not remember even though she had dialed it less than 30 seconds earlier. What caused Debbie to forget the number?

The answer: Most simply, she stopped rehearsing it. She looked it up and repeated it just enough to remember it while dialing the number. However, then she stopped repeating it and started talking to June again, thus interfering with -- in fact, eliminating! -- rehearsal. Since rehearsal is required to hold information in short-term memory, when rehearsal was stopped, the number was lost.

Long-Term Memory

Although we understand the sensory storage system and short-term memory, there is much less knowledge -- but many theories -- about the most permanent storage, long-term memory. The active rehearsal used to hold something in short-term memory is necessary to aid long-term retention of new information. However, just repeating a word is not enough to insure that it will be retained permanently. Repetition does not involve deep levels of cognitive processing; thinking about the words does. Repetition with the intent to learn increases retention substantially. Preventing rehearsal, as the Petersons did, causes information to drop from short-term memory and limits its entry into long-term storage.

One group of psychologists showed yearbook pictures of classmates to people who had graduated from high school two weeks to 57 years earlier. Astoundingly, people retained about 90 percent accuracy in identifying randomly selected high school classmates even 35 years after graduating. There is some evidence of increasing loss of these memories among people in their 60's and 70's, although it is not clear why this occurs.



Long-term memory involves at least two sources of information: (1) some kind of trace of the remembered event (this is what most people mean when they talk about a "memory"); and (2) some kind of retrieval cue, or information offered at the time an event is to be remembered. This cue allows us to search our memory for the stored trace. Cues are discussed in Techniques for Studying Memory elsewhere in the chapter. This time-based model based on sensory storage, short- and long-term memory is summarized in the Figure.

Episodic, Semantic, and Procedural Memory

In 1972, Canadian psychologist Endel Tulving introduced a new way of thinking about memory. Instead of organizing memories in terms of length of storage as had the Human Associative Model, he suggested that storage is organized around the particular nature of the stored information. Specifically, episodic memory was hypothesized to store information about personal experiences, such as when particular events happen. Each event is remembered in relation to other events; the time of an event is an important feature of episodic memories. It would be in this memory that information such as whom you ate lunch with yesterday would be stored. The episodic memory of each of us is unique; it is the record of our individual life experiences.

Semantic memory stores knowledge about symbols, including meaning and the rules for using words as is discussed in the language and communication Chapter. Forgetting is more likely to occur in episodic than semantic memory. Having proper cues is very important for recall from episodic memory, whereas concepts in semantic memory are richly interwoven with one another, making retrieval easier. Which of these two memories would be impacted by amnesia? Interestingly, only episodic memory. In amnesia, people may forget a portion of their personal life -- even months or years of it -- but they almost never forget language or professional skills learned during those years.

Have you ever had the experience when driving a car of suddenly becoming aware that you have no memory of the events of the last mile or two? It happens to all of us who drive, and it is indicative of an effect of a third type of memory suggested by Tulving: procedural memory. It involves mechanical skills -- such as driving a car. Such skills, as they become highly practiced, almost automatic, do not require all of our processing capacity. As a result our attention may wander to other topics. Suddenly something returns our attention to driving (or bike riding) and we realize we've been thinking so intently about something else, that we have no memory of our actions in the preceding time interval. You are not, as a driver, dangerous under these conditions; it's just that your excess processing capacity may involve you in something more interesting than your driving. You can walk and talk or drive and carry on a heated discussion, but if the driving gets tough, you are likely to suspend conversation in mid-sentence 'til the momentary difficulty has passed. More processing capacity is needed then for driving.

Techniques for Studying Memory

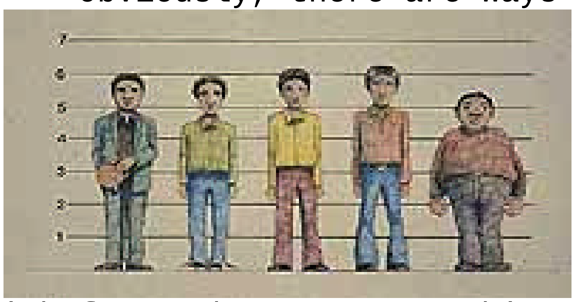
The study of memory has a long history. While psychologists are still theorizing about memory today, Aristotle, the Greek philosopher (384-322 B.C.), first suggested three bases for memory: (1) contiguity (closeness in time or space of two events); (2) similarity (recall of one event may be caused by the occurrence of a similar event later on); and (3) contrast (opposites will sometimes cause one another to be recalled). Through the long history of studying memory, however, very few methods have been developed for measuring how well a person remembers something. Here are the three most commonly used:

First, tests of relearning support the common-sense notion that after you've learned something once, it's easier to learn that material again. The less time or effort it takes to relearn something, the greater the amount you have remembered. Even the slightest amount of remembered material will assist you in relearning old material, and the saving can be easily detected.

One formula permits calculating a % Savings Score: {[Original Learning (OL) - Relearning(RL)]/OL} x 100 = % Savings in a learning task where you can quantify number of recitations or trials in the original learning and those in relearning. A trial is one complete presentation of the material being learned, such as the months of the year. Thus, if you learned something originally in 10 trials, and years later you were able to relearn it in 7 trials, the savings is calculated as follows: {[10OL- 7RL = 7]/ 10 OL } x 100 = 30% savings in relearning.

Second, another measure of memory is based on recognition. You are given a choice of several answers and asked to choose the correct one. A multiple-choice test is a good example. Try this, for instance: In the "What's the answer?" section at the beginning of this chapter, a telephone number was mentioned in one of the stories. Was it 739-9267 or 666-4137 or 851-2600 or 443-4568? The correct answer is 739-9267. Did you recognize it? Could you have repeated it without having seen it again?

Obviously, there are ways to make such a test harder.



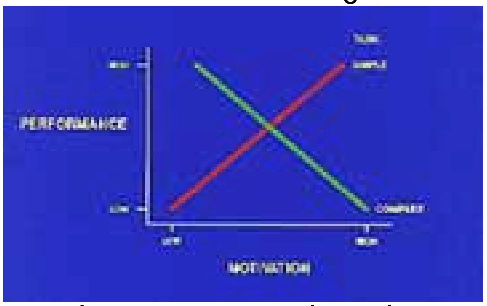
A police line-up of suspects can provide a good example. If the suspect is a 17-year-old white male, the police can make the identification harder by lining him up with four other teen-age white males. They can make it easier by lining him up with four other teen-age white males. They can make it easier by lining him up with people who are black, Hispanic, female, or old. The similarity of the incorrect choices must be properly controlled. Except for the problems caused by too much similarity between the choices, recognition can be a measure of how much information has been remembered.

Third, recall is the most demanding of all measures of memory. If you are asked to identify the three primary economic factors which lead to the Civil War in the United States in the early 1860's, you have been told precisely what to write about and been given exactly no help in retrieving that information. Recall involves simply telling what you know. You either do or do not remember an answer through recall; you get no help from the question or stimulus.

