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A MEMORY SCHEDULE.

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A POSSIBLE SOLUTION FOR PROBLEMS OF MEMORY IN FOREIGN LANGUAGE LEARNING IS THE "GRADUATED INTERVAL RECALL," A PROCEDURE FOR AIDING STUDENTS TO REMEMBER THE VOCABULARY AND STRUCTURES THEY HAVE LEARNED. WHEN A NEW WORD IS LEARNED, THE PROCESS OF FORGETTING BEGINS AT ONCE AND PROCEEDS VERY RAPIDLY. IF THE STUDENT IS REMINDED OF THE WORD BEFORE HE HAS COMPLETELY FORGOTTEN IT, HIS CHANCES OF REMEMBERING WILL INCREASE. AFTER EACH SUCH RECALL, IT WILL TAKE HIM LONGER AND LONGER TO FORGET THE WORD AGAIN. THUS, A SMALL NUMBER OF RECALLS, IF PROPERLY SPACED, CAN BRING ABOUT RETENTION OVER A LONG PERIOD. THOUGH THE SAME SCHEDULE OF RECALL CANNOT BE USED FOR ALL STRUCTURES AND WORDS, IT IS POSSIBLE TO APPLY THE FINDINGS OF EXPERIMENTAL PSYCHOLOGY IN FORMULATING A BASIC SCHEDULE WHICH CAN THEN BE ADAPTED TO EACH CIRCUMSTANCE. THIS ARTICLE WAS PUBLISHED IN "MODERN LANGUAGE JOURNAL," VOLUME 51, NUMBER 2, FEBRUARY 1967. (AUTHOR)

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A Memory Schedule

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PROBABLY no aspect of learning a foreign language is more important than memory. A student must remember several thousand words and a considerable number of processes for adapting and combining them to attain even a minimal proficiency.

Yet no aspect of language learning has been less well examined. While linguistic analysis and methods of teaching have developed rapidly, the problem of memory has remained virtually unexplored.

It is generally assumed that the student's memory is a private matter; that the teacher should present material in as organized and striking a way as he can, but that beyond this, the question of whether a student remembers what he has learned is largely out of the teacher's control.

Nothing could be farther from the truth. We know, for example, that if the teacher could use all of the first day's vocabulary (I'll say vocabulary for simplicity, but I mean structures as well)—if all the first day's vocabulary could be used again every day, all the students would probably remember it very well. This of course is impossible, for new vocabulary is added on the second day, and again on the third, and so on; so that the sheer volume of vocabulary to remember precludes recalling all of it every day.

The usual practice is all too often at the opposite extreme. The vocabulary of a given lesson is studied at a given time; then it may fade from use in the class until it reappears later on a test and the student is graded on whether he remembers it. If he does remember it, it is probably because he has studied it at home. Most teachers do little in the classroom to help guarantee that students will remember. Many do, of course, review vocabulary periodically. But there is nothing in a teacher's training that helps him to do this systematically, nor do the textbooks aid him in this task.

Yet there is much the teacher can do to help his students to remember. Between the impossible extreme of repeating all the vocabulary every day, and the undesirable but common practice of hardly repeating it at all, there may be a certain pattern or schedule of repetitions which is sufficiently frequent to raise the student's memory level appreciably, yet not so frequent as to preempt all the class time. What is needed is a schedule the teacher can follow in

FL 000 291

[Modern Language Journal, Vol. 51, No. 2, February 1967]

spacing the recall of previously learned materials.

