Effects of Massed and Distributed Practice on the Learning and Retention of Second-Language Vocabulary

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ABSTRACT **High school students enrolled in a French course learned vocabulary words under conditions of either massed or distributed practice as part of their regular class activities. Distributed practice consisted of three 10-minute units on each of three successive days; massed practice consisted of all three units being completed during a 30-minute period on a single day. Though performance of the two groups was virtually identical on a test given immediately after completion of study, the students who had learned the words by distributed practice did substantially better (35%) than the massed-practice students on a second test given 4 days later. The implications of the findings for classroom instruction and the need to distinguish between learning and memory are discussed.**

Many of the traditional learning variables studied in psychological laboratories either have relatively small effects that limit their overall practical usefulness or the nature of the variable is such that it cannot readily and easily be manipulated by a teacher in his or her classroom. One apparent exception to this generalization is distributed practice (DP)—that is, interrupting practice or study time with rest intervals of up to 24 hours or longer. For example, a person may spend an hour studying some material, but this hour might occur all at one time (i.e., massed practice or MP) or it might occur as three 20-minute study periods on each of three consecutive days.

The purpose of the present study is to compare the effects of massed and distributed practice on classroom learning—specifically, the learning of vocabulary words in a French course at the high school level. While there is evidence (Keppel, 1964, 1967; Underwood & Ekstrand, 1967; Shuell, Note 1) that distribution of practice can have large effects on the learning and retention of word lists in laboratory settings, virtually no attempts have been made to determine whether similar effects can be obtained under normal classroom conditions. It should be apparent that a teacher has a certain amount of control over the allocation of study time and that it is possible to manipulate this variable without too much difficulty. Thus, if a sizable DP effect can be obtained in typical classroom settings, a variable with important implications for classroom learning will have been isolated.

Early research on distribution of practice with verbal materials (e.g., Underwood, 1961) used procedures similar to those used in studies of motor learning in that the distribution intervals were relatively short—e.g., 1 to 4 minutes for the DP condition versus 2 to 8 seconds for the MP condition. When practice is distributed in this manner, effects on learning and retention are relatively small (e.g., Houston, 1966; Houston & Reynolds, 1965; Underwood, 1961). More recently, however, several studies (Keppel, 1964, 1967; Underwood & Ekstrand, 1967; Shuell, Note 1) have used relatively long distribution intervals (i.e., 24 hours) during learning and obtained large and impressive differences in amount of material remembered. For example, in one series of studies (Keppel, 1964) subjects who learned under conditions of DP retained as much material after 29 days (34%) as the MP group retained after 24 hours (31%). Thus, because the magnitude of the effect seems to depend in critical ways on the length of the distribution interval, the present study employs the longer intervals where the effect appears to be greatest.

Method

Fifty-six students enrolled in a second-level French course at a high school in a working-class suburb of a large metropolitan city were randomly assigned to two groups, stratified on the basis of the students' previous performance in French. The students were taken from all three second-level classes, which met at three distinct time periods each day: early morning, mid-morning, and early afternoon. By assigning one-half of the students in each class to one of the two procedures, a control for time of day and class effects was included. The DP group consisted of 20 girls and 8 boys; the MP group consisted of 21 girls and 7 boys. The students were in grades 9-12, with the majority of students being in grades 9 and 10. The students were all academic-

track students with IQs generally over 100. Two students assigned to each condition (all four were girls) were absent for part of the experimental procedures. Consequently, the following results are based on 26 students per group.

Twenty French vocabulary words representing names of occupations and their English equivalents (e.g., *l'avocat* –lawyer) were learned as part of the students' regular classwork. These 20 pairs of words were printed on a sheet of paper and given to the students to study only during class in preparation for a vocabulary test to be given at the end of the week. A series of three, 10-minute written exercises was developed for use by both groups during class study periods. The first exercise was a written, multiple-choice exercise (e.g., fireman: *le proviseur, le facteur, le pompier*) for the students to complete and correct on their own. The second exercise was a written fill-in exercise in which the student was to write in French the name of the occupation described in a sentence (e.g., *Il cultive les legumes et les fruits.* _____). The third exercise was a written practice test in which the students were to write the French word for each occupation given in English (e.g., businessman-_____). The vocabulary test given at the end of the unit and the unannounced test given 4 days later (the dependent variables for the study) were written tests in which the students provided the French word for each occupation given in English. The words appeared in a different order on the test and retest, and neither order was the same as the order on the original study list or on the practice test.

The study was conducted as part of the regular, ongoing activities of each class. Students were told ahead of time that the study sessions were part of their classwork, that they would be graded on the vocabulary test given at the end of the unit, that the two groups would be learning the words by two different methods, and that a more complete explanation would be given later.