Each measure of learning offers different cues to the learner to aid in measuring what has been retained. Relearning uses the material itself as a cue -- presumably the best cue of all, since if anything has been retained, the organism will benefit with easier learning. Recognition uses the material itself, but sets it with other material more or less similar to the original. Thus, recognizing material as previously learned may be somewhat difficult. Recall provides the fewest cues of all and is therefore the least sensitive measure of learning.

Inputting Information

The process of remembering information involves three distinct phases: input, storage, and retrieval. We examine each, noting those factors at each phase that influence the process of remembering.



If you are expecting to learn something, there are a number of things that may influence how well you will succeed. The first of these is your motivation. Motivation is discussed in much greater detail in the Chapter discussing Your Motivations, but for now we can simply define it as the driving force that guides you toward a goal. Motivation may range from very low to extremely high. The impact of motivation on learning depends directly on the level of that motivation. For maximum learning ability an intermediate level of motivation works best. If motivation is too low, no learning will occur. If motivation is too high, you may be too nervous or so overactive that you react to too many things. The result will interfere with your ability to learn.

The complexity of the material to be learned also influences the effect of motivation. If you are learning a very simple task, increasing your motivation will (within limits) simply increase the speed with which you learn. However, if you are learning a very complex task, a high level of motivation may interfere. Increasing the level of motivation may speed up your response but make it less likely that your response will be the right one.

A second thing affecting success in learning is attention. Attention is your ability to focus on certain aspects of the environment while ignoring others. Your skill at focusing your attention has a lot to do with how much you will learn. Closer attention means better learning. However, psychologists have also been concerned with the question of incidental learning, that is, learning that occurs without intent. Consider, for instance, learning a foreign language. If your language professor is attempting to teach you Spanish vocabulary, he or she will present you with English words and ask you for the Spanish. But what would happen if that was the only direction (English into Spanish) in which you practiced? What would happen if you suddenly found yourself in a Spanish-speaking community or in Spain and people were speaking only Spanish? This would demand that you be able to take the Spanish word and supply the English -- exactly the reverse of what you practiced in class. Could it be done?

The answer is mixed -- some would say yes; some would say no. Basically, the important distinction here is between what your instructor told you to do (supply Spanish words) and what you learned incidentally -- how to translate Spanish into English. Therein lies the cue. The major difference between incidental and intentional learning concerns instructions; intentional learning involves learning in response to instructions. Incidental learning involves learning where no instructions have been given. Is the knowledge gained any different? Probably not. What really determines how well you learn (and thus remember) something is the number of responses you make. If you respond as often to incidental stimuli as you do to intentional stimuli, the amount learned will be about the same, whether or not you "intend" to learn.

Another factor that influences learning is wakefulness. Now and then you will see advertisements that lead you to think you can learn things while you are asleep. Can this actually be done? The evidence strongly indicates no, it can't. We discuss sleep in the Physiological Processes Chapter. Sleep, as measured by EEG waves, involves four distinct stages, from Stage 1 (the lightest stage of sleep) through the intermediate stages to Stage 4 (the soundest sleep of all).

Experiments have been conducted to determine whether people could remember facts read to them while they were asleep. Some psychologists thought they had shown that this could be done. Since most people sleep five to eight hours out of every 24 hours, think of the savings in study time!

However, it turned out that in those early studies there was no effective way to detect whether the participants were or were not asleep. After the EEG measuring device was refined, some of the most basic experiments on learning while "asleep" were repeated. When the EEG indicated Stage 4 sleep, participants couldn't remember anything played to them. It was later believed that those participants in earlier tests who seemed to have learned while they were asleep were not, in fact, actually asleep. Too bad!

Finally, the last major influence on learning is intelligence. Intelligence is discussed in detail in the Testing Chapter. Here we will just mention that level of intelligence is positively related to the speed with which information can be learned. Put most simply, smarter people learn faster.

Meaningfulness

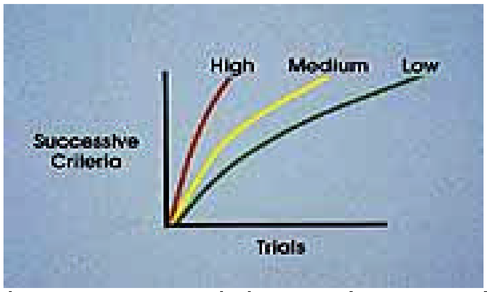
The nature of verbal material being learned and remembered can affect the speed and ease with which it is mastered. Important factors in the process of inputting information include the meaningfulness of the material, its manner of presentation (whether whole or in parts), and its structure (the ease with which it can be organized).

The meaningfulness of verbal material can be measured in a variety of ways. A word's association value is a measure of the number of other words of which a stimulus reminds you. Another factor which influences ease of learning is the rated imagery value of a word -- a measure of the ease with which a word calls an image to mind. As you might expect, the greater a word's imagery value, the easier it is to learn that word. And as anyone who is employed in advertising knows, the frequency with which a word is used also impacts its ease of learning. Higher frequency words are easier to learn. All of these factors are aspects of a word's meaningfulness.

Your own life should easily suggest examples of the major impact meaningfulness has on the ease of learning and retaining verbal material. Symptoms experienced when trying to master material of low (or no) meaningfulness include boredom, sleepiness, high -- Want to go to a movie? Sure! -- distractibility, and the experience of difficulty in learning. With highly meaningful material, your interest in learning is higher, the speed with which the material can be learned seems (and is) shorter, and the material forms or suggests easy links to other material.

The Role of Association Value

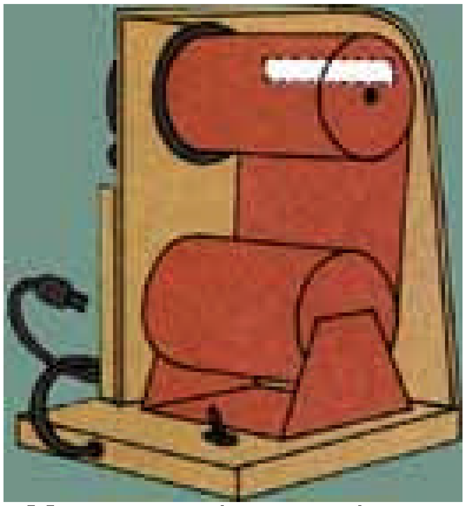
Look at Lists I-II in the Figure.
Which list would be easier to learn? Why? One measure of a word's meaningfulness, and therefore its ease of learning, is its association value. This can be determined by presenting the word to a group of people. Each of them is asked to write down every word the stimulus word makes them think of in a minute, with one stimulus word on each sheet of paper. Some highly meaningful words make the average person think of a dozen or more related word associates. Words that can do that are words such as KITCHEN (which makes the average person think of 9.61 words) or ARMY (which elicits 9.43 words in a minute). By contrast, words such as NAPHTHA (3.64 words in a minute) and FLOTSAM (2.19 words in a minute) are of much lower meaningfulness. Their association value (that is, the number of other words they make people think of) is much lower than words such as KITCHEN and ARMY.



