

*** The information in sensory memory vanishes unless it captures our attention and enters short term memory and then long term memory.**

This implies that teachers should try to gain students' attention. To do so, they can use cues to signal when they are ready to begin. They can move around the room and use voice inflections to make students be on the alert.

*** short term memory has a limited capacity (5±2 items).**

This implies that teachers should point out the important information. If some students can only process three items at a time, let us make certain it is the most important three.

*** Chunking or using meaningful units can increase the capacity of short term memory.**

This implies that teachers should show students how to categorize (chunk), related information. They should present information in categories and should teach inductive reasoning.

*** Organized information which relates to semantic networks already present in mind is remembered more easily.**

This implies that teachers should try to bring to mind relevant prior learning. They should review previous days' lessons and have a discussion about previously covered content.

*** Retrieval cues which have a distinctive feature are more effective.**

This implies that teachers should try to be innovative. They should try to use a variety of teaching techniques while presenting the points.

*** Elaborative rehearsal which involves deep processing of meaningful material improves long term memory.**

This implies the importance of providing students with meaningful tasks.

*** One cause of forgetting may be the decay of memory traces over time or the loss of retrieval cues.**

This implies that teacher should remind students of the importance of reviewing. Teachers should ask students questions from previously covered

material every now and then.

*** Negative and unpleasant experiences are not encoded carefully and therefore are forgotten soon.**

This implies that teachers should try to make learning a pleasant experience and should try to create a convivial atmosphere in the classroom in which students regard learning a pleasant and enjoyable activity.

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this model. Among them, Craik and Lockhart (1972) argued that memory depends on the depth of processing i. e., deep processing which involves meaning will result in a better recollection (cited in Baddeley, 1999). They also felt that Atkinson and Shiffrin had provided an oversimplified view of rehearsal. According to them, there are different types of rehearsal. Type 1 or maintenance rehearsal involves repetition of the processes which have already been carried out (e. g., simply repeating a word over and over again). Type 2 or elaborative rehearsal, involves deeper processing of the stimulus material that is to be learned and it was claimed that type 2 rehearsal improves long term memory while type one does not.

Why people forget?

Forgetting is usually defined as the loss of information over time (Roediger, 2003). However, the rate of this loss is not the same. Many experiments done in this regard indicate that "forgetting is rapid at first but gradually slows down" (Baddeley, 1999, p. 109). But the question is why forgetting occurs at all. Psychologists have proposed four explanations.

According to the first explanation which is called '*decay hypothesis of forgetting*', memory trace simply fades or decays over time rather like a notice which is exposed to the sun and rain and gradually fades until it becomes illegible. But the fact that we sometimes remember information totally forgotten indicates that this explanation is rather problematic. The second explanation which is called '*interference hypothesis*' maintains that we forget things because of the interference from other information or activities and a distinction is made between two kinds of interference: *proactive* and *retroactive*. Proactive interference occurs when prior learning troubles the recall and retrieval of newer information. For example, if we have already learned a word like '*unanimous*' and later a word like '*anonymous*', while needing

the latter, the former comes to the surface. Retroactive interference, on the other hand, occurs when new information interferes with our ability to recall earlier information. For example, if we learn a word like '*carcass*' and later a word like '*cascade*', while needing the former, the latter comes to the surface.

According to the third explanation which is called '*retrieval cue hypothesis*', forgetting occurs because we lose access to the cues which help to retrieve the required information. To prove this hypothesis, its advocates have done some experiments using free recall and recognition tests. In free recall tests, subjects are asked to memorize a list and then they are asked to remember it. But in recognition tests, they are provided with some cues such as '*which of the following words was in the list?*' It was found that subjects could perform much better on recognition tests which may be due to this fact that in recognition tests, there are retrieval cues which contribute to the memory.

Finally it is assumed that another cause of forgetting resides in the concept of repression which refers to forgetting as an unpleasant event or piece of information due to its threatening quality. The idea of repression was first presented by the Austrian physician Sigmund Freud, the founder of psychoanalysis. But the real cause of forgetting negative experience may be the fact that they are not usually encoded carefully and in details. For example, the reason that many people may not remember the details of an accident may be the fact that most people avoid looking carefully at terrible scenes.

Implications for teachers

To remind teachers of the implications of the memory research, important points from the foregoing review are extracted and the implications of each are presented. Of course, reading the article, teachers may find much more noteworthy points.

