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Serial Position Effects and Forgetting Curves: Implications in Word Memorization

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Abstract

Word memorization is important in English learning and teaching. The theory and implications of serial position effects and forgetting curves are discussed in this paper. It is held that they help students understand the psychological mechanisms underlying word memorization. The serial position effects make them to consider the application the chunking theory in word memorization; the forgetting curve reminds them to repeat the words in long-term memory in proper time. Meanwhile the spacing effect and elaborative rehearsal effect are also discussed as they are related to the forgetting curve.

Keywords

serial position effects, forgetting curves, word memorization

1. Introduction

English words are extraordinarily significant for English foreign language (EFL) learners because they are the essential basis of all language skills. As Wilkins said, "...while without grammar very little can be conveyed, without vocabulary nothing can be conveyed" (Wilkins, 1972). Effective word memorization plays a significant role in the process of vocabulary learning. Researchers have and are still pursuing and summarizing the effective memory methods. Schmitt, for example, classified vocabulary memory strategies into more than twenty kinds (Schmitt, 1997, p. 34). However, it is hard to improve the efficiency of the vocabulary memory in that different students remember the huge amount of words with some certain method or methods that may not suit them. Even worse, the difficulty in turn may hamper students to remember vocabulary and cause them to lose confidence in vocabulary learning.

Vocabulary learning in essence is the process of cognition that human beings get information from the world. Memory is an indispensable part in cognitive psychology. Therefore, some fundamental principles of psychology pertain to human memory are capable of helping analyze and shape the memory methods. Hence, it is proposed in this paper that teachers should help students comprehend the principles and seek diversified ways to strengthen the vocabulary memorization. In the paper, serial

position curve and forgetting curves with their implications are discussed in details to help achieve the goal of word memorization.

In general, memory is the reflection of the past experiences in peoples' mind. The process of memory can be divided into 3 links: memorization, retention, recall or recognition. Memorization is to recognize and remember experiences. Retention is to solidify the acquired information. Recall or recognition is to recover the information in different situation from the mind. The 3 links are associated and restrictive with each other. Memory is composed of sensory memory, short-term memory (STM, lasting 20-30 seconds, a limited capacity of 5-9 meaningful items), and long-term memory (LTM) generally. Once the sensory information enters the STM, rehearsal of information occurs for the purpose of forming LTM. During the process of memorization, a lot of information will be lost at each stage of information transmission. Only a small part of information in sensory will be able to enter STM. The information that has not been processed, encoded and transformed will be unable to get into LTM and will be quickly forgotten. During the encoding process, people will utilize memory methods to associate new information with the stored one so that the information can be transferred to LTM.

The visual code (image), voice (sound), semantic (stimulus meaning), a motor (action) are the forms of a word memory. When a word enters STM, it should be rehearsed and transferred to LTM. Once in the LTM, word can be recalled through the long process of retrieval. If the word receives no review, it may ultimately be forgotten. The ultimate goal of memorizing a word is the encoding the four forms to be retrieved for the future application.

2. Serial Position Effects

2.1 Researches Reviewed

Memory researches showed that when participants are presented with a list of items, they recalled the initial and final items more probably than the middle ones (Deese & Kaufman., 1957; Waugh & Norman, 1965). Murdock (1962) conducted one experiment. Participants were asked to learn a word list varying in length from 10 to 30 and then free recall them. Each word was presented for one to two seconds. He found that when the words were presented at the beginning (the first three or four words), or at the end (the last eight words) they were easily recalled, while those in middle were often forgotten by the participants. This is called serial position effect (SPE, see fig 1).The advantage showed to the earlier items is called the primary effect and the later items is called recency effect.

