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STIMULUS FAMILIARIZATION AND
STIMULUS SIMILARITY IN
PAIRED-ASSOCIATE PERFORMANCE

Thesis for the Degree of M. A.
MICHIGAN STATE UNIVERSITY
Joseph R. Levine
1961



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ABSTRACT

STIMULUS FAMILIARIZATION AND STIMULUS SIMILARITY IN PAIRED-ASSOCIATE PERFORMANCE

by Joseph R. Levine

Gibson (1940) hypothesized that predifferentiation of the stimulus items of a paired-associate list would lead to increased speed of learning of that list. Tests of this hypothesis utilizing various types of stimuli; e.g., visual nonsense forms, colored lights and nonsense syllables, have yielded inconsistent results.

Previous studies of stimulus predifferentiation did not control for the level of discriminability of the stimulus items previous to the predifferentiation training. In the present study Morse Code signals were used as the stimulus items of the paired-associate task. Morse Code signals were used because: 1) they are relatively unfamiliar to our subjects and therefore the subjects have made no previous discriminations among the items, and 2) previous work by Rothkopf (1957) enabled us to choose lists of stimuli whose discriminability was specifiable.

The effects of three amounts - 0, 20, and 40 - of stimulus familiarization trials on the learning of two paired-associate lists were studied using a transfer of training paradigm. One list had high interstimulus similarity; the other list had low interstimulus similarity. During familiarization Ss merely listened to eight Morse Code signals which were later used as stimulus items on a paired-associate list. In the paired-associate transfer task Ss were provided with a list of eight two-digit numbers which served as responses to the Morse Code signals.

In the second transfer task (detection) Ss listened to a series of signals and judged which signals had been previously presented in the paired-associate task.

The hypotheses were: 1) Ss receiving no familiarization would commit more errors on both the paired-associate task and the detection task than Ss receiving familiarization; 2) performance on the paired-associate list containing low interstimulus similarity would be significantly better than performance on the list containing high interstimulus similarity.

The results supply confirmatory evidence for the above hypotheses. Facilitation of learning on the paired-associate task by stimulus familiarization was independent of the level of interstimulus similarity.

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Approved Abram M. Barch
Committee Chairman

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STIMULUS FAMILIARIZATION AND STIMULUS SIMILARITY
IN PAIRED-ASSOCIATE PERFORMANCE

By

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INTRODUCTION

One of the crucial questions in paired-associate learning concerns the manner in which acquaintance or familiarity with the materials to be learned influences the rate of acquisition and the frequency of errors.

Gibson (1940) hypothesized that generalization among the stimulus items is an important source of errors in paired-associate learning. She further proposed that procedures which increase differentiation among the stimulus items would reduce the amount of generalization and thereby reduce errors in paired-associate learning as well as reduce trials to criterion. She posits that one effect of practice with the material to be learned is to increase the differentiation among the stimuli so that each stimulus can be more readily associated with a given response. Thus, positive transfer would be expected when a test list is learned which contains the same stimulus items as a previously learned list. Positive transfer is predicted because the stimulus items have been differentiated as a result of having been previously learned.

Methods of Stimulus Familiarization and Types of Studies

Three general methods for producing stimulus differentiation prior to a test situation are: 1) requiring subjects merely to observe the stimuli, 2) requiring subjects to observe the stimuli with instructions to attend to the material in order to be able to answer questions about it, and 3) requiring subjects to perform a task in which successful performance depends upon making discriminations among the stimuli (discrimination learning, paired-associate learning).

These methods have been referred to interchangeably as familiarization or stimulus predifferentiation.

From the standpoint of clarity the two terms should not be used interchangeably. Familiarization refers to an experimental procedure while stimulus predifferentiation (or stimulus differentiation) refers to one possible result of familiarization; i. e., increased discrimination.

All the studies on stimulus familiarization utilize the transfer of training paradigm. In each case subjects are familiarized with materials which will be used as the stimulus items on a criterion (transfer) task; then comparisons of performance are made between subjects who have and have not received familiarization. The effect of stimulus familiarization has been studied in perceptual-motor skills, perceptual identification tasks, and verbal learning tasks.