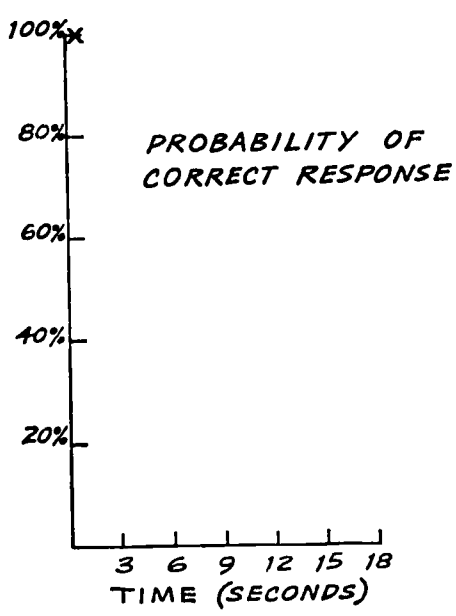
The elaboration of such a schedule, taking into account such factors as the length of each word, the pronunciation difficulties it contains, and the interactions between it and other words, would properly be the subject of a full-scale experimental investigation. Nevertheless, the general form such a schedule might take may be advanced here, based upon certain well-established findings from the field of experimental psychology, and my experience in programming three self-instructional courses.[1]

Taking an example from Modern Greek, you, the reader, should now imagine that you have just been taught (orally) the word for *Excuse me*, which is /siGNOmin/. You repeat it several times after the native speaker, to smooth out pronunciation difficulties.

Now we trace what happens to this knowledge, starting from this moment.

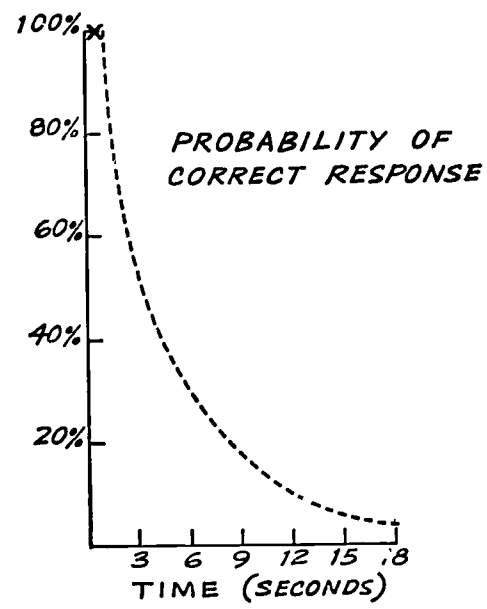
If I were to ask you to recall the word one second after you learned it, you could do so with virtually 100% certainty. We make a graph of this fact, indicating by an X that, at the moment after learning it, your probability of responding correctly is approximately 100%. Notice how this information is conveyed on graph 1.

GRAPH 1



Now as the seconds move on, the probability of your remembering this word will decrease rapidly, particularly as you will be busy learning other Greek material in the interim. We may show this rapid decrease by a dotted line, as in graph 2.[2]

GRAPH 2



Clearly this word will disappear from your memory if it is not repeated again very soon. But let us suppose that, being aware of this danger, the teacher chooses a moment when you still have a good chance (say, 60%) of remembering, to ask you: "Do you remember how to excuse yourself in Greek?" And whether or not you respond correctly, you are then reminded of the right answer. At that moment, your knowledge of the word is back up to 100%. Let us show this on graph 3 by another X, and also show by another dotted line how forgetting begins again—though not as rapidly this time as before.

Suppose we repeat this process several times. Every time your memory begins to fade, we ask you to recall the word and, after a moment's pause, provide a confirming answer. Soon the graph will look like this (Graph 4).

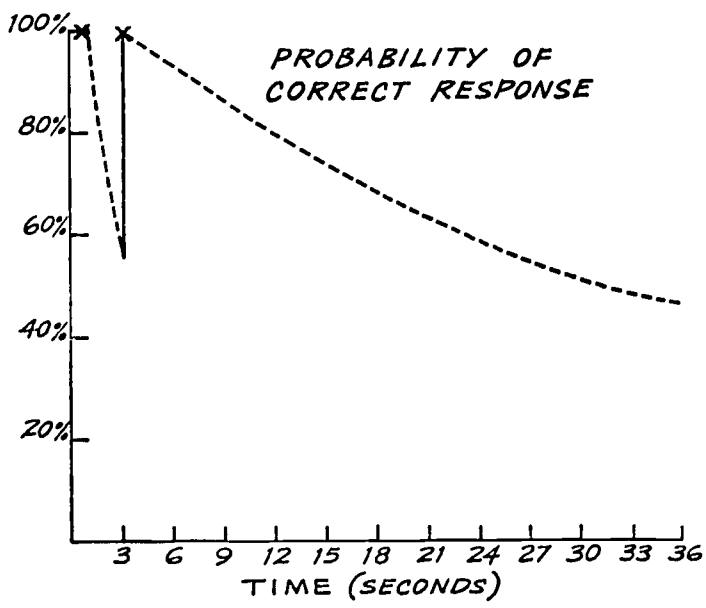
Notice in graph 4 that the X's are getting farther apart. That is, the length of the time be-

