

# THE SIGNIFICANCE OF PAUSES

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## INTRODUCTION

This paper discusses the importance of pauses, not from a syntactic or a semantic point of view, but as regards their influence on short-term memory. The hypotheses which led to the experiments to be described are:

(1) A rhythmic organization of physical, e.g., acoustic, stimuli facilitates their short-term retention.

(2) Such a rhythmic organization can be achieved by pauses between stimuli of roughly the same time extension.

(3) A list of monosyllabic nouns can be rhythmicized by pauses at regular intervals.

(4) The presence and number of such regular pauses in these lists increases the short-term memory.

## 1. THE EXPERIMENTAL PROCEDURE

The five lists (shown in Table 1), each of twelve monosyllabic German nouns in the nominative singular, were recorded by myself under studio conditions, each word being pronounced on a falling intonation to low pitch and separated from the following word by a pause.

The listing presentation was to guarantee that the test material was not only homogeneous from a morphological point of view, but also as regards the prosodic features of pitch and duration, since the durations of listed monosyllables with terminal contours before pauses have a greater tendency to be the same in spite of differences in the segmental set-up.

From these five lists three test tapes were compiled. See Table 2. Each list appears five times in succession. At the same time all the signal pauses between the words in each list were removed from the tape recordings and the words joined together (in the original order), (a) with no pauses in Lists A, E, and Lists B, D of tape 3, (b) with pauses of the constant length of 1.5 sec. (by insertion of colour

TABLE 1

List A	List B	List C	List D	List E
Mund	Bett	Bein	Uhr	Haus
Stuhl	Fuß	Schiff	Haut	Knie
Tür	Kopf	Ohr	Bild	Gold
Brot	Teich	Glas	Kleid	Licht
Zahl	Ball	Stein	Fleisch	Haar
Band	Schrank	Topf	Knopf	Fluß
Mann	Zelt	Ring	Schwamm	Blut
Buch	Baum	Mund	Holz	Frau
Tisch	Heft	Wand	Stadt	Dorf
Dach	Nacht	Blatt	Sohn	Strand
Kamm	Rauch	Zahn	Kinn	Kuh
Dieb	Boot	Turm	Hund	Wein

TABLE 2

Tape 1	Tape 2	Tape 3
I. List A	I. List B	I. List A
II. List B	II. List A	II. List B
III. List C	III. List C	III. List D
	IV. List D	IV. List C
		V. List E

tape) after every fourth word in List B of tapes 1, 2, (c) after every third word in List C, (d) after every second word in List D of tape 2; so that the test lists as shown in Table 3 resulted:

TABLE 3

Tape 1	Tape 2	Tape 3
I. no pauses, 5x	I. pauses after every	I. no pauses, 5x
II. pauses after every	4th word, 5x	II. no pauses, 5x
4th word, 5x	II. no pauses, 5x	III. no pauses, 5x
III. pauses after every	II. pauses after every	IV. pauses after every
3rd word, 5x	3rd word, 5x	3rd word, 5x
	IV. pauses after every	V. no pauses, 5x
	2nd word, 5x	

Each tape was prefaced by this instruction:

Ich möchte hier einen Versuch machen, mit dem nicht Ihre Fähigkeiten oder Ihr Wissen festgestellt werden, sondern etwas ganz anderes. Ich kann Ihnen aber jetzt nicht sagen,

worum es geht, weil das das Ergebnis des Versuchs beeinflussen würde. Die Aufgaben, die Sie zu lösen haben, sind nicht schwer, erfordern aber intensive Aufmerksamkeit. Vor sich haben Sie ein Bündel von sechs zusammengehefteten Blättern. Auf dem ersten notieren Sie bitte die für die Auswertung der Versuchsergebnisse wichtigen biographischen Daten. Die übrigen fünf sind für Ihre Antworten vorgesehen. Sie sind von 1 bis 5 nummeriert und in die Spalten A bis E eingeteilt. Sie werden nun eine Liste von zwölf deutschen Wörtern fünfmal hintereinander in exakter Wiederholung hören. Diese Liste trägt die Bezeichnung 'Liste A', und die Wiederholungen sind von 1 bis 5 durchnummeriert, also 'Liste A1', 'Liste A2', 'Liste A3' usw. Wie Sie bemerken, entspricht die Numerierung auf Band der Numerierung auf den Blättern vor Ihnen. Nach Abspielen der Liste A1 wird das Tonbandgerät abgeschaltet, und Sie sollen dann so viele Wörter der Liste in der Spalte A auf dem ersten Blatt, d.h. also in Spalte A1 aufschreiben, wie Sie behalten konnten. Bitte beginnen Sie mit dem Aufschreiben erst, wenn das Gerät abgeschaltet ist. Wenn Sie damit fertig sind, knicken Sie das Blatt bitte so um, daß es unter das letzte Blatt kommt. Bitte schauen Sie bei den weiteren Versuchen dieses Blatt nicht mehr an; Sie verfälschen sonst das Versuchsergebnis. Es wird dann zur Liste A2 übergegangen, wo genau die gleichen Instruktionen gelten; dann zu A3 usw.