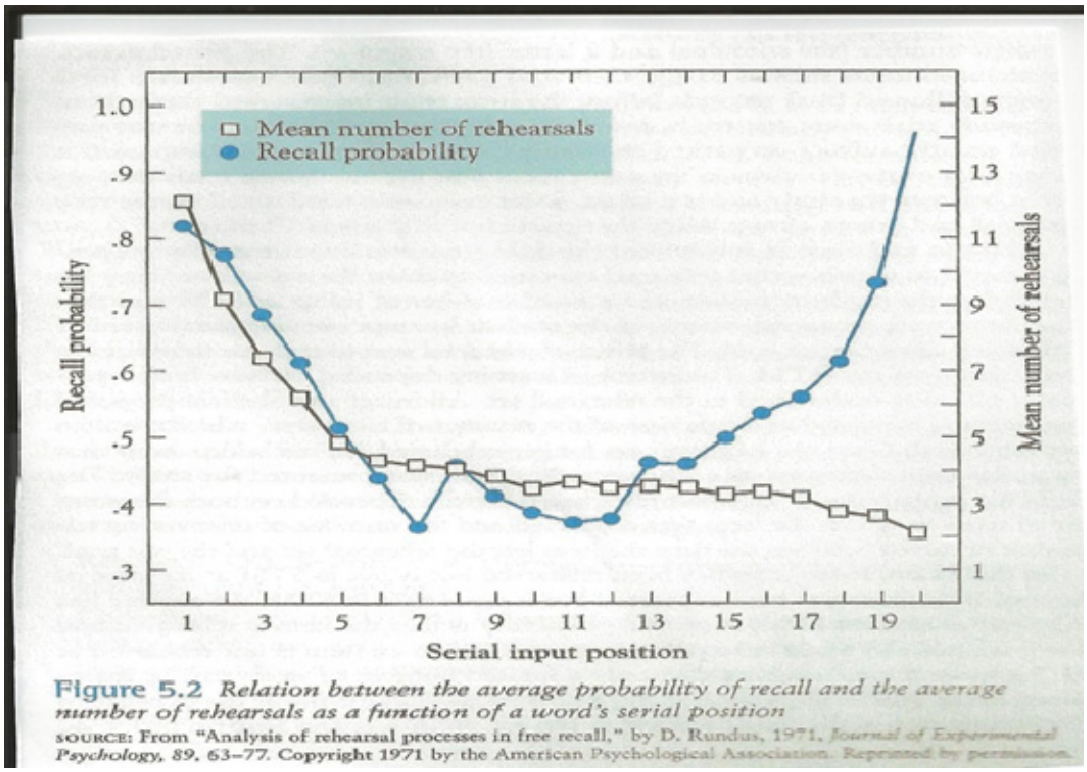

Figure 5.2 *Relation between the average probability of recall and the average number of rehearsals as a function of a word's serial position*

SOURCE: From "Analysis of rehearsal processes in free recall," by D. Rundus, 1971, *Journal of Experimental Psychology, 89*, 63–77. Copyright 1971 by the American Psychological Association. Reprinted by permission.

Figure 1. Serial position effects

Source: From "Analysis of rehearsal processes in free recall". Journal of Experimental Psychology, 89, 63-77.

The reasons accounting for the primacy effects are more attention and rehearsal result in LTM. Rundus (1971) provided evidence to prove the primacy effect was due to rehearsal. During the experiment, subjects were asked to repeat aloud and were recorded. The study found participants obviously spent more time on the first several items. When they spent the same amount of time on all of the words, the primacy effect disappeared.

The recency effect attributes to the STM (Atkinson & Shifrin, 1968). In the free recall test, participants prone to recall the last items first. And the delayed recall or interference between experiment and test will obviously remove the effect. Postman & Phillips (1965), for example, asked the participants to do some arithmetic problems before recalling. Research showed that the STM buffer was affected by the distractor and the subjects experienced difficulties in recalling the last few items. In another word, recency effect decayed.

Words presented in the middle (pre-recency effect) have little time to be processed in STM for the quick displacement by the subsequent words; at the same time, the processing time is not long enough for the items to enter into long-term memory.

Empirical evidences demonstrate that SPE is apparent at different recall tasks: Words of 6-9 syllables (Horowitz et al.,1968); nonword list recall tasks(Gupta, 2005) opposing rugby teams played over a season (Baddeley & Hitch, 1977); parking lot locations (Pinto & Baddeley, 1991), etc.