Words with high association value are much easier to learn than are words with a low association value. As association value increases, the time to learn a list decreases. List I is much easier to learn than List II, as demonstrated by using serial anticipation learning described in Feature 1, because of the higher average association value of the words composing List I.

Feature 1

YEARNING FOR LEARNING



Traditionally, psychologists who were interested in studying verbal learning processes usually used one of two methods. The first, serial anticipation learning, involves presenting a list of words one at a time. Originally using a piece of apparatus called a memory drum, nowadays the material would be presented using a computer (See the Figure). The first word appears for a short time (usually 2 sec.). It is replaced by the next word in the list for the same length of time. The first time through the list the participant simply reads the words as they appear. After that, the participant has been instructed to attempt to guess (or anticipate) what word would show up next. A participant has learned the list when he or she is able to anticipate correctly each word that will appear while the word preceding it is still showing in the opening. The material to be learned is always presented in the same order

The other procedure used is paired-associate learning. Using the same apparatus, a word (stimulus) appears and shortly afterward (usually 2 sec.) that same word appears again, but now it is paired with a second word (response). Then again, usually 2 seconds later, another stimulus will appear, and likewise this one will shortly reappear paired with another word. There are usually 8-12 such word pairs. The participant is assumed to have learned the list when he or she can correctly anticipate which response word is paired with each of the stimuli. The word-pairs remain the same during any learning session, but the order in which the pairs are presented will vary. The pair that was first might be at the middle or end of the list the second time through.

The MAP model of memory proposes that words can be viewed as nodes with links from each node to all related words. You might then think of a word such as KITCHEN as having a lot of links (associations) to the many other words to which it is related -- refrigerator, stove, cooking, sink. . .these and many others. The MAP theory would suggest that words with many links are easier to learn and remember because of the large number of words with which they are associated. Thus a wide variety of stimuli can be used to link to a word such as KITCHEN, making it an easy word to learn and to retrieve.

The Role of Imagery

Imagery is a second important factor influencing the meaningfulness of words which impacts the ease with which verbal material can be learned. A word with a high imagery rating is one that is easy to picture. For instance, APPLE has a very high imagery rating. Although we may not all be imagining the same apple, there is little doubt in anyone's mind as to what we are referring when we speak about apples. Another way to describe this is to say that APPLE is a very concrete word. By contrast, BEAUTY is a very abstract word. It has a lower imagery rating since it is more difficult to create an image of BEAUTY. There is no single concrete object in the real world to which any of us can point and all agree it represents beauty. MARSHMALLOW has a high rated imagery value because everything thinks of an image quickly, easily, and consistently. Not so TRUTH. TRUTH may have a moderate to high association value, but it has a very low rated imagery value. For every person participating in a discussion of "truth," there may be a different image in their mind, if there's any image at all!

To measure the imagery of any word we can ask a group of participants how easily the word brings an image to mind. We can have them rate it from one for "Very difficult -- image aroused after long delay, or not at all" to seven for "Very easy -- image aroused immediately."

With this procedure we can arrive at a rating of each word's imagery. As words become more concrete in the ratings, they become easier to learn. Thus List III -- see the Figure -- has an average imagery rating of 6.32 (out of 7), whereas List IV has an average imagery rating of 3.19. In other words as a word's imagery increases, so does the ease of learning it. A high imagery list is learned much more rapidly than a low imagery list.

The Role of Frequency

A third way words vary in their meaningfulness is in the frequency with which they are seen in print and are used in speech. Thorndike and Lorge counted and listed 18,000,000 words, giving each a number that showed how often it appeared per million words. What do you think was the most frequent word? The answer is THE, which occurs 236,472 times per million words. The frequency of appearance of a word is important because the more often you have seen or heard it, the easier it is to learn.
Lists V and VI in the Figure show some high and low frequency words.

The importance of frequency has also been demonstrated as follows. A psychologist placed want-ads in the student newspaper at the University of Michigan and at Michigan State. Each ad was as wide as one column of newsprint and was one inch high. In the center of each space was printed one "word," but the words were selected from the Turkish language, such as civadra. The combination could always be pronounced, but it didn't mean anything in English. A total of 12 words, were "advertised," as listed in the Figure. Some words appeared once or twice, while others were "advertised" as many as five, ten, or twenty-five times during one semester.

What the experimenter did was to vary the frequency with which students at the two universities were exposed to each of the Turkish words. After the advertising was completed, he asked several classes of students to rate how well they liked the words.

Results indicated that the more often the word had been shown, the more positive regard the students had for it, as seen in the Figure. As frequency of exposure increased, so did the rated "goodness" of the word. This is happy news for companies and political candidates that advertise in magazines and newspapers or on radio and television:the more often they advertise, it would seem, the better their product will be rated! Coca-Cola should be especially happy. Yet, there is a limit to the role of frequency in increasing rated "goodness." Beyond a certain point, too much repetition.

Task Variables

Another question important to inputting materials for purposes of remembering them later is whether it is better to learn material as a whole unit or to break it into parts. Do you play any kind of musical instrument? If so, how do you go about learning a new piece of music? Do you simply "sight read" your way through it the first time, and then gradually improve the quality and timing as you play it all the way through more and more often? Or do you practice the parts one section at a time, paying most attention to any parts that are giving you a lot of trouble, and then gradually add the pieces together until you can play the whole thing?

Feature 2

**"NUMBER EIGHT ON THE TOP 40 THIS WEEK:
'TOY BOAT, TOY BOAT, TOY BOAT. . . ' "**

Increasing the frequency of exposure of a new word will increase the rated "goodness" or meaning of that word. However, it is also known that if you say a familiar word or phrase over and over rapidly, it will start to lose its meaning. For example, if you said "toy boat" rapidly many times, it would soon start to sound senseless to you. A stimulus repeated too often loses meaning.

Fads take many different forms. A popular song seems to start almost instantly, be repeated frequently, and then rapidly disappear. One psychologist studied what happens to the ratings of songs that eventually make it to the Top Ten listed each week in Variety—a weekly show business magazine.

A Top Ten song at the height of its popularity is played time and time again. In fact, many radio stations have daily programs that play only the Top Ten songs. Thus, after it gains popularity, a Top Ten song should begin to lose its "goodness" in direct proportion to the frequency with which it is heard. The more times it is heard, the greater should be the loss. But what happens to Top Ten songs?

Let's look only at songs that spent ten weeks or longer in the Top Ten during a twelve-month period. The longer a song took to reach the Top Ten, the longer it tended to be listed in the Top Forty (or Fifty, depending on whose charts you read). On the other hand, the longer a song stayed in the Top Ten, the more rapidly it fell off the Top Forty list once its popularity started to slip. In other words, a song's rated popularity exactly follows predictions which are based on what happens to a word's meaning as a result of its frequency of exposure. The more often a song is repeated, the more rapid is its fall from popularity once that decline begins.