[1] Paul Pimsleur, *Speak and Read Modern Greek*, Pittsburgh: American Institutes for Research, 1963; *Speak and Read Essential French*, Columbus, Ohio: Tapeway, 1964; *Speak and Read Essential Spanish*, Columbus, Ohio: Tapeway, 1966.

[2] This curve closely approximates the experimental findings of L. and M. Peterson, as reported by B. J. Underwood, "Forgetting," *Scientific American*, March, 1964.

Modern Language Journal, Vol. 51, No. 2, February 1967

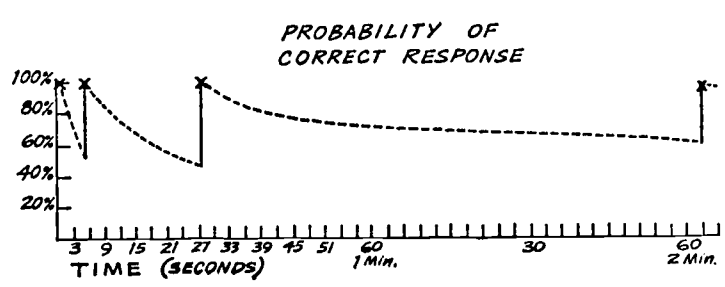
GRAPH 3



tween recalls is getting longer; you are remembering for longer and longer periods each time. This fact—that each time a memory is "boosted" it retains its strength longer than the time before—is the keystone upon which to build foreign language materials. There is no generally accepted term for such a schedule, but I have called it "*graduated interval recall.*"

What is the exact nature of this schedule? No simple answer is possible, for it would be foolish to think of using one and the same schedule for all types of words and structures. A short, frequent cognate word (e.g., *le garage*) might require very few recalls, while a long infrequent non-cognate (e.g., *ahurissement*) might require a great many. Still, the evidence both from my programming experience and from the findings of experimental psychology[3] seems to indicate that there is an "ideal" schedule one can keep in mind and adapt to fit the circumstances. This schedule is exponential in form. That is, if the first interval (between the original presentation and the first recall) is, say, five seconds then next interval may need to come $5^2 = 25$ seconds later, the next one $5^3 = 125$ seconds (2:05) later, the next one $5^4 = 625$ seconds (10:25) after that, and so on. The first interval can roughly be defined as the time that elapses before the student's probability of remembering the item drops to some arbitrary level, say 60%.

GRAPH 4



This suggests in practical terms that the teacher should recall the item very frequently right after it is first presented, though interspersed with other activities which take the student's mind off it between recalls. Then he should continue recalling it with decreasing frequency during the succeeding days and weeks. It seems he can not only insure maximum retention in this fashion, but that he may actually save time as well, by eliminating most of the repetition usually given at the beginning in hopes of "drumming it in." The principle advanced here argues against massing large numbers of repetitions when the word is first presented (except of course as may be required for pronunciation purposes), and in favor of spreading them out in a way that approximates the pattern just discussed.

If the exponential relationship can be believed—and the evidence indicates it is at least on the right track—then we make the following discovery. The tenth recall of our Greek word will not take place until 5^{10} or 9,765,625 seconds after the first. That's about 113 days or more than four months later. And that one should hold the student for well over a year.

[3] See, for example, R. S. Woodworth and H. Schlosberg, *Experimental Psychology*, New York: Holt, Rinehart and Winston, 1954, pp. 726 ff.; and C. E. Osgood, *Method and Theory in Experimental Psychology*, New York: Oxford University Press, 1953, pp. 554 ff.