Subsequent lists on the tapes were introduced by:

Sie hören nun eine weitere Liste, nämlich Liste B (C, D, E), mit ebenfalls zwölf deutschen Wörtern; auch Liste B (C, D, E) wird fünfmal hintereinander in exakter Wiederholung gegeben, allerdings sind die Wörter jetzt ganz andere als in der Liste A. Verwenden Sie nun die Spalten B (C, D, E) in genau derselben Weise wie im ersten Versuch.

Three groups of university students of speech (average age 21, all native speakers of German) were selected; tape 1 was presented to group 1 (41 subjects), tape 2 to group 2 (47 subjects), tape 3 to group 3 (29 subjects). All the experiments were conducted between 9 and 10 a.m. At the beginning of the experiment the subjects were given the answer sheets referred to in the instructions. After hearing the instruction from tape the subjects were asked by the experimenter (myself) if it was clear to them what they were required to do. Any technical queries were answered; in the case of questions on the purpose of the experiment the subjects were promised to be given a detailed account immediately after the experiment. The test time ranged from ca. 20 mins. in group 1 to ca. 30 mins. in group 3.

## 2. RESULTS

In the analysis of the answer sheets four questions were asked:

(1) How many subjects of each group reached the maximum of twelve correctly reproduced words in which list, i.e., without regard to the correct ordering and to the number of repetitions necessary? Each list in a group was thus analyzed separately.

(2) How many subjects of each group reached this maximum after the smallest number of repetitions in which list (again without regard to the correct ordering)? All the lists in a group are thus compared as to which shows the maximum first. This question implies the further question of how many subjects of a group never reached the maximum.

(3) How many subjects reproduced how many correct words in the 5th presentation of which list (again without regard to the correct ordering)?

(4) How many subjects reproduced how many correct words in correct order in the 5th presentation of which list?

2.1. *Question 1.* — See Table 4.

TABLE 4

Group 1	Group 2	Group 3
I. 24%	I. 36%	I. 21%
II. 60%	II. 23%	II. 34%
III. 61%	III. 72%	III. 34%
	IV. 72%	IV. 59%
		V. 59%

For each group we get values above and below 50%. These two sets of values co-vary with the presence and absence of pauses, with the notable exceptions, namely the first list in group 2, where a complete co-variance would require a higher value, and the fifth list in group 3, where we would expect a lower value accordingly. In both instances I introduce the further hypothesis that the subjects learn how to memorize, not only from repetition to repetition, but also from list to list. This means that the greatest learning effort is necessary when the list is given at the beginning and that this learning effect continues from list to list thus interfering with the variable 'presence - absence of pauses'.

We find this interpretation supported when we compare the results for the initial lists in the three groups since the values for the lists without pauses in groups 1 and 3 are, in fact, much closer to each other than to the value for the list with pauses in group 2. Further support is provided independently by the ordering of values in the three groups: only group 2 shows a decrease in the progression from one list to the next, and this drop co-varies with the change from a list with pauses to a list without pauses. The results for questions 3 and 4 supply further confirmation (see 2.3, 2.4). The answers to question 1 thus show an influence of the presence/absence of pauses, but not their number, on short-term memory.

2.2. *Question 2.* — To allow a comparison between groups for this question it was necessary to analyze the data for three and for four lists in group 2, and for three, for four and for five lists in group 3 separately. This was possible since the experiment can be regarded as having ended after any list; the subsequent material can simply be discarded for the particular question in hand. See Tables 5, 6, 7.