It is the task itself that largely determines which method is better for learning. Research doesn't provide a clear-cut answer as to whether one should learn parts or the whole on a particular task. So what should we do?

Two major factors are involved: task complexity and task organization. Complexity refers to the demands made by each part of a task on your ability to process and store information. Organization refers to the need to interrelate several task demands all at once. Note the examples of such tasks shown in the Table 1.

Table 1

Relation between task complexity and task organization

TASK ORGANIZATION	**TASK COMPLEXITY** **LOW**	**HIGH**
LOW	Kicking a football	Driving
HIGH	Juggling	3-Dimensional tic-tac-toe

The following advice may help you: For highly organized, integrated tasks, the whole method is almost always better, no matter how complex the task. For unorganized tasks of low complexity, either part or whole learning will be effective.

However, as the complexity increases, the part learning method becomes the better choice.

Structure is a third attribute of materials that affects how easily they can be learned. Can the material be clustered or organized in some way? For example, look at Lists VII and VIII in the Figure. First, read List VII to some friends at the rate of one word every two seconds, then allow them to recall the words in any order. Do the same for List VIII. When you compare the results of learning each list, you should find two things: (1) more of List VII will be recalled than of List VIII; and (2) the material recalled from List VII will tend to be grouped in clusters composed of men's names, sports, fruits, countries, and colors. Related words tend to be recalled together. The ability to organize the material makes it easier to learn and to remember.

Procedures for Learning

The procedures used as we learn will affect the ease with which material is learned -- and sometimes the ease with which we can later recall it. There are a number of factors which influence your learning of verbal material: (1) time and how you use it; (2) the activities in which you engage as you learn; (3) the feedback you get about your performance; (4) the "tricks" you know to help organize and retain the information.

Obviously some of the time during which you are learning new information must be spent in repeating the material. The experiments of the Petersons discussed in short-term memory show the importance of rehearsal activity. Without it you would forget within a minute almost everything to which you had been exposed. You would never learn it; it would never reach long-term memory.

However, it turns out that the way in which you engage in that rehearsal for retention is very important. Massed practice means that all the practice is done at one time from start to finish. Distributed practice means that rehearsal occurs in blocks of time separated by rest periods or intervals during which you do something else.

Which is better? It depends on the kind of material you are trying to learn, and it also depends on how much time you have to devote to the task. If you are learning a list of materials, a serial list or a poem or a speech, then distributed practice is almost always better. Practice a while, but then set it aside and do something else for a time before coming back to it. On the other hand, if you are learning more complex materials, the benefits of distributed practice are not so great. The more complex the task, the less benefit there is to distributed practice.

Think About It

The question: The twins who were described at the beginning of the chapter had performed equally well in college. Both had the same two tests in poetry and equations for which to prepare One twin spent three hours on one subject and then three on the other; the other twin alternated hours studying each subject. Both spent a total of six hours studying. Why did the one twin do less well?

The answer: The English test required memorizing poetry, and the math test required learning a list of equations. Because of the simple nature of the material, it was likely that distributed practice would prove best. The results of the twins' performances bears this out. The twin who used massed practice on both subjects did less well than the twin who used distributed practice.

Time and how you use it is also a factor in the process of overlearning. Suppose you were given the assignment of learning the following football fight song:

Rah! Rah! Ree!
Kick ‘em in the knee!
Rah! Rah! Rass!
Kick ‘em in the. . .other knee!

Let's suppose you had to read that verse six times out loud before you could repeat it correctly all the way through without error. Learning took six trials.

Is there anything to be gained by spending any more time studying it? Yes, there is. Six times to learn it means that if you read it three more times, you would overlearn it by 50 percent. If you read it six times after the first perfect recitation, you've overlearned it by 100 percent. So what? Why bother?

Well, you will remember information better if you overlearn it. One psychologist tried this experiment: He asked three groups of students to learn a list of 12 two-syllable nouns. One group read the material until they could repeat it perfectly once. The second group overlearned the material by 50 percent. The third group overlearned the list by 100 percent. Each group was then brought back to the laboratory at varying times after they had learned the material. They were asked to recall it. The Figure shows the results. It is easy to see that the more overlearning that took place, the better was the recall many days later. If you want to remember something, don't just learn it, overlearn it!

Think About It

The question: Do people who learn things faster tend to learn things better? In the Learning Chapter we say that the speed of learning does not influence how well information is remembered. We say that fast and slow learners who have learned an equal number of facts will remember those facts equally well. Why might it seem to most people that fast learners do remember things better?

The answer: The key issue is overlearning. Both fast and slow learners are usually given an equal amount of time in which to learn information to be remembered. As a result, the speed of the fast learners gives them a great deal of time (not available to slow learners) to overlearn the material. As the graph shows, overlearning results in better retention. Thus, if equal amounts of time are allowed, unequal amounts of learning will occur. When the amount learned is controlled and equal, the retention of fast and slow learners will also be equal.

Depth of Processing

Ease of learning is affected by your activities as you learn. One of the most effective procedures for learning verbal material involves increasing the depth at which you process the material to be learned. Canadian psychologists Gus Craik and Robert Lockhart have suggested that the level at which a word is processed will directly influence how well it is remembered. In one experiment participants were asked one of three different levels of "yes-no" questions about each word in a list. Is it printed in capital letters? Does it rhyme with another word? Would it fit in a particular sentence? Each question involves more processing than the previous one and more concern with the meaning of the word. After the questioning, the lists were taken away and the participants tested. Participants were almost three times as likely to remember a word if they had answered the last of these three questions than if they had answered one of the first two. Greater depth of processing led to better retention. Others have shown that making information personally relevant redoubles the amount that can be retained. The lesson is quite clear: think about material as you try to learn it.

To master new material, you should recite it rather than just read it, and outline it rather than just underline it. The more times you expose yourself to new material, the more likely you will learn it. When you recite and outline material, you increase the number of exposures. And, if you can make it personally relevant, you further increase the likelihood you will remember what you have studied.

Knowledge of Results

A procedure which will have a direct impact on improving your learning is finding out how well you're doing. Knowledge of results is very important in helping you maintain a skill or learn something new.

Consider your performance as you drive a car. If the car starts to cross the centerline as you are steering, you tug the wheel slightly to the right so as to stay on your side of the line. If you over-correct and start heading for the gutter, you pull the wheel slightly in the other direction. In short, you maintain a constant balanced position, keeping your car at some point midway between the curb and the centerline. Your ability to do this is based solely on the instant knowledge of results available to you. With each turn of the steering wheel you can see the effect on the car's motion, and you adjust your actions accordingly.

If there is too much delay between the time a task is performed and the feedback about it is received, the feedback is of very little use. The person may have forgotten what he or she was supposed to be learning or how the task was actually performed. This is especially true in practicing physical skills which require fine muscle coordination. It would be markedly more difficult to learn to play golf wearing a blindfold. Though not impossible, the inability to see immediately the effects of your coordinated swing on the golf ball significantly increases the difficulty in learning the game.