In familiarization studies involving perceptual-motor skills subjects are given various amounts of pretraining (familiarization) with perceptual features or configurations to which they will later execute motor responses. The one clear-cut finding in these studies is that a large number of familiarization trials is necessary for positive transfer to occur. Relationships between amounts of familiarization and amounts of transfer have been sought but no simple one-to-one relationship between these variables has been found.

A second type of study testing the predifferentiation hypothesis utilizes perceptual identification tasks. In such tasks sets of physical (non-verbal) stimuli are presented to subjects who differ, ideally, only with respect to the number of times they have seen the stimuli during familiarization. The subjects then judge whether the stimuli are the same or different. Results indicate that familiarization facilitates performance on such criterion tasks.

In the third type of experiment both the stimuli and the responses are verbal material. Conflicting results have been reported. In some cases familiarization leads to positive transfer while in others no significant effect has been found.

Perceptual-Motor Familiarization Studies

Gagné and Baker (1950) studied the effects of four levels of stimulus familiarization on the acquisition of a perceptual-motor skill. On the criterion task, subjects pushed one of four levers in response to colors and locations of flashes of lights on a panel before them. During familiarization they learned letters as responses to the different lights. The group with the most pretraining made significantly fewer errors than the group with no pretraining. No other comparison was significant.

Cantor (1955) using procedures similar to that of Gagné and Baker found that performance on the Iowa Star Discrimeter was facilitated by relevant familiarization; i. e., familiarization on the colors which later served as stimulus items. Cantor controlled for warm-up and performance set by comparing groups familiarized on the relevant stimuli with groups familiarized on irrelevant stimuli.

Goss (1953), also using apparatus and stimuli similar to that of Gagné and Baker, studied the effects of three different kinds of familiarization on a perceptual-motor transfer task. One group of subjects learned letters in response to four different intensities of light. A second group was instructed to look at the lights noting the number of different intensities presented. A third group was simply shown the lights under the ruse that the purpose of the experiment was to determine certain effects due to looking at these lights. Each group was divided into three subgroups which received different amounts of exposure to the stimuli.

The subgroup which learned letters to the light intensities during familiarization and had the greatest amount of exposure to the stimuli performed significantly better than all other groups both singly and combined. The subgroup receiving no familiarization performed worse than all other subgroups except the one which merely looked at the lights for the greatest amount of time. Goss concluded that the "best" subgroup

showed positive transfer above the amount of transfer expected from prior habit arousal or performance set.

Rossman and Goss (1950) and Baker and Wylie (1950) have demonstrated the facilitative effects of learning discriminative labels on subsequent performance of a perceptual-motor task.

Battig (1956) using relevant S-R and relevant S pretraining and four levels of task complexity found: 1) task complexity is a factor in transfer; i. e., familiarization resulted in positive transfer on two simpler tasks while there was no positive transfer on the more complex ones, 2) where positive transfer did occur, relevant S-R pretraining was superior to relevant S pretraining.

In general, the data indicate that familiarization of perceptual features of a perceptual-motor task leads to positive transfer but many questions remain unanswered. Among these are questions concerning the amount of familiarization necessary and the exact way in which familiarization does lead to transfer.

Perceptual Identification Studies

Arnoult (1953) used nonsense shapes of high similarity as stimulus figures in a paired-associate pretraining task. On the criterion task subjects judged, under short exposures, whether two shapes were the same or different. There were no significant differences between groups receiving familiarization of the relevant shapes and a control group receiving irrelevant familiarization. In a second experiment Arnoult used a recognition test as the criterion task. In this test S was shown a single shape which was followed immediately by a display of five similar shapes. From the set of five, S chose the shape he judged to be the same as the original one. Again there was no significant difference between subjects receiving relevant and irrelevant familiarization.

In another study Arnoult (1956) varied the meaningfulness of the responses during paired-associate familiarization while using nonsense shapes of a very high degree of similarity. During familiarization eight shapes were paired with either a nonsense syllable, a girl's name, the modal name elicited by the figure (as empirically determined in a pilot study) or a label which each subject supplied. A fifth group merely observed the shapes during familiarization. Another variable in this experiment was the amount of familiarization; i. e., each shape was seen either 1, 2, 3, 4, 5, 8, 10 or 15 times.