In Table 5, I.-III., the figures for groups 1 and 2 fall into two classes such that there is a substantially greater numerical difference between any elements from different classes than between any elements from the same class; the figures for group 3, on

TABLE 5

	Group 1	Group 2	Group 3
I.	2%	7%	7%
II.	27%	7%	10%
III.	34%	55%	14%
simultaneous in more than one list	15%	8%	20%
nowhere	22%	23%	49%
total	100%	100%	100%

the other hand, are much closer together and do not attain the same magnitude. Furthermore, approximately the same percentage of subjects in groups 1 and 2 never reached the maximum, whereas in group 3 the figure is twice as high. Since both groups 1 and 2 were given lists with and without pauses, but group 3 only lists without pauses, the same covariance of percentages with the presence and absence of pauses as in response to question 1 is noted. In group 3 there is thus only an effect through learning from list to list, whereas in the other groups there is the additional and far more substantial effect through pauses on short-term retention. List I in group 2 shows the same discrepancy with the other results as for question 1, attributable to the same hypothesis stated in 2.1.

TABLE 6

	Group 2	Group 3
I.	2%	3%
II.	2%	0%
III.	34%	3%
IV.	34%	38%
simultaneous in more than one list	17%	25%
nowhere	11%	31%
total	100%	100%

The same co-variance applies in Table 6, with the same exception of list I in group 2. In spite of the same number of lists, 31 % of the subjects in group 3, as against 11 % in group 2, did not reach the maximum. This again co-varies with the number of pauseless lists in the two groups. The percentage decreases to 27 % when the fifth list is added in group 3. See Table 7.

The results for question 2 thus confirm the results in 2.1 and show, in addition, that the percentage of subjects who do not reach the maximum decreases more with the number of lists containing pauses than with the number of pauseless lists. The

TABLE 7

Group 3	
I.	0%
II.	0%
III.	3%
IV.	27%
V.	17%
simultaneous in more than one list	26%
nowhere	27%
	100%

value for the fifth list in group 3 is substantially higher than the values for lists I to III, thus according with the results of 2.1, but is nevertheless lower than for list IV, thus supporting the hypothesis of the effect of learning.

2.3. *Question 3.* — The results are shown in Figures 1-3. A falling curve co-varies with a list containing pauses, a rising one with the absence of pauses, again with the exception of list V in group 3; list I in group 2, however, conforms to this pattern.

2.4. *Question 4.* — The results are shown in Figures 4-6. In Figure 6 the curve for the first presentation of list V is also given. Although the number of pauses has no influence on the NUMBER of correct words, it determines the number of correct words in the correct ORDER. The maxima of the curves tend to occur at whole number multiples of the number of words that are separated by pauses, and there is a fundamental difference between a 4-unit and a 3-unit rhythm.

When there are no pauses maxima occur at 2 and/or 4; a small maximum at 12 seems to presuppose a preceding list with pauses. When there are pauses after four words the maximum lies at 4 and at 12, the latter being greater than in the previous case. This also applies to the 2-unit rhythm, where we find maxima at 2, 4 and 12. Lists IV and V in group 3 are now clearly differentiated in the sizes of their maxima at 12, similarly lists I and II of group 2 in the opposite way. A further interesting result is that the 3-unit rhythm of list IV in group 3 is carried over into list Va of group 3.

3. CONCLUSIONS

(1) The presence or absence of regular pauses in a word list influences the number of words in short-term memory.

(2) In addition to this rhythmical factor in the stimulus there is a learning effect to be noticed from repetition to repetition and from list to list. But this effect on short-term memory is smaller when the subsequent list contains no pauses than when it does.