Mnemonics

An effective procedure that can have a major impact on how easily material may be learned is a "trick of the trade," called a mnemonic (knee-MAH-nick). A mnemonic is any device or phrase or scheme of organization that aids in the learning, storage, and/or retrieval of information. The skill in developing a successful mnemonic is to create one that is very simple to learn and remember. Time spent learning a mnemonic is time not spent learning the material to be remembered. That fact must be kept in mind so you don't waste time looking for magic formulas to aid your recall. There is no substitute for hard work and rehearsal, but a good mnemonic can organize your work and time in a most efficient manner.

Note that we are discussing mnemonics as part of the input process in learning and remembering. Mnemonics are a means of organizing information for input and output. They don't really improve storage directly -- they just aid the input and output processes.

One mnemonic is based simply on clustering into smaller units the information that is to be recalled. State license plates are a good example of this. Texas, South Carolina, and California, to name just three, organize their license plates in terms of three letters and three numbers. Telephone numbers are clustered into area code, exchange, and four numbers for a particular phone. When you are spelling your own last name for someone, don't you cluster the letters?

Another mnemonic, requiring more preparation, involves a formal technique called the method of loci. You pre-memorize a series of places or objects with which you are already familiar. When you need to learn a list, you connect each item to be remembered with a serial position along the route of your mental journey. For instance, you could imagine what you pass when walking from your psychology class to your next class, or what you pass walking from your bedroom to the kitchen at home, or from your dorm room to the library -- any route with a series of objects with which you are quite familiar. To use a mnemonic as an aid to memory, you may form bizarre (literally, memorable) associations between the items in your mental trip and the items on the list you must remember. See Feature 3 for an example of how this works.

Feature 3

"HERE'S THE UMBRELLA FULL OF ICE CREAM YOU WANTED"

Let's suppose that on your way home from the university you must mail a letter for a friend, stop at the drug store for aspirin, get some peanuts at the grocery store for a party you're going to have, and pick up your watch at the jewelry store. To remember that list without writing it down, let's suppose you imagine the trip from your seat in the psychology class to your next class. As you pass the wastebasket, you imagine a large letter sticking out of it. As you pass through the classroom door, you imagine that you bump your head and thus give yourself—yes, a headache. Imagine the hose of the fire extinguisher in the hall squirting into a bag of peanuts. Finally imagine a giant watch band wrapped around the doorknob of your next classroom.

To remember the items after school, all you need to do is to retrace mentally the trip from your psychology class to the next class. You are using the method of Ionic. Now, shut your eyes and think: What were the four items in the list we just went through?

A final mnemonic is purely cognitive, based on a previously memorized rhyme. The ten-item list in the Figure is most frequently used. What you do is form unusual mental pictures connecting the PEG-word images with the items you want to remember. Of course; the PEG-word list itself must already be well-known so that all your time can be spent developing associations between those words and the items. You might need a little practice before you get the system down pat, but notice each pre-memorized stimulus word rhymes with its ordinal position in the list: GATE is eight. This feature aids in recalling a specific numbered item, if that's necessary.

USING PSYCHOLOGY: Studying for Input

Any attempt to improve your skills in studying is an attempt to apply the principles of learning. Thus, it makes sense to organize your study plan along the same lines as our discussion of memory: (1) input, (2) storage, (3) retrieval. Organizing your studies for input will draw on many procedures for learning. We can propose a specific mnemonic here: An SR Model: Schedule and Read!

Most information reaches us through our ears via conversation or discussion (live or recorded), and through our eyes, often via reading. It follows, then, that finding the best way to read is one important factor in effective learning. How can your reading skills be improved? Efficient reading is a matter of encouraging yourself to read as rapidly as possible. Once that pressure for improvement has been established, it then becomes a matter of balancing speed with comprehension.

Frequently, negative transfer from earlier experiences in reading is responsible for inefficient reading. Think back to the first grade, when you were being taught how to read. In order for the teacher (or your parent) to work with you, it was necessary for you to read the words and sentences out loud. You often pointed your finger at each word you tried to pronounce.

Logically enough, most people assume that efficient reading as an adult is nothing more than speeding up these same processes. That's where the negative transfer occurs. In fact, effective silent reading is accomplished not by pronouncing each word, but rather by trying to comprehend contents in phrases or thoughts. The good reader's eyes skip across material, not stopping on each word but pausing only to take in several words at a time. Practice in good reading involves increasing the scope of material you can understand with each pause of the eyes.

There are also other things that influence how effectively you study. You must pay attention! We learn in the Sensation and Perception Chapter that humans can attend to only one thing at a time. Some people maintain that they must have noise around them to study -- music or people, for instance. The research evidence argues strongly against this. Anything that gains your attention distracts you from the task at hand. Thus, quiet and a simple, uncluttered view provide the best environment for studying.

The principle involved here is stimulus control. It is important that you set aside for yourself a place where all you ever do is study, as illustrated in the Figures. If you must do other things, do them someplace else. In that way you gradually condition yourself so that all the cues at your desk elicit the appropriate response -- studying.

You should also schedule your activities. There are probably many things competing for your time and attention -- friends, sports, family affairs. Set aside time for studying, but allot some portion of your time to other activities in a way most satisfying to you. Some of us work best late at night or early in the day. It is beneficial if you schedule your time for studying at a time when you are at your sharpest. Block your time horizontally -- meaning, arrange your schedule so that you are always studying during the time intervals of the day when your experience suggests you are sharpest.

Retaining information:
Are Remembering and Forgetting Related?

An important aspect in analyzing the process of putting information into storage, is the storage process itself. What processes occur that may help or hinder our ability to remember information until we need it? Remembering and forgetting: Are they related? Put most simply, yes. The amount of material remembered or retrievable at any time plus the amount of material by then forgotten (or unretrievable) equals the total amount of information originally learned.

One of the first studies of retention and forgetting was conducted in the late 1800's by the experimental psychologist Hermann Ebbinghaus. He learned a large number of nonsense syllables, three-letter combinations that had no meaning -- XAC, VIL, and REQ, for example. Ebbinghaus studied the material he wished to remember until he could recite it perfectly. Obviously, then, retention at the time of perfect recitation was 100 percent. Ebbinghaus immediately tested himself again after zero minutes, and then again 1, 8, 24, and 48 hours later. The Figure shows the results of his studies. It is amazing how much information he forgot in just two days. It is obvious then, that as forgetting increases, the amount of material retained decreases.

Why do we forget things? Many theories have been advanced about forgetting, based on what is probably happening to the information that has been stored away. One possibility involves some kind of weakened memory due perhaps to a process of decay. This is a very old and appealing theory of forgetting. It also appears to be quite wrong. According to the theory, with the passage of time and without rehearsal or use, memory of learned material will gradually fade away. It decays through lack of use. Appealing, but contrary to scientific evidence.