The transfer task was a recognition task consisting of sixteen items. "Each item consisted of four shapes and a category marked NONE." The subjects indicated whether the items had been presented during the pretraining trials. For eight of the items the correct answer was "NONE" while the remaining items contained a figure used in the pretraining.

Three different scores were determined for each subject. They were: 1) Correct Gross Rejections - indicating choice five ("NONE") when in fact none of the previous figures had been presented in the pretraining, 2) Correct Gross Recognitions - indicating the wrong figure when in fact one of the figures had been shown previously, 3) Fine Recognitions - indicating the figure that had been presented previously. Each of these scores measures a different level of difficulty of the transfer task.

Significant differences between methods of familiarization were found for Gross Rejection scores but not for Gross Recognition scores. Increasing the meaningfulness of the response aided Gross Rejection scores. A significant interaction between amount of familiarization and training method was found for Fine Recognition scores - indicating that increasing meaningfulness of the response in pretraining aids recognition when a small number of pretraining trials (1-4) is given but has

no effect when more pretraining trials are given. Gross and Fine Recognition scores for all familiarization groups varied significantly with the number of pretraining trials, yielding a monotonic negatively-accelerated function of the number of trials.

Pfafflin (1959) investigated the variables of both stimulus and response meaningfulness as related to familiarization. Thirty different silhouette forms were submitted to subjects for labeling and the modal name determined for each stimulus. The figures were divided into three sets on the basis of consistency of labeling. (The high, medium, and low meaningful forms were labeled with an average consistency of 94%, 48%, and 12% respectively.)

Subjects were then familiarized (twelve trials) with the forms in three different ways. One group had paired-associate learning in which the stimuli were paired with the modal name (relevant pretraining) while a second group learned to respond to the figures with adjectives (irrelevant pretraining). The third group merely observed the stimuli during pretraining. The criterion task was a discrimination learning task in which the forms were presented one at a time and to each of which one of two responses was correct.

The discrimination learning scores indicated that the meaningfulness of the figure and the kind of pretraining were significant sources of variance. Groups receiving relevant or observation pretraining did significantly better than the no pretraining group and the irrelevant pretraining group when the stimuli were of medium or low meaningfulness. When the stimuli were highly meaningful, the group receiving relevant pretraining performed worse on the criterion task than the other pretraining groups but the significance of this difference was not tested. The results support the conclusion that "both stimulus and response meaning are important factors in predifferentiation."

A more direct approach to the predifferentiation hypothesis is afforded by Gibson (1942). She achieved different levels of intra-list stimulus discriminability by using lists constructed to maximize or minimize intra-list stimulus similarity rather than by familiarization procedures. She found that lists containing the easily discriminated forms were learned faster than those lists which contained similar forms.

Verbal Studies of Predifferentiation

Hovland and Kurtz (1952) found familiarization of nonsense syllables facilitated the subsequent learning of serial lists of six to twenty-four items in length.

Noble (1955) using six-item lists of paralogues found familiarization facilitated serial learning and he found the locus of the benefit in the early trials.

There is a serious flaw in any argument which ascribes positive transfer in serial learning to stimulus predifferentiation. The items in a serial list not only serve as stimuli for the next item: they serve as responses as well. In view of the Underwood and Schulz (1960) finding that response familiarization facilitates learning in a paired-associate list, we cannot exclude the possibility that the positive transfer found in serial learning is due to response learning rather than stimulus familiarization.

Underwood and Schulz (1960) using several different familiarization techniques found that as much as forty trials of stimulus familiarization of nonsense syllables (CVC's) did not yield positive transfer in a paired-associate verbal task. It should be noted that they chose the stimuli such that the intra-list similarity was minimized.

Gannon and Noble (1961) report positive results in a paired-associate verbal task for stimulus familiarization of paralogues of low meaningfulness but not for response familiarization.