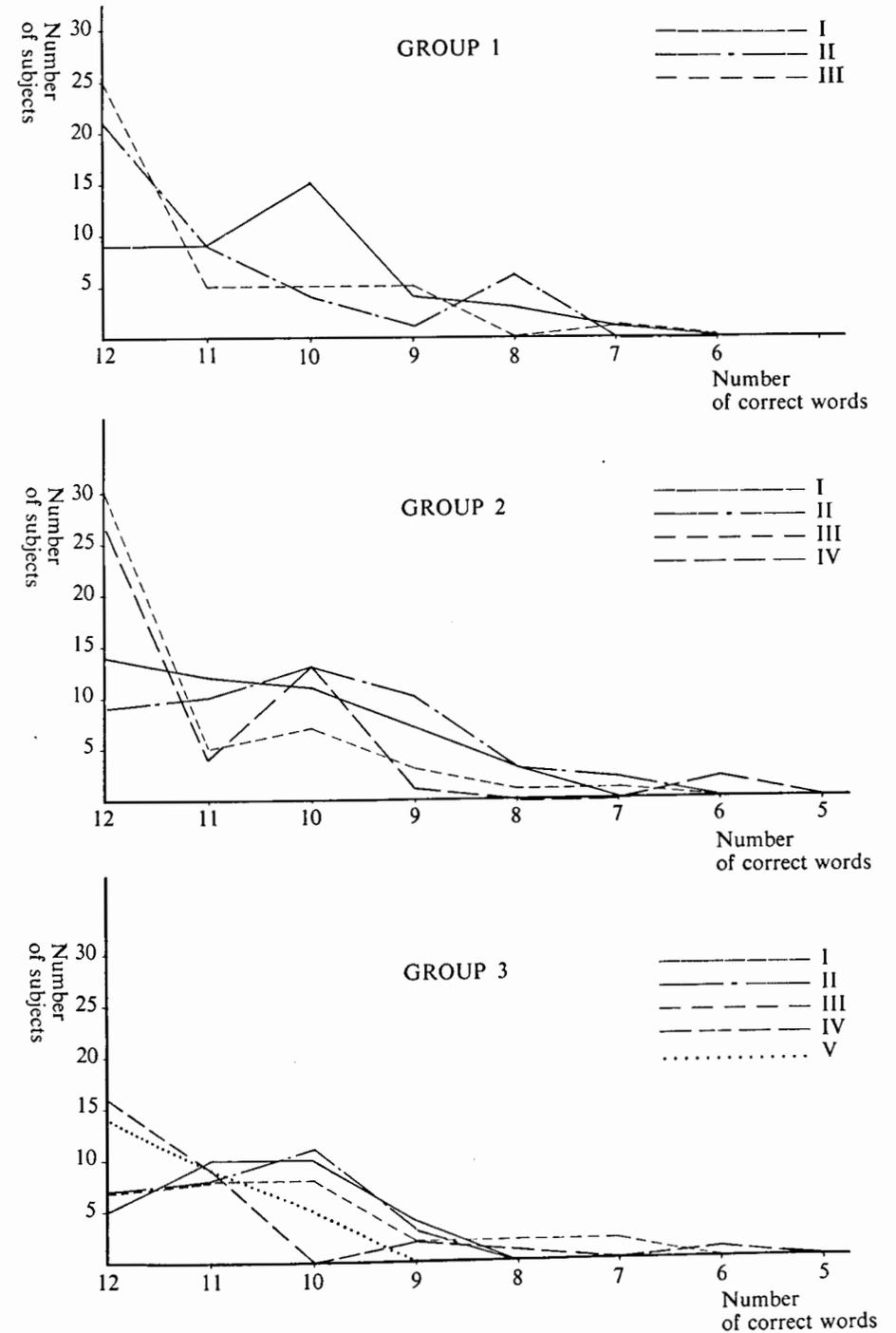


Fig. 1-3.