Consider, for example, the old friend you haven't seen for a long time whom you run into quite unexpectedly one day on the street. You can't for the life of you remember the person's name, but either one of two things may very well bring it to mind. If the person gives his or her name, you will recognize it ("Of course, how nice to see you . . ."). It is also true that if given a choice of five or six names, you could recognize the correct one almost every time. If not, it might be just on the tip of your tongue, so to speak, and you'll continue to worry about it. That you can in time recall the name is evidence against the decay notion.

Some people suggest that lack of attention when you first learn a name or a fact is an explanation for forgetting, but this also is wrong. Lack of attention when learning is a problem of faulty or partial input. It is not a matter of forgetting. You can't forget what you never learned. It is important that you study for storage if you intend to retain new information.

Another explanation for forgetting lies in the processes that alter memory in some way. One of these processes is interference. When new learning interferes with previously learned information, it is called retroactive interference (backward-acting) . On the other hand, when previously learned material interferes with more recently learned material, it is called proactive interference (forward-acting). See the Figure for a demonstration that illustrates both forms of interference. Of these two processes, psychologists believe that proactive interference is the more powerful. Forgetting is more often caused by learning that precedes what we wish to remember than it is by learning which follows.

Humans require another process if they are to store information successfully in memory. Evidence about this need comes from a variety of sources. For instance, people involved in automobile accidents -- especially those who are briefly knocked unconscious -- frequently are unable to report any memory of the events immediately preceding the time of the accident. It is as though the period of unconsciousness in some way wipes out memory of events that took place just before consciousness was lost. The same is true of patients experiencing ECS (electroconvulsive shock, discussed in the Personality Therapies Chapter). They are frequently unable to report anything afterward about events occurring as much as 15 minutes prior to the shock treatment. Experiments discussed in Short-term Memory, such as those by the Petersons, also indicate that interfering with the rehearsal of recently learned material results in a much greater memory loss.

These facts indicate that for us to remember something, there must be a period of time allowed for consolidation to occur. Anything -- a bump on the head, inability to rehearse, or an electric shock to the head -- that interferes with the process of consolidation will lead to reduced memory. The memory has been in some way modified or altered.

USING PSYCHOLOGY: Studying for Storage

Since you can't forget what you haven't learned, our primary concern is to make sure that you really do learn in the first place. Basically there an two requirements: a strategy of attack, and a program. Let's discuss strategy first. Different systems for studying have been proposed, but one that has been widely accepted is the SQ3R approach. This plan of attack involves five steps: Survey, Question, Read, Recite, and Review.

First, survey the material. Skim the material very rapidly, taking only a minute or two to survey a chapter. Look at the headings, and read the summary at the beginning -- as is available in this text -- or at the end, if one is included. Check the table of contents at the start of the book, or read the outline that may be listed near the start of a chapter -- as we do in this text! This is to acquaint yourself with the basic content of the reading. What subjects are covered, and in what order? Think of the mnemonics we discuss elsewhere in this chapter. A quick survey will give you a bare-bones outline on which to hang the chunks of information further reading will supply.

Second, raise questions about the material. This can be done ahead of time, but is perhaps most effective if done as you read. Changing the section headings into questions will actively involve you with the subject. As you attempt to answer your own questions, you will be bringing your own experience to bear. This will also help you understand the material better. Though it seems trivial, this questioning is vital in personalizing the material for you. Read anything to answer questions for yourself -- it makes it much easier to learn and remember!

Third, read the material. Read actively. What is the answer to the question you just made up at the start of the section? Read to find that answer, and read to the end of the section covered by the question you developed. This is also the point at which to practice the efforts we discuss elsewhere to speed up your reading. Read rapidly, but read to learn the answer to your question.

Fourth, recite the material you've just read. Try to answer the question you developed at the beginning of the section, but try to do it in your own words, without looking at the material. One good way to do this is to attempt to outline your answer in a few key phrases on a sheet of paper. If you can't do it, go back over the section until you can. Don't move on until you understand what you've read.

Fifth, review the material once you've completed the reading. You might scan the notes you just wrote to see if the major points you've listed agree with those in the material you read. Can you now repeat the major points of the material? And with those points expressed, can you list the lesser points under each of them? For instance, can you now shut your eyes and recite not only the five steps of the SQ3R method, but what each step requires? Try it. Review!

With this SQ3R method, you have a plan of attack to organize your reading. Another tip on effective studying relates to our discussion of massed versus distributed practice.

All things considered, it is better to spend an hour or so with each school subject every day or two rather than spending four or five hours at one clip once a week. However, we suspect you can see that planning ahead is important. If you've fallen way behind in a subject, you're going to have trouble catching up when you start scheduling your time. Your goal should be to give all your subjects a more equal amount of attention.

Retrieving Information from Memory

Remember what happened when you returned to school in August/September? Undoubtedly at some point you ran into someone you hadn't seen, much less thought about, since last spring. Yet, you knew his or her name, or at least you thought you had learned it. You couldn't quite remember it, but it seemed as if it was on the tip of your tongue. Such experiences offer a number of helpful hints about how information is stored and retrieved.

Feature 4 describes studies on the tip-of-the-tongue phenomenon. These experiments suggest that words are stored in terms of their features, including the first and last letter, and also, perhaps, by the number of syllables that they have. Sound is more important than meaning. One of the most effective cues that can be given as a hint to someone who is trying to recall a word is another word that rhymes with it.

Feature 4

WHAT IS: "A LIGHT-WEIGHT UMBRELLA USED AS A SHADE FROM THE SUN"?

The "tip of the tongue" phenomenon (called TOT for short) occurs when you cannot quite recall a familiar word, yet you can recall others of similar form and meaning. Reading the definition of a word to people who may be familiar with it results in one of three responses: (1) they know the word; (2) they don't know it; or (3) they tell you it's on the "tip of their tongue."

In one experiment people were read definitions of words like the one in the heading above. These "target words" that they defined occurred between one and four times per four million words in print—recognizable as words, perhaps, but hardly in one's active vocabulary. People who said they had such a word on the tip of their tongues were asked a number of questions: How many syllables does the word have? What is its first letter? What are some words that sound like it? Finally, they were asked to list some words that were similar in meaning.

When guessing the number of syllables in the target word, participants in the TOT state were correct more than 50 percent of the time for words of one to three syllables. Even more amazing, the initial letter was guessed accurately 57 percent of the time! (There may be one to five syllables but there are 26 letters In the alphabet.) Participants in the TOT state were more than twice as accurate in their sound-alike guesses as they were in their mean-the-same-thing guesses.

These results suggest that when a word is stored in our memory, its features are analyzed. Features such as the beginning and end of the word are stored first, probably along with the number of its syllables. With this much information, when participants start trying to think of the correct answer, they are more likely to come up with words that sound alike than with words that have a similar meaning. The TOT state occurs when enough features have been recalled to narrow the choices to only a few words. However, the "I've got it!" experience will not occur until enough features have been recalled to eliminate all the other likely answers, leaving only the correct one.