Purpose

One major criticism which may be lodged against all the studies reported here except that of Gibson (1942) and Arnoult (1953, 1956) is the failure to use stimuli which challenge the discriminative ability of the subjects. The predifferentiation hypothesis can hardly be tested unless the stimuli are similar initially, since there is little point in using a technique to increase discrimination when the items are already discriminable. Another inadequacy of the previous studies, especially the experiments on verbal material, is the inability to distinguish errors due to learning responses from errors due to stimulus confusions.

The present investigation is designed to remedy these two difficulties in studying the effect of stimulus familiarization on a task intermediate between verbal learning and perceptual identification. The stimuli, Morse Code signals, have both perceptual and language-like characteristics. Furthermore, the confusability of these stimulus materials has been scaled previously (Rothkopf, 1957) thereby allowing the construction of lists of high and low intra-list similarity. To minimize the influence of response learning highly familiar discriminable response items were used. Furthermore, subjects had a list of these response items available at all times during the criterion task.

The hypotheses are the following:

1) Groups learning the lists containing stimuli which are highly confusable will make more errors on the criterion task than groups learning the list containing stimuli of low confusability.

2) Groups that have been given familiarization trials will have significantly fewer errors on the criterion task than groups receiving no familiarization.

METHOD AND PROCEDURE

Subjects

The subjects were 120 students (85 women and 35 men) enrolled in the introductory psychology course at Michigan State University who received course credit for participating in this experiment.

Ss were tested in groups of two to five persons each. The experimental conditions were given in a predetermined order and Ss were assigned to the experimental conditions in order of appearance at the laboratory.

Stimuli

The stimuli were Morse Code signals transmitted at a rate of 12-15 words per minute with an intensity of 85-95 db. and a frequency of 925-935 cps. Two lists of eight signals each were used. In the High interstimulus similarity list (High) the likelihood of intersignal confusions was maximized and in the Low interstimulus similarity list (Low) the likelihood of interstimulus confusions was minimized. List construction was based on the work of Rothkopf (1957) who measured confusability by presenting various two signal combinations which subjects judged to be same or different. The similarity percentage refers to the percent of the time they were judged as the same. The mean percent similarity (a measure of confusability) for the High list was 29.86 and 11.04 for the Low list. (For a further discussion of confusability of Morse Code signals see Rothkopf (1957).)

The two lists contained four signals in common and four signals which were unique to each list. (See Appendix A for the composition of the lists.) The signals common to both lists appeared on corresponding

trials in corresponding positions in both the familiarization trials and the paired-associate transfer task; for example, if one of these signals appeared as the sixth item of a given trial on the High list it also appeared there on the Low list. This procedure was intended to minimize differences between lists while varying the degree of list difficulty; i. e., intersignal similarity.

Procedure

The stimuli and the correct responses were presented via a tape recorder. The instructions were read to the groups by the experimenter and clarifications were given whenever necessary.

The sequence of tasks was: (a) signal familiarization, (b) paired-associate learning, (c) detection test.

Tasks

(a) Familiarization Task: A familiarization trial consisted of 8 signals of either the High or the Low list. The signals were given at 4 second intervals. A preparatory signal ("Ready") was given 4 seconds before the beginning of each trial. The intertrial interval was 6 seconds. Each trial was in a different random order.

Ss were not required to make any overt response during the familiarization trials but they were instructed to pay close attention to the signals and to try to memorize them. (See Appendix B for complete instructions.)

(b) Paired-Associate Task: In the paired associate task Ss learned two digit numbers as responses to the Morse Code signals. Each S was supplied with a list of the response numbers to which he could refer during the paired-associate task. The responses were: 24, 31, 46, 57, 68, 79, 85 and 93.

Each paired-associate trial began with the word "Ready." After a 4 second delay the first stimulus occurred. S was allowed 4 seconds to respond by writing the response number on his answer sheet. After this 4 second interval the stimulus was repeated and the correct response was immediately given. The interval between the reinforcement and the next item was also 4 seconds. Ss scored their own answers; i. e., if their answer agreed with the announced answer they put a check (✓) next to it; if not, they put an "x" next to it. The paired-associate task consisted of 25 trials of either the High list or the Low list. The stimuli were arranged in a different random order for each trial. The first trial was used to acquaint Ss with the paired associate procedure and was not scored.