Tulving (1972) was the first psychologist who talked about this idea and made a distinction between episodic memory and semantic memory (cited in Eysenck & Keane, 2001). Episodic memory refers to the storage and retrieval of specific events or episodes occurring in a particular place or time. For example, what you have had for dinner on Saturday night two weeks ago is an example of episodic memory. Since information in episodic memory is unorganized, retrieving it seems highly difficult. In contrast, semantic memory is a collection of organized semantic networks; hence, retrieving information from semantic memory is much easier. For example you may easily remember what *canary* is because you may have a semantic memory in your mind which classifies *canary* as a bird under a bigger or super-ordinate term such as animal.

To make the difference between episodic and semantic memory, Newall (1994) states that to memorize a pair associate like 'book' and '13' involves episodic memory because what is being learned is not that book and number 13 belong together, but they belong together on a particular occasion. This situation seems to contrast sharply with learning that $2+2=4$ because they are permanent facts independent of the occasion for learning them and therefore belong to semantic memory.

In spite of the differences between them, both episodic and semantic memory involve what has been called declarative knowledge. A simple definition of declarative knowledge is 'knowing that' (e. g., knowing that Tehran is the capital city of Iran). There is another kind of knowledge called procedural knowledge and it is the matter of 'knowing how' (e. g., how to ride a bicycle). While people consciously recall facts, events, and experiences in their declarative knowledge and can verbally declare or describe what they have remembered, procedural knowledge which relates to skills that humans possess does not require conscious effort to recall and it is not of course

easy to declare. For example, while riding a bicycle, you do not have to consciously remember how to start, which foot to put first and even if you want to describe it to someone, it is not an easy task (Eysenck & Keane, 2001).

Retrieval

Encoding and storage are necessary to acquire and retain information, but the crucial process in remembering is retrieval or bringing information from long term memory to working (short term) memory. In retrieval process, the role of retrieval cues is essential. A retrieval cue is any stimulus that helps us to recall information in long term memory. Retrieval cues can cause us to suddenly remember something from years ago. For example, returning to where you once lived or went to school may bring back memories of events experienced long ago. The fact that retrieval cues can provoke powerful recollections has led some researchers to speculate that perhaps all memories are permanent and forgetting is just the matter of failing to retrieve them, an idea which is challenged by many other psychologists (Roediger, 2003). To be effective, a retrieval cue should have two general features. The first feature is called "encoding specificity".

This means that a stimulus may act as a retrieval cue for an experience if it is encoded with that experience. Distinctiveness is another feature that determines the effectiveness of the retrieval cues. For example if a group of students is given a list of 100 words to memorize and only one word is accompanied by a picture, if they are given the clue that which word was accompanied by a picture, almost everyone would remember it. Therefore, the more effective retrieval cues attached to an item, the better it would be recalled.

Up to here, we have focused on information processing model as represented by Atkinson and Shiffrin. But as already stated, there are some psychologists who have disputed and criticized

Shiffrin, many psychologists believe that, regarding the storage of information, we have three kinds of memory: sensory memory, short term memory and long term memory.

Sensory memory

Sensory memory refers to the initial momentary recording of information in our sensory system. Watching a movie, you see what appears like a continuous scene in which people apparently move. But in fact, the movie is a set of images separated with very short periods of darkness, and this is your brain's visual system that has a capacity to store the information from one frame until the next one arrives. This kind of sensory memory i. e., the capacity of mind to store the visual information for a very short time (less than 1/2 second) is called *iconic* sensory memory. The brain's auditory system has the same capacity for storing auditory information or sounds for a very short time (about 3-4 seconds). This capacity is called *echoic* sensory memory (Solo, 2001). The information in sensory memory vanishes unless it captures our attention and enters short term or working memory.

Short term memory

To understand this sentence, you need to remember the beginning until you get to the end. Without some kind of memory to keep words and the order in which they occur, the sentence would be incomprehensible. This kind of memory is called short term memory and it relates to what we are thinking about at any given moment in time as well as what we have attended to in recent past. Psychologists originally used the term to refer to the ability to hold information over a brief period of time. But as conceptions of short term memory expanded to include more than just the brief storage of memory, psychologists created new terminology. The term working memory is now commonly used to refer to a broader system that

both stores information briefly and allows manipulation and use of that information.