2.2 Implications of Serial Position Effects in Word Memorization

Word memorization includes a process responsible for the retrieval of a word's spelling in LTM (orthographic output lexicon). STM ensures that each of the word's component letters is selected for production in the appropriate order. Serial learning is common when you learn something in a fixed sequence or rigid serial order, the most common example is episodic memory in learning or daily life. Word orthography definitely observes the pattern. Serial learning can explain the spreading activation, which indicates that items being learned are associated with a gradually changing representation of temporal context (Shankar et. al 2009). Miller ((1956) pointed out, a subject naturally tried to make associations and used them to support memory. After the first item in the list, each subsequent item served first as a response, then as a stimulus for the next item. The same opinion is held by the contiguity effect, which refers to the higher chance of recall for words immediately before or after the previously recalled word on the list (Sederberg, etc., 2008). Together with the SPE, the above model and effect lead us to ponder upon the chunking theory again.

Miller (1956) suggested that STM capacity is 5 to 9 units. This does not mean that people can only remember 5 to 9 letters at a time, or only remember a long word. In fact, people tend to chunk letters during vocabulary memorizing. Chunking makes several letters string into a unit, which is combined with other letter units into larger units (Solso, Maclin, & Maclin, 2005). For example, people can transfer alphabetic string into words, words into phrases, so as to increase the STM capacity, and thus optimize the STM. At the same time chunks is in encoded into long-term memory for future recall (Gobet & Simon, 1998).

Servan-Schreiber (1990) proposed that people will automatically chunk the long meaningless alphabet. For example, to memory TTXVPXVS, subjects will divide them into (TTX), (VP) and (XVS). They also put forward that the letter blocks familiarity (frequency) with letter chunks may determine the division of the new letter string. For example, after mastering of above letter strings, subjects will divide new string such as VXVPXXXVS into V X (VP) X X (XVS).

In memorizing a single word, students may not encounter the SPE if the word consists of a few letters. However, they may suffer from the obstacles of obscure memory for the middle letters in the words with more letters. And even worse that they have to process the word visual code, voice, semantic and motor at the same time. Under such condition, chunking letters with the aids of their corresponding pronunciation into manageable pieces can help to overcome the insufficient attention paid on the middle letters. Most commonly, Students face the situation of memorizing a list of words at one time. Again, they should be taught that SPE research indicates that the primacy effect (the first three or four words) and the recency effect (the last eight words) implies that they can chunk the words into groups (e.g. 10 words or so once) and memorize them in separate time so that they will not suffer from the pre-recency effect.

3. Forgetting Curve

3.1 Researches Reviewed

Ebbinghaus' forgetting curve (Figure 2) revealed a relationship between forgetting and time. The precise data of the curve is displayed clearly: just after memorization, memory can recall all things; twenty minutes later, there only 58.2% left in the brain; after six days, 25.4% are remained, and the curve inclines to form a line parallel with the horizontal axis. This indicates two facts: (1) for the first twenty minutes the rate of memory loss is up to the highest point; (2) after six days the information in memory maintains at a relatively certain level as time passes by. The hyperbola suggests the relation between what retained in the brain and the interval on the condition that the input is meaningless information without repetition in time.

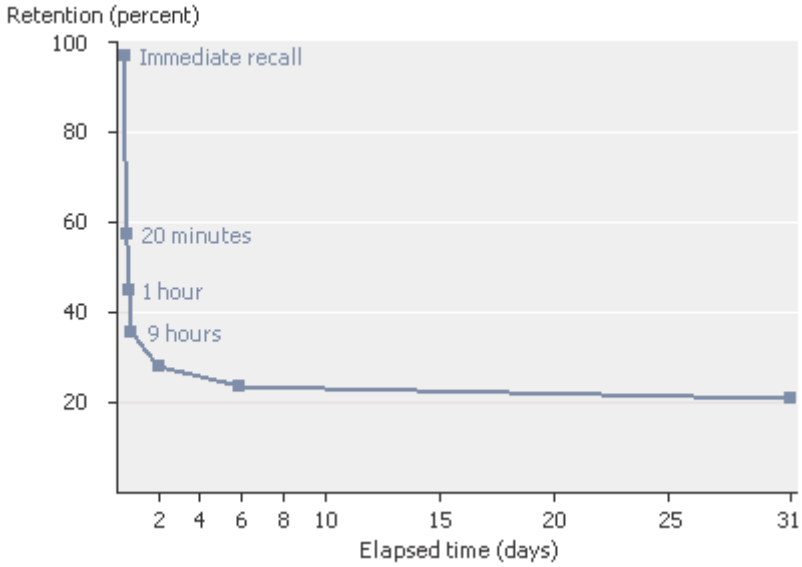

Figure 2. Ebbinghaus' forgetting curve

Source: Hermann Ebbinghaus. Memory: A Contribution to Experimental Psychology, 1985/1913.