Ss were informed that each trial was in a different order and they therefore had to learn which signal was associated with each response number.

(c) Detection Task: All Ss were given the same set of 12 signals - eight of which they had heard during the paired-associate procedure and four of which they had not previously heard. The list consisted of the set of the four signals common to both High and Low lists plus two sets of four signals unique to both lists. Each signal was preceded by an identifying number; e. g. 1, 2, ..., 12, and the signals occurred at 4 second intervals. S made a check mark next to the identifying number if he judged that the signal corresponding to that number occurred in the previous paired-associate task.

Experimental Design

There were two levels of list difficulty and three levels of stimulus familiarization; e. g., zero, twenty and forty trials.

RESULTS

Paired-Associate Task

The number of correct responses, with omissions scored as errors, was tabulated for each S. As seen in Table 1, performance on the Low interstimulus similarity list was better than performance on the High interstimulus similarity list. Within each list, performance under conditions with greater familiarization was better than under conditions of less familiarization.

Table 1. Means and Standard Deviations of Correct Responses on the Paired-Associate Task

Number of Familiarization Trials	0		20		40	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Low Interstimulus Similarity List	110.2	28.1	122.7	29.5	129.6	28.1
High Interstimulus Similarity List	75.2	18.7	91.4	25.5	101.3	32.6

The F max test was used to test the assumption of homogeneity of variance. Since the ratio was not significant, the variances were assumed homogeneous. For purposes of this analysis the paired-associate trials were divided into three blocks of eight trials each, with each block serving as a repeated measure. A Lindquist (1953) Type III analysis of variance was used to test the overall effects of familiarization as well as its effects over the learning trials. Table 2 is a summary of this analysis. The F ratios for familiarization, level of difficulty,

and interaction of difficulty by blocks of trials were all significant at $\alpha = .01$.

Table 2. Summary of Analysis of Variance of Correct Responses on the Paired-Associate Task

Source	df	Mean Square	F-Ratio
Between <u>Ss</u>	119	344.46	7.29*
Familiarization (F)	2	1756.31	41.22*
Difficulty (D)	1	9933.00	1.22
F X D	2	37.38	
Error (b)	114	240.96	
Within <u>Ss</u>	240		
Blocks (B)	2	15791.22	513.37*
F X B	4	13.54	.44
D X B	2	413.95	13.45*
F X D X B	4	24.66	.80
Error (w)	228	30.76	

*Significant at $\alpha = .01$.

Each of the three familiarization levels was significantly different ($\alpha = .05$) from the other two familiarization levels. The learning curves for each of the three familiarization groups are presented in Figure 1. Each point on a curve is an average of three trials; i. e., the first point is the mean of trials 1, 2, and 3, and the second point is the mean of trials 4, 5, and 6, etc.

The learning curves for the two lists are presented in Figure 2. Examination of Figure 2 suggests that the significant list difficulty by trial blocks interaction is due mainly to a differential rate of learning early in the task.