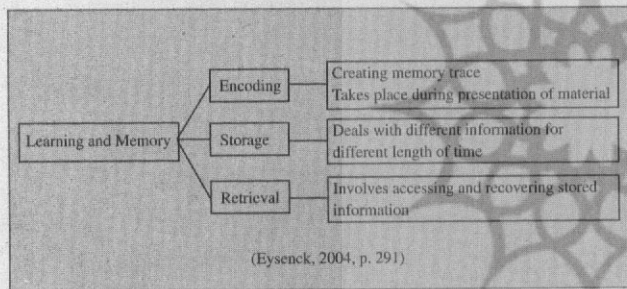
As it was stated, to transfer information from sensory memory to short term memory, attention has a crucial role and to keep information in short term memory rehearsal is very essential. For example to keep a telephone number in mind, you should say it to yourself again and again. Short term memory initially lasts around 15-30 seconds unless it is repeated (rehearsed) at which point it may be available up to 20 minutes (Solo, 2001). Another major limit on information processing in short term memory is in terms of the number of units that can be processed at any one time. In 1956, an American psychologist, George Miller, reviewed many experiments on memory span and concluded that people could hold an average of 7 ± 2 items in short term memory (cited in Roediger, 2003). But nowadays psychologists agree more on 5 ± 2 items.

However, people can overcome such storage limitations by grouping information into chunks or meaningful units. For example, separate words such as *soldier* and *brave* are considered two items but a meaningful combination like a *brave soldier* is one item. As another example try to memorize this list of letters: T, E, I, L, N, I, G, L, N, T, E. It seems really difficult. But if you form a meaningful unit like the word INTELLIGENT, all letters are kept as one item.

Long term Memory

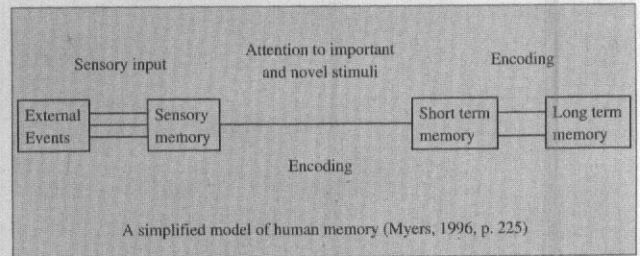
Long term memory is the ability of the brain to store vast amounts of information on a relatively enduring basis. There seems to be no finite capacity to long term memory. By a careful estimate, an average adult has "about a billion bits of information" in memory (Myers, 1996, p. 234). As long term memory contains an amazing variety of different kinds of information, it is assumed that there should be different types of long term memory for holding this plethora of information.

perspectives. One of the earliest and mostly accepted approaches to memory is '*information processing approach*' proposed by Atkinson and Shiffrin (1968 cited in Huitt, 2003). Researchers advocating this approach maintain that humans have extremely complex internal systems for performing behavioral tasks and following Atkinson and Shiffrin, they use the analogy of computer systems (Lutz, 1994; Eysenck & Keane, 2001) in that information is encoded in the memory, stored there and retrieved when necessary. Accordingly, Atkinson and Shiffrin's model is also called '*stage theory*' because they believe information is processed sequentially in the brain through three stages of encoding, storage and retrieval and they distinguish three kinds of memory as sensory memory, short term memory and long term memory.



There are also two other approaches to memory which are called parallel distributed processing model and connectionist model. The parallel distributed model states that information is processed simultaneously by several different parts of the memory system rather than sequentially as hypothesized by Atkinson and Shiffrin. The connectionist model maintains that the mind does not work exactly like a computer. Researchers supporting this model prefer to consider the mind as a network of connections. Information processing approach and connectionist approach are not, however, contradictory; rather the latter tries to complement the former (Martindale, 1991). Hence, as the terms used in information processing approach seem to

be more familiar, the following explanation is mostly based on information processing approach, though the connectionist viewpoint will be taken into account when necessary.



Encoding

Encoding is the process of perceiving information and bringing it into the memory system. Encoding is not simply copying information directly from the outside world into the brain. Rather, the process is properly conceived as *recoding*, or converting information from one form to another. The human visual system provides an example of how information can change forms. Light from the outside world enters the eye in the form of waves of electromagnetic radiation. The retina of the eye transforms (converts) this radiation to bioelectrical signals that the brain interprets as visual images. Similarly, when people encode information into memory, they convert it from one form to another to help them remember it later (Roediger, 2003). It is said that most of the early childhood memories are encoded as images or pictures. In a variety of experiments researchers have demonstrated the benefits of mental images. For example, we remember words that lend themselves to picture images better than we remember abstract, low imagery words. It has also been found that when processing verbal information for storage, we usually encode its meaning. For example, we associate it with what we already know or imagine (Wortman et al., 1999).