During the study, the MP and DP groups worked in separate rooms in order to minimize information relevant to the activities and progress of the other group. Both groups received a total of 30 minutes in class to study the 20 vocabulary words. These 30 minutes were separated into three 10-minute work periods with a different written assignment to be completed during each work period. The group receiving distributed practice studied for 10 minutes on each of 3 consecutive days. The group receiving massed practice worked on a totally unrelated French activity during the first 2 days without access to the vocabulary list or the exercises related to this study. On the third day the MP group worked on the same three exercises during three successive 10-minute periods (i.e., they worked for a total of 30 consecutive minutes on a single day). During the MP group's first two 10-minute study periods, the DP group worked on the unrelated French activity completed earlier by the MP group. All relevant materials were collected at the completion of each 10-minute study period (the list of vocabulary words was collected at the end of each day's work for those students in the DP group and at the end of the 30-minute period for those in the MP group). At the completion of the MP group's second study period, the two groups were rejoined and completed the third 10-minute study period (the one involving the practice test) together.

Immediately following completion of this third 10-minute study period, all students were given the same vocabulary test as previously announced. Following this test, the nature of the study was explained to the students, and questions were answered. Seven days later, without having the vocabulary list to study and without prior warning, a retest was administered. All tests were scored in the same manner (minus 1 for incorrect response or incorrect spelling of the response, minus ½ for incorrect accentuation). This scoring method was used in order to follow normal classroom procedures where spelling and accentuation are considered an important part of learning French vocabulary.

Results

The initial test, given at the completion of study, provides an index of learning. As can be seen in Table 1, performance on this initial test was virtually equivalent for the two groups, $t(50) = 0.93$. Thus, it appears that distributed and massed practice during learning have comparable effects on the learning of vocabulary words. This comparability also provides a baseline for evaluating the effect of the variable on memory; because the two groups are equivalent at the start of the retention interval, any differences that appear must be due to an effect on memory rather than learning.

An inspection of Table 1 reveals that on the retest given 4 days after completion of study, the group of students that had studied the words under conditions of distributed practice remembered substantially more words than those students who had studied under conditions of massed practice (performance was 35% better with distributed practice). In order to evaluate these data, a 2 X 2 analysis of variance (two levels of practice–massed and distributed–and two time intervals) was performed with repeated measures on the time factor (each subject was tested both immediately and after 4 days). This analysis revealed an overall main effect due to type of practice, $F(1,50) = 7.12$, $p < .05$, and a significant effect due to the length of the retention interval, $F(1,50) = 79.43$, $p < .01$. Because this latter test indicated that forgetting occurred, it is then possible to ask

Table 1.–Mean Numbers of Words Correct on the Two Vocabulary Tests (standard deviations are in parentheses)

	Test	
Group	Initial Test	Retest
Distributed Practice	16.85 (3.00)	15.04 (3.78)
Massed Practice	16.12 (2.64)	11.15 (4.02)

whether there was differential forgetting in the two groups (i.e., massed vs. distributed practice); this possibility is evaluated by considering the interaction between type of practice and length of the retention interval. This interaction was statistically significant, $F(1,50) = 17.24, p < .01$. Thus, taken together, these results indicate that massed and distributed practice affect learning in an equivalent manner (as shown in the initial t test); in addition, though forgetting occurred for both groups, there was substantially less forgetting for the group that had learned the words under conditions of distributed practice.

Discussion

The results of this study indicate that distribution of practice during learning in a school setting can substantially increase the amount of material students remember. It should be noted, however, that a relatively long (e.g., 24 hours) distribution interval was used in order to obtain the sizable effect evident in this study; in view of past research (e.g., Houston, 1966; Houston & Reynolds, 1965; Underwood, 1961) it seems unlikely that a similar effect would have been obtained with relatively short intervals. The effect of using distribution intervals of intermediate duration (e.g., one to several hours) has never been investigated. The absence of any effect of distribution of practice on learning is not totally unexpected, since similar results have been obtained in comparable laboratory studies (Keppel, 1964, 1967; Underwood & Ekstrand, 1967; Shuell, Note 1). Together, these findings underscore the importance of distinguishing between learning and memory, an issue that shortly will be discussed in more detail.