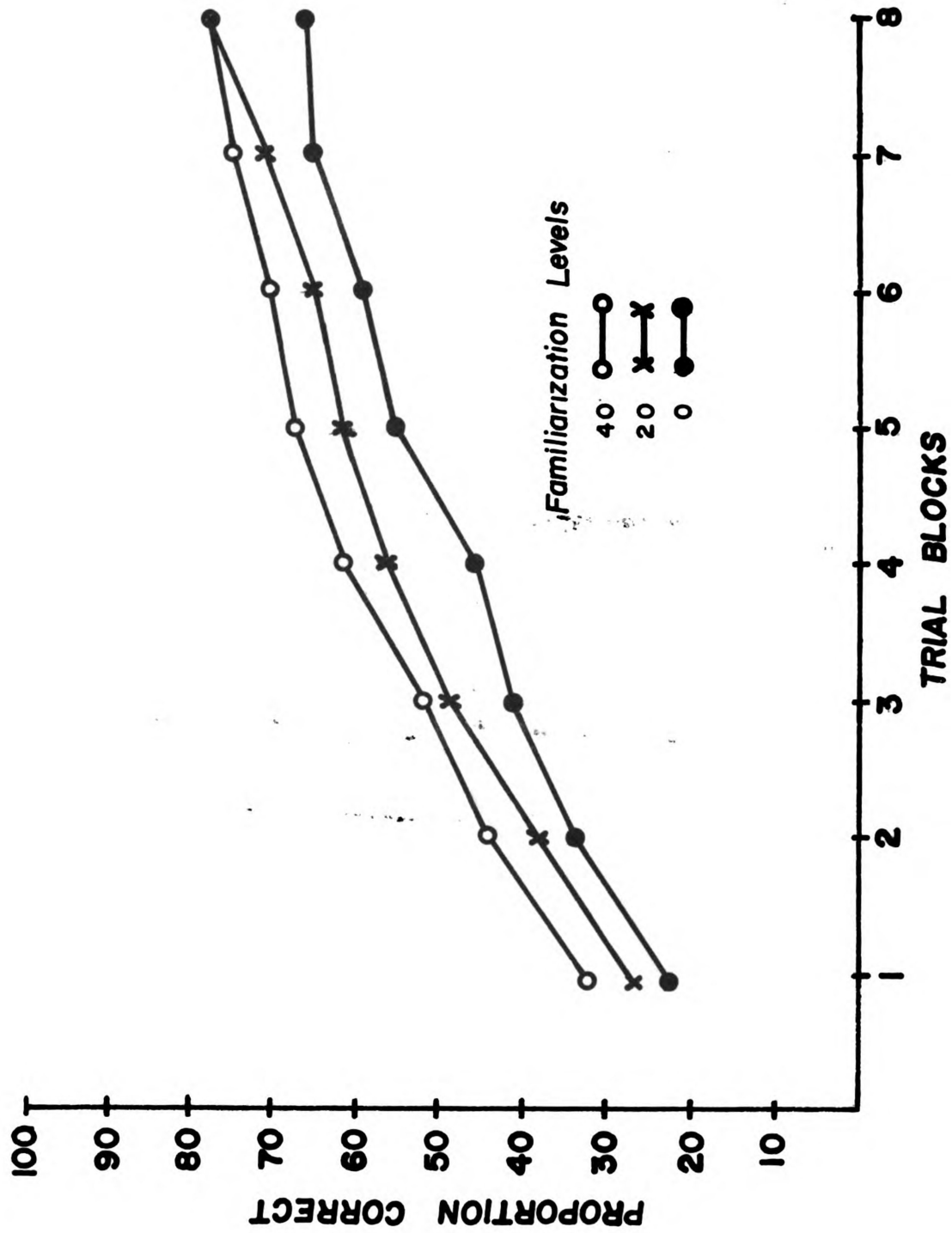


FIG. 1. MEAN PROPORTION CORRECT FOR EACH FAMILIARIZATION LEVEL OVER BLOCKS OF THREE TRIALS

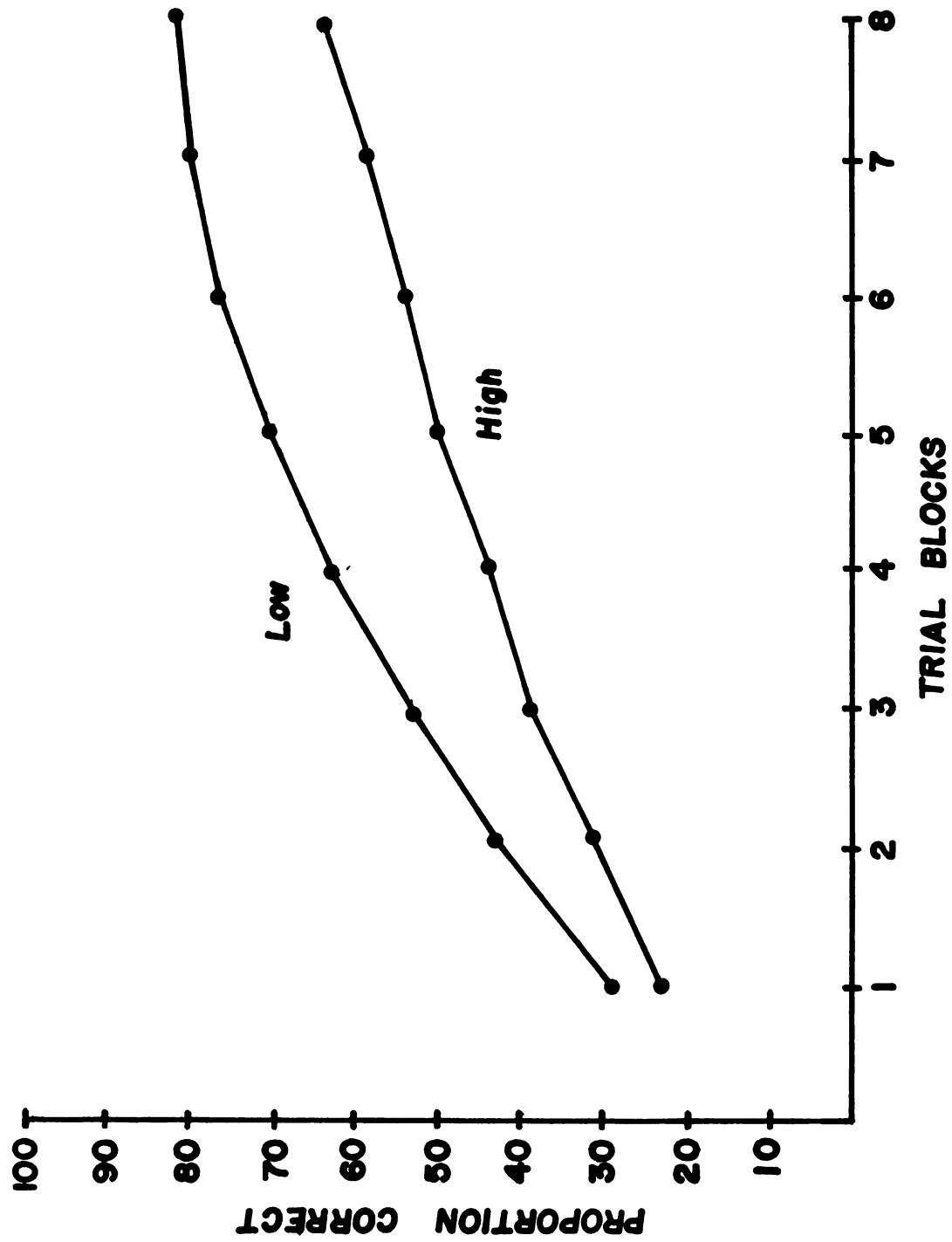


FIG. 2. MEAN PROPORTION CORRECT ON HIGH AND LOW SIMILARITY LISTS OVER BLOCKS OF THREE TRIALS

Detection Task

The number of correct detections was tabulated for each S. The mean and standard deviation of each group are given in Table 3. Performance of the High interstimulus similarity list group on the detection task is superior to performance of the Low interstimulus similarity list group, and Ss with more familiarization trials generally performed better than those with fewer familiarization trials.

Table 3. Means and Standard Deviations of Correct Responses on the Detection Task

Number of Familiarization Trials	0		20		40	
	M	SD	M	SD	M	SD
Low Interstimulus Similarity List	8.4	1.6	9.3	1.4	9.8	1.6
High Interstimulus Similarity List	10.5	1.3	11.6	1.4	11.2	0.9

The hypothesis of homogeneity of variance was tested (F-max) and it was found tenable. A factorial analysis of variance was performed with number of familiarization trials and levels of difficulty considered as treatments. Table 4 is a summary of this analysis.

The F ratios for both number of familiarization trials and level of difficulty were significant. Individual comparisons between three levels of familiarization were made. The difference between the two levels receiving familiarization (20 and 40 trials) and the no familiarization level was significant at $\alpha = .05$. The difference between the two familiarization levels was not statistically significant.

Table 4. Summary of Analysis of Variance of Correct Detections

Source	df	Mean Square	F-Ratio
Familiarization	2	14.41	9.74*
Difficulty	1	112.13	75.76*
F X D	2	2.16	1.46
Error	114	1.48	

*Significant at alpha = .01.