Storage

Storage is keeping or retaining encoded information over time. Following Atkinson and

آسان تر از بازیابی اطلاعات از حافظه‌ی نامنظم است. این مقاله بر آن است که ضمن بررسی دقیق حافظه از دیدگاه نظریه پردازش، اطلاعات و عوامل مؤثر در بروز فراموشی، آموزه‌های این رویکرد را به معلمان زبان یادآوری کند تا هنگام تدریس و تمرین‌های کلاسی، به گونه‌ای عمل کنند که موجبات یادگیری بهتر و حفظ دقیق تر مطالب فراهم آید.

کلید واژه‌ها: پردازش اطلاعات، رمزگذاری، ذخیره، بازیابی، حافظه‌ی حسی، حافظه‌ی کوتاه مدت، تقطیع، حافظه‌ی بلند مدت، حافظه‌ی معنایی، حافظه‌ی نامنظم، فراموشی، آموزه‌ها.

Abstract

Learning in general and language learning in particular have a close relationship to the ability of memory to store information and retrieve it when necessary. There are various approaches to the mechanism and function of memory, among which information processing is one of the most important. According to this approach, information first enters sensory memory which is highly transient and will rapidly vanish unless it is paid attention to. In this case, the information enters short term memory which has also a very limited capacity. However, using techniques such as chunking information into larger meaningful units can help to increase the capacity of short term memory. Repetition and rehearsal will also help to consolidate and transfer information to long term memory. Long term memory is also divided into semantic memory which stores organized information, and episodic memory which stores disorganized information. Retrieval of information from semantic memory is much easier than retrieval of information from episodic memory. This article intends to review the information processing approach to memory and influencing factors in forgetting, and reiterate its implications to teachers so that, while teaching and during class practices, they act in a way which will lead to deeper learning and better memorization of materials on the part of learners.

Key words: *information processing, encoding, storage, retrieval, sensory memory, chunking, short term memory, long term memory, semantic memory, episodic memory, forgetting, implications*

Throughout the years, different schools of psychology with different claims and perspectives have emerged. Among the points viewed differently by these schools of psychology is the concept of learning. For many years, behaviorists tried to develop theories about the behavior of an organism with no reference to what might be happening in the mind of that organism. Hence, their definition of learning as a change in the behavior of organisms made no reference to the mind. However, with the advent of cognitive psychology and its main objective to study human cognition including attention, perception, learning, memory, language learning and concept formation (Eysenck, 1994), the role of mind in learning was taken into account and it was argued

that learning is not limited to changes in behavior with observable manifestations, rather it is "the process by which relatively permanent changes occur in the behavioral potential as a result of experience" (Anderson, 1995, p. 4). It was argued that not everything we learn has an impact on our behavior. For instance, we many learn the name of an individual but never have the opportunity to use it. So, learning is not just a spontaneous change in behavior but only a change in potential of behavior. Thus, the concept of memory as the "relatively permanent record of experience that underlies learning" (Anderson, 1995, p. 5) was taken into account as well.

Since the emergence of cognitive psychology, mind and memory have been studied and investigated from different approaches and

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On the Role of Memory in Learning and Its Implications for Teachers

چکیده

یادگیری به طور کل و یادگیری زبان خارجی به طور خاص، با توانایی حافظه در نگهداری اطلاعات و بازیابی آنها هنگام ضرورت، رابطه‌ی نزدیکی دارد. نظریات و رویکردهای متفاوتی درباره‌ی ساز و کار حافظه و عملکرد آن وجود دارد که «رویکرد پردازش اطلاعات» از مهم‌ترین آنهاست. براساس این رویکرد، اطلاعات ابتدا وارد حافظه‌ی حسی که بسیار کوتاه است می‌شود و در صورت جلب توجه، از آن جا به حافظه‌ی کوتاه مدت می‌رود. در غیر این صورت، از بین خواهد رفت. ظرفیت حافظه‌ی کوتاه مدت نیز بسیار محدود است، اما با استفاده از تکنیک‌هایی مانند تقطیع اطلاعات به واحدهای معنی‌دار بزرگ‌تر، می‌توان ظرفیت آن را افزایش داد. تمرین و تکرار اطلاعات موجود در حافظه‌ی کوتاه مدت نیز باعث تثبیت و ماندگاری طولانی آن‌ها و انتقال این اطلاعات به حافظه‌ی بلندمدت می‌شود. حافظه‌ی بلندمدت، خود به «حافظه‌ی معنایی» که اطلاعات سازمان یافته را ذخیره می‌کند و «حافظه‌ی نامنظم» که اطلاعات پراکنده و نامنظم را ذخیره می‌کند، تقسیم می‌شود. بازیابی اطلاعات از حافظه‌ی معنایی