Inaccessible memory refers to the apparent forgetting of previously learned information. There are perhaps more theories and fewer facts about this process than about any other. It might seem that inaccessibility is a storage problem, but actually it is a problem of faulty retrieval, as we shall see. However, there seem to be two kinds of events in which inaccessibility of a memory takes place.

One comes directly from the personality theory of Sigmund Freud and concerns an active process of repression. It's almost as if we told ourselves to forget something. Repression is a basic concept in Freud's theory. According to Freud, repression involves unconsciously preventing the recall from memory of any event, actual or imagined, that is unpleasant or threatening. Successful psychoanalysis may allow a person to bring back memories of these disturbing earlier events. Obviously some kind of active prevention of retrieval would be involved in such problems of retrieval, though the experimental evidence supporting this theory is scant.

Another process involves the use of wrong cues in attempting to retrieve stored information. Memory may be inaccessible simply because the organism doesn't know the right cue to use for correct recall. A very simple example will illustrate this point. If you live in Miami Beach, Florida, and meet a new friend at your school who has an address on Collins Avenue, it will do you very little good to try to drive to that friend's house if you only remember the name of the street. Collins Avenue starts at the southern end of Miami Beach and runs north along the Atlantic coast quite a ways towards Fort Lauderdale. Without a street number, it would be a hopeless task to try to find that friend. Without the correct cue for retrieval from memory, it is an equally hopeless task to attempt to recall the information. Much work remains to be done before psychologists can fully explain the importance of cues for retrieving information from memory.

USING PSYCHOLOGY: Studying for Retrieval

If you've used your skills in learning, to complete the input and storage processes correctly, you should have no trouble with output, or retrieval. Successful output means being able to answer questions correctly. To do so, you need to be able to retrieve the information you have learned and stored. Elsewhere in the chapter we asked you to write your responses in the form of a first, second, or third association to each of 20 stimulus words with your answer sheet folded top to bottom in thirds. You were to store the sheet with your answers covered. Now -- without looking at your original answers, retrieve the sheet. On the middle panel write down as many of your original responses as you can remember. Spend no more than a couple of minutes recalling your answers. Complete this task before reading further.

Now, look back at the original stimulus list without looking again at either the first or second panel. Using the original stimulus list, write on the third panel as many of your original responses as you can remember. Again, take no more than a couple of minutes to complete the third panel. Do it now, then return to your reading here.

Finally, check your accuracy on both panels two and three, using the words you wrote on the first panel as your "Answer key." On Panel Two, most of us are lucky to recall 8, let alone 10 or 12 of our responses. Essentially no one recalls all 20 without aided recall. Yet, your performance on Panel Three should be very close to perfect. Why? First, the responses you were asked to supply were your own; they were personally relevant. Second, just as occurs with pre-learned mnemonics, by supplying you with the stimulus terms -- what was your first association to precious stone? -- the list serves as a mnemonic for you. All you have to do is supply the response. All 20 responses were in there; you just had trouble cueing your recall properly.

The point should be obvious: Under proper conditions of input and storage, retrieval of information is both easy and accurate. Massed practice, or cramming, immediately before a test is bad for several reasons: (1) It creates fatigue. (2) It overloads memory with a large amount of information fed into it in a very short length of time. (3) It creates the conditions for a great deal of interference -- all the facts tend to become very jumbled. (4) It greatly increases the likelihood (because of all these other processes) that you will not remember the information when you need it. Finally, it is likely you will forget most of what you crammed shortly after the test -- if you're lucky enough to remember it even that long.

One of the few absolute rules in taking a test is that there are very few absolute rules. Scheduling your time during a test is most helpful. Surveying the material on the test before you begin will give you a rough idea of what's coming. Then you can organize your time accordingly. Answer first the questions you know; answering them may give you cues for recalling other information with which to answer questions of which you are less sure.

Finally, a test should always be a learning experience. Even if you flunk an exam, you should go over your paper to find out why you failed. Were you misreading the questions? Did you fail to follow instructions? Did you mismark your paper? Or, did you simply not know the material; worse yet, did you know, but find yourself unable to retrieve it? Finding the answers may avoid future failures.

Transfer -- Positive and Negative

Another concept that relates to learning and remembering is that of transfer. Transfer refers to the effects of past learning on the ability to learn new material or tasks. The Figure showed a test of the problems you might have if you were studying both French and German during the same school term. The problems were basically those of negative transfer, or the hindering of learning of one language because of similar experience with another language. Properly controlling transfer can make learning and remembering an easier task, if the lessons of transfer are well learned. Let's examine the two major kinds of transfer, positive and negative.

There are many examples of positive transfer in everyday life. For example: (1) learning to drive a truck or bus after having learned how to drive a car; (2) learning how to use an electric typewriter after having learned to type on a manual machine; (3) learning to fly an airplane after having practiced on a flight simulator and so forth. In each case, the first task helps the person learn the basics of the second task, as suggested in the Figures; the transfer effect is positive.

Are there general principles that might help us predict whether transfer is likely to be positive or negative? Yes, because most tasks can be analyzed into the stimuli and responses that go with them. You get the most positive transfer when familiar stimuli from one task are again present in the second, or transfer, task when familiar responses are again to be learned. For instance, if you are learning to play the piano, all of your practice prior to today might be viewed as Task 1. Task 2 occurs when you sit down today to practice. Obviously, transfer will be most positive since familiar stimuli (the same piano and the same piece of music) are again being paired with familiar responses (all the motions involved in playing the piano that you've already learned).

Positive transfer will also occur if old responses must be associated with new stimuli. At the start of the 1974 season the National Football League moved the goal posts ten yards further back from the goal line to the ends of the goal zones. The first year following that change, the league's statistics indicated that fewer field goals were kicked (which was the reason the change was made), but the accuracy at each distance from the goal posts was unchanged. The same old responses involved in kicking the football were still required of the place kicker, but these responses were simply paired with new stimuli (goal posts ten yards further back than they had been in prior seasons).

If you are expected to learn new responses to old stimuli, however, the result is very likely to be negative transfer, as illustrated in the Figure. Think about it. If you have a carpool of two friends and yourself driving to school everyday, what happens if the three of you suddenly decide to start giving a ride to a fourth mutual friend? Each morning whoever is the driver is suddenly faced with having to make new responses to the same old stimuli -- he or she must remember to pick up that fourth person. Until the new responses are learned, that fourth person had better have another way to get to school. Any negative transfer in the driver's responding means the fourth person is without that ride! Requiring new responses to familiar (old) stimuli usually produces negative transfer. The same result -- negative transfer -- occurs if you break up with a significant other, especially if the other person initiates the break-up. Formerly, he/she elicited smiles and approach behavior. Now you're supposed to keep your distance, not call, and forget about him/her. It's very difficult to do because the old stimuli are now supposed to elicit new responses; again, it's negative transfer.

Finally, and most briefly, if the stimuli and responses in the second task are both brand new, then no transfer will occur. How could it? With no prior experience with either the new stimuli or the responses to be learned, no transfer is possible.