DISCUSSION

Paired-Associate Task

The results indicate that: 1) familiarization leads to positive transfer on the paired-associate task; and 2) increasing the amount of interstimulus similarity leads to a greater number of errors in this task. Furthermore, the significant interaction between list difficulty and stage of learning indicates that the learning rates of the two lists differed during the first part of the task.

The present study differs from the other studies of stimulus familiarization in that patterned or configurational auditory stimuli were used instead of visual material. Since auditory stimuli are not continuously present - existing in time rather than space - while visual stimuli are usually left continuously available for inspection, memory plays a greater role in learning responses to auditory stimuli than to visual stimuli. In the visual task as typically studied S need only remember which response is associated with the stimulus now present. In the auditory task he must also remember which stimulus was presented. Another characteristic of the auditory stimuli used here is that the "duration of exposure" is rather short. Both of these conditions - the need to remember the stimulus and the short duration of the stimulus - can be manipulated with visual stimuli. They have not been so manipulated in prior stimulus familiarization studies. Since the results of the present study, in the main, agree with the more recent work on stimulus familiarization, these factors are apparently of secondary importance when considering stimulus familiarization.

In at least one respect Morse Code signals may be considered analogous to verbal material: both materials contain a large number of

patterns based on a relatively small and discrete set of elements. Insofar as the task can be considered a verbal learning task, it is interesting to note that results achieved here are in accord with Gannon and Noble (1961) who found stimulus familiarization to aid later paired-associate learning, but conflict with Underwood and Schulz (1960) who did not.

So many differences in material and procedure exist between those two studies and the present one as to render detailed comparisons unprofitable. One point which might be made is that Underwood and Schulz constructed their lists to minimize interstimulus similarity while Gannon and Noble required only that their verbal material be of low meaningfulness.

The design of the present study was intended to afford a direct test of the relation between stimulus familiarity and the degree of initial stimulus similarity. Our expectation was that stimulus familiarization should be more and more beneficial as the stimuli become more similar. No support for this hypothesis was found since its confirmation required the presence of a significant interaction between list difficulty (based on estimates of stimulus similarity) and amount of familiarization. It is possible that stimulus familiarization and interstimulus similarity have independent effects on paired-associate learning at all levels of interstimulus similarity. We hypothesize, however, that procedures for further reducing the interstimulus similarity of the material would cancel the benefit of stimulus familiarization. Such alteration in stimulus similarity could be made by: 1) shortening the list; 2) reducing the rate of transmission of the signals; 3) double presentation of the signals during the paired-associate task; and 4) concurrent auditory and visual presentation.

Detection Task

Results of the detection task indicate that amount of familiarization and level of stimulus confusability in the familiarization task are significant sources of variance. The detection task was initially included in the design of the experiment to provide an alternative method of measuring the influence of stimulus familiarity in the event that no differences occurred in the paired-associate task. Since differences did occur, the results of the detection task are influenced both by the familiarization manipulation and by the nature of the paired-associate performance. This confounding of familiarization and practice effects must be kept in mind in considering the results of this phase of the experiment.

The group which was familiarized and practiced on the High interstimulus similarity list performed significantly better on the detection task than the group familiarized and practiced on the Low interstimulus similarity list. This result becomes reasonable when it is recognized that the High interstimulus similarity list groups were given prior training on the difficult discrimination in the detection task, while the Ss trained in the Low interstimulus similarity list had no such prior contact with the difficult discriminations. Thus, the detection task inadvertently became a test of hard-to-hard transfer versus easy-to-hard transfer.

Insofar as our task can be considered a perceptual identification task, the finding that familiarization facilitates detection is in accord with Arnoult (1956) but conflicts with Arnoult (1953).

Failure to obtain positive transfer in the Arnoult (1953) study may lie in the fact that his Ss could learn to discriminate during paired-associate familiarization training among the highly similar figures by attending to only one or two parts of the figure.

On the recognition test Ss were required to judge whether the entire figure was same or different. Thus, what was intended