While considering the forgetting term, we should differentiate the STM and LTM decay. The information stored in STM will diminish within 20 to 30 seconds or so without being retrieved. Therefore, the forgetting curve is more applicable to LTM. Klatzky' experiment (2002) showed that subjects forgot 55% of the newly-learnt words within six hours and 80% within 72 hours. The reasons people forget information are varied and complex, and it often takes conscious effort to remember important pieces of information.

3.2 Implications of the Forgetting Curve

Ebbinghaus reminded us the importance of word repetition in time in the discussion of the forgetting curve. However, there is no consensus as to exactly how many repetitions are required for a word acquisition. Saragai et al. (1978) investigated the impact of repetition on L2 vocabulary learning.

Results showed that words presented to learners fewer than 6 times were learnt by half of the learners whereas words presented 6 or more times were learnt by 93% of participants. The authors proposed that, in general, 10 encounters were required for the acquisition of an unknown word. Horst et al. (1998) indicated 6 encounters were needed for considerable lexical gains to occur and that vocabulary growth through reading had a stronger effect on passive than active vocabulary knowledge. Waring & Takaki (2003) speculated that it might take between 25-30 encounters to acquire new vocabulary.

Word repetition should observe two effects: The spacing effect and elaborative rehearsal effect. In general, repeating the knowledge with farther time gap will yield greater effects than repetitions close in time. Bahrick et al. (1993) said, "Thirteen retraining sessions spaced at 56 days yielded retention comparable to 26 sessions spaced at 14 days." It shows that retention of foreign language vocabulary will be greatly enhanced if practice sessions were spaced far apart. However, Dempster (1988) wrote the insufficient application of the effect in classroom, "The spacing effect would appear to have considerable potential for improving classroom learning, yet there is no evidence of its widespread application." The spacing effect also reveals that it's appropriate and beneficial to chunk the to-be-remembered words into small groups and memorize them separately.

However, the key to the spacing effect application is to repeat the word in a proper time, so there also should be time gap limit in the spacing effect. Banaji and Crowder (1989) put it this way, "As an empirical rule, the generalization seems to be that a repetition will help most if the material had been in storage long enough to be just on the verge of being forgotten." In another word, the closer you are to forgetting something, the more fresh exposure to it helps.

Repetition is categorized into elaborative repetition and maintenance repetition. Elaborative repetition is different from maintenance repetition. Maintenance repetition is simple mindless in that it doesn't encode word in a deep way or involve meaningful comprehension, while elaborative rehearsal occurs when students elaborates upon the word during repetition, relating it to other knowledge or analyzing its details. Elaborative rehearsal aids secondary memory; maintenance rehearsal does not (Craik and Watkins, 1973). In word memorization, the words should undergo thoughtful repetition that integrating the word with other aids, such as context, filling-in exercises, comparison, or applying them in some oral exercises. All these can help to retrieve the learned word later.

4. Conclusion

Psychological findings are not only beneficial to understand the mechanism of human minds, but also help to improve the efficiency of teaching and learning. The paper presents one example of the application of two findings in word memorization. According to the SPE curve, the longer the items for memorization, the more middle items receiving insufficient rehearsal. Forgetting curve reminds us the importance of timely repetition/review. To form LTM of a list of words it is important to chunk the words into manageable groups, spread studying over several times or days, and use elaborative rehearsal methods. Of course, other psychological findings will also help the process of word encoding

into long-term memory, for example, the Decay Theory suggests that with time and disuse, the physical memory trace in the nervous system fades away (Passer et al., 2004,). In general, cultivating the awareness of basic psychological mechanism may benefit our word memorization greatly.

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