All of your education and training is based on the premise that you will be able to transfer successfully your experiences in college to the outside world after graduation. Within the limits of its budget, your college attempts to make your classroom and lab experiences as similar as possible to the real-life situations you will encounter in your future world of work.

REVIEW QUESTIONS

TYPES OF MEMORY

1. Name three different kinds of memory. How are they related?
2. What are three methods used to test the amount of information that is remembered?
3. Is the speed at which information is learned related to how long it is remembered? Support your answer.

PROCESS OF REMEMBERING

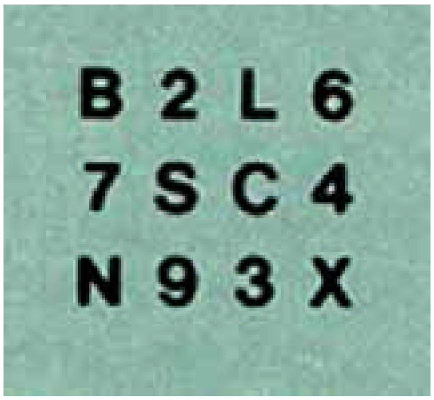
1. Name the three steps in the total process of learning and remembering
2. What aspects of the learner and the learning situation affect how quickly and well material is learned?
3. What aspects of the material affect how quickly and how well it is learned?
4. Name three processes that may cause forgetting.

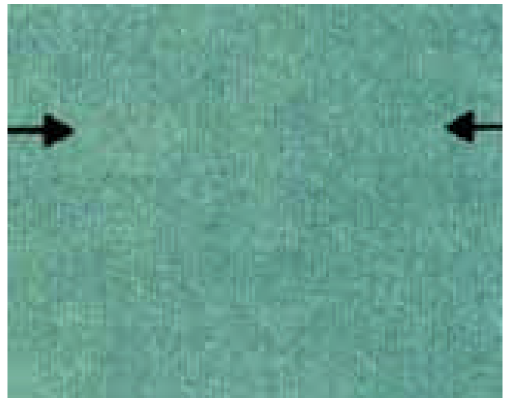
INTERFERENCE

1. Explain proactive and retroactive interference.
2. Define and give examples of positive transfer and negative transfer.

ACTIVITIES

1. Using a deck of 3" X 5" index cards, you can create a demonstration of the existence of the sensory store. Use a stack of 24 cards; copy letters and numbers onto the eighth card as shown in the Figure.





This will be your stimulus card. Make one of similar format for each trial, but alter the letters for each trial. Also make three cue cards like the right card in the figure that have just two arrows pointing at the location of the top, the middle, or the bottom row of symbols. By varying how many cards come between the stimulus card and the cue card, you can vary the retention interval for the stimulus letters. Practice until you can hold the cards firmly in one hand and "fan" the other end so that the cards flip past one at a time at a fairly steady and very rapid rate. Now find some friends and try it out (always with the stimulus card in Position 8), first placing the cue card in position 9 (zero-second retention), the second time in Position 16 (one-half-second retention) and the third time in Position 24 (one-second retention). Can your friends recall the indicated row correctly? Is their recall better with shorter retention intervals?

2. In order to test the limits of short-term memory, read to someone (or have them read to you) the following list of numbers: 347; 8156; 54921; 607043; 2859610; 92845036; 734196528; 8405396172; 18472943065; 657413298014. Each series should be read at an even rate of one per second in a monotone. After the series is completed, the person reading the numbers should nod his/her head. Then (and only then!) write down what you remember, or have your friend do so. Tally the number of correct numbers they (you) have recalled with all numbers in exactly the correct order. How good is your/their short-term memory?

3. Using a set of 3" x 5" index cards, you should be able to repeat the original experiments on short-term memory for individual letter sequences. For each test, create a deck of cards as follows: Card #1 -- blank, Card #2 -- three letters printed, Card #3 -- three-digit number, Card #4 -- blank, Card #5 -- "Recall." Tap your finger once a second while viewing your watch to relay the time. To gather data, place your participant in front of you and indicate that you will flip over the cards in your hand one at a time. He/she is to read out loud the three letters, then read out loud the three numbers, then -- once a second -- subtract three from the number first read and repeat the result out loud. Use stimuli such as RAK, GUL, HIV, BEC, LOQ, DIZ, YEF, JAT, KUR, MOJ, NAH, PEM, SIL, VOP, and CUW, when making cards for Position #2. Using the 15 stimuli, randomly assign three stimuli to be remembered for 0, 4, 8, 12, and 16 seconds. For each trial, flip over the first four cards, once a second, and then tap your finger once a second for the required interval. Then, flip over the last "recall" card and record your participant's response. When done calculate the average recall for each interval and plot your results on a graph with seconds on the X-axis and percent recalled on the Y-axis. What did you find?

4. How much easier it is to learn high imagery items than low imagery items? To find out, place each of the items in Lists III and IV (found in The Role of Association Value section of this chapter) on a single card. Arrange the cards for List III in a particular order, and sit down opposite a friend who will be your participant. Explain how a serial-learning experiment is conducted and then proceed to flip each of the cards in front of him/her at the rate of one card every two seconds. Starting the second time through the list, ask him/her to guess what word will come next. Simply record the number he/she guesses correctly on each trial (taking as little time as possible to do so) and then repeat the trial, being careful not to change the order of the cards!

Using different participants for each list, how many trials does it take to learn List III? List IV? What can you conclude about the value of high-imagery in learning words?

5. At some point you may have visited a psychology laboratory at your college or university. If not, now might be a good time to seek out such a lab at your own school. If any faculty or graduate students at your institution are conducting experiments in learning or (especially) memory, write a brief

summary of the experimental design used and any conclusions reached.

INTERESTED IN MORE ABOUT REMEMBERING?

LUCAS, J. & LORAYNE, H. (1975). *The Memory Book.* Ballantine. A former star basketball player and a renowned memory expert discuss tricks and techniques for learning quickly and recalling correctly vast amounts of information.

LURIA, A. R. (1968). *The Mind of a Mnemonist.* Basic Books. Luria was a famous Russian psychologist who studied a man who could remember anything he wished for any length of time.

MORGAN, C. T. & DEESE, J. (1969). *How to Study,* 2nd ed. McGraw-Hill. Two experimental psychologists apply the principles of their discipline to the task of effective studying. Many helpful suggestions for organizing study space and time.

ROBINSON, F. P. (1970). *Effective Study,* 4th ed. Harper & Row. A classic book for improving study techniques. Contains explanations and exercises concerning the SQ3R method.

TARBY, R. M. & MAYER, R. E. (1978). *Foundations of Learning and Memory.* Scott, Foresman. Includes both animal and human learning concepts. Broad coverage but heavy reading.

Worm Runner's Digest. Univ. of Michigan. Published annually. A sometimes funny, sometimes serious journal. Formerly edited by J. V. McConnell, one of the first psychologists to demonstrate a possible molecular basis for memory.