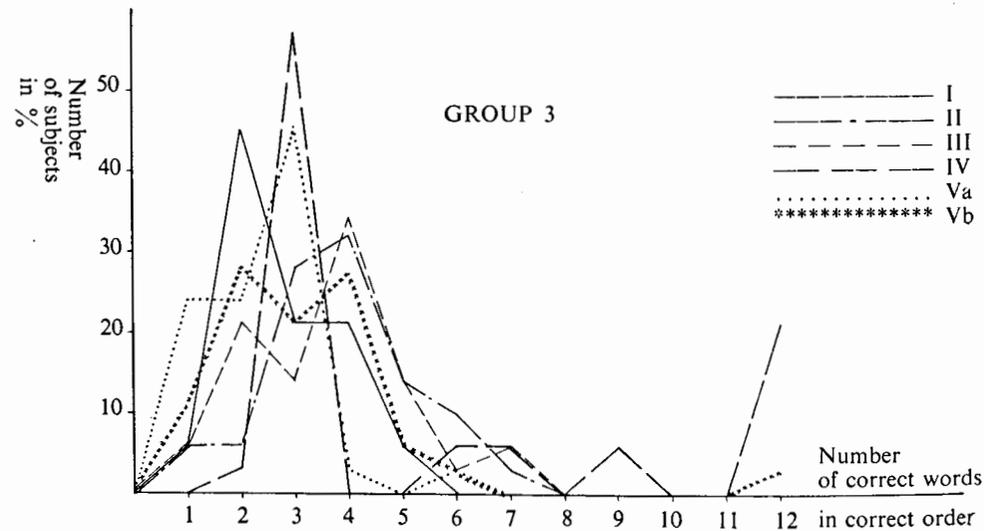
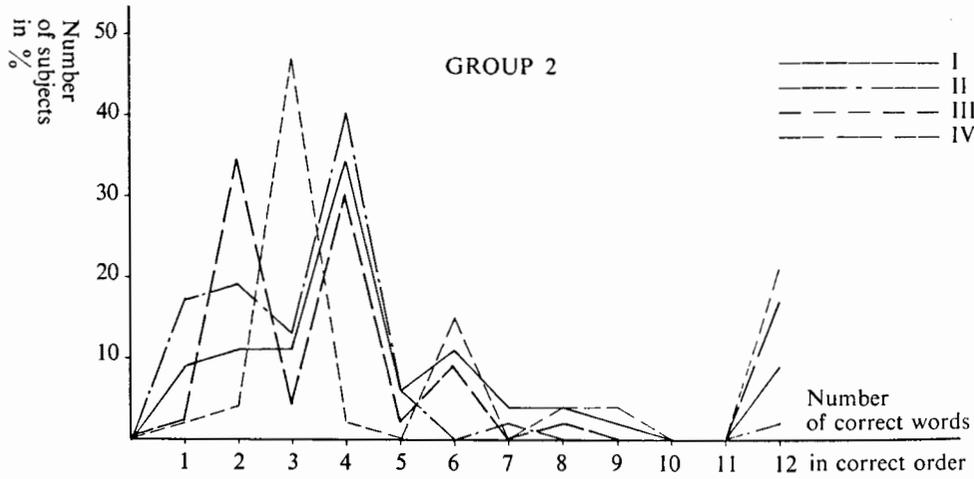
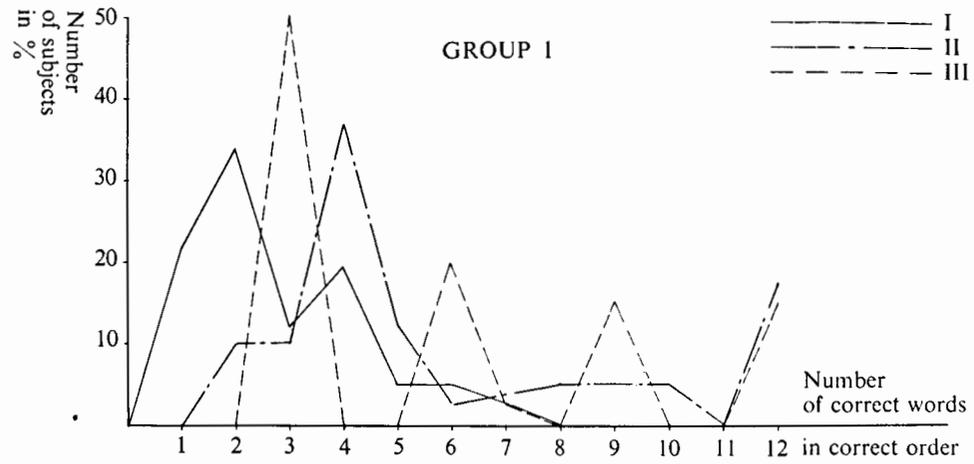


Fig. 4-6.

- (3) Factors 1. and 2. are independent; they enhance, or interfere with, each other.
- (4) The number of pauses only has an influence on the correct order.
- (5) This order may be continued in a new list without pauses.

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