While the present findings are consistent with several studies conducted in laboratory settings with unrelated lists of words (Keppel, 1964, 1967; Underwood & Ekstrand, 1967; Shuell, Note 1), the present study demonstrates for the first time that distributed practice can be used in conjunction with regular classroom activities to obtain substantial improvements in students' memory of verbal materials. Similar results have been obtained for training government employees to type (Baddley & Longman, 1978). Reynolds and Glaser (1964) found that spaced review of material learned by programmed instruction can improve retention of the material whereas simple repetition has little if any effect, although in their study it is not possible to determine whether distributed practice affected learning or memory. The extent to which these findings can be extended to other types of school materials (e.g., the learning and retention of more meaningful and interrelated knowledge) is not clear at this time, but it is clear that distribution of practice can facilitate the retention of at least certain types of material typically learned in schools.

The finding that distributed practice affects learning and memory in different ways indicates that it is important to distinguish between these two concepts (e.g., Shuell & Lee, 1976, pp. 56-60). Though the concepts of learning and memory are obviously related, they do involve separate and distinct processes. Conceptually, for example, it makes sense to think about the acquisition of a task to a certain level of proficiency and the forgetting of the task once that level of proficiency has been reached as separate aspects of the overall concern for learning and memory. Empirically, many variables that have sizable effects on rate of learning appear to have very little, if any, effect on rate of forgetting when variables known to affect rate of forgetting (e.g., degree of original learning) are taken into account (Olton, 1969; Postman & Burns, 1973; Shuell & Keppel, 1970; Shull & Lee, 1976; Underwood & Richardson, 1958).

It is easy for practitioners and researchers alike to blur the distinction between learning and memory, but it is important to keep these two concepts separate if we are to understand fully the importance of the present findings —namely, that it is possible to obtain substantial improvements in memory without a corresponding effect on learning. Although we often place little emphasis on memory in education (perhaps because we think of it only in the overly restrictive sense of rote memorization), it is clear that memory plays an extremely important role. If students cannot remember what they have learned, they might as well not have learned it in the first place. Students obviously remember something of what they have learned, but the better we understand the factors that influence memory and the relationship between processes of learning and processes of memory, the more likely it is that we can improve the educational experience for all students.

The reasons why distributed practice seems to facilitate memory are not clear at present. Several theoretical interpretations have been suggested (e.g., cf. Shuell, Note 1), although none appears to be completely satisfactory. One possibility is that the effect may involve something as straightforward as providing an opportunity to practice the recall of material after some period of time has elapsed. In the present study, for example, when the student studies the words on the second and third days, he must recall the vocabulary words learned on previous days from long-term memory, and he must do the same on subsequent tests. Thus, the student is not only practicing the vocabulary words themselves, but he is also practicing their recall from long-term memory. This possibility suggests that the ability to retrieve information from long-term memory may be a process that can improve with practice. Individuals learning materials under conditions of massed practice only have the opportunity to recall information from short-term memory during learning. Yet on a test given at some later time they must recall the material from long-term memory, something they have not practiced.

A teacher or instructional designer can implement distribution of practice into regular classroom procedures in various ways without a great deal of difficulty. For example, delaying feedback on the correctness of items on a classroom test may improve later performance on those items that were missed (Surber & Anderson, 1975). Some

possibilities for using distributed practice may at first seem unreasonable or counterintuitive. For example, most of us have been taught that learning is best with immediate feedback, and such is in fact the case (e.g., Shuell & Lee, 1976, pp. 22-24). As we have seen, however, this does not necessarily mean that the same is true for memory. Thus, instructional conditions optimal for learning and for memory may be different. This suggests that some trade-off or balance may be desirable. During early phases of instruction, for example, when one is trying to establish the initial learning of the material, immediate feedback or massed practice may be most appropriate. Later in the instructional sequence, when acquisition of the material has been established at some reasonable level, delayed feedback or distributed practice may be most appropriate in order to guarantee maximum retention of the material. It is also useful to remember that if one is using distributed practice, differences must be looked for only after some period of time has elapsed; it is not reasonable to expect differences favoring distributed practice to appear during learning.

REFERENCE NOTES

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ERRATUM

An error appears in the caption to Figure 1 of the article "Factors That Correlate with Cognitive Preferences of Medical School Teachers" by Pinchas Tamir and Sabina Cohen (JER 74: 2, Nov./Dec. 1980, p. 71). The caption should read: **Figure 1.—Results of small space analysis (SSA) of cognitive preference scores (*N*= 85). Guttman Lingoes smallest space coordinates for M = 2 after principal axes rotation. Normalized phi = .01571 for 10 iterations. Coefficient of alienation = .176571E + 00. Space diagram, for M= 2. Vector 1 plotted against vector 2. TOT = 1, 2, 3, 4; PHYS = 5, 6, 7, 8; PHAR = 9, 10, 11, 12; CLIN = 13, 14, 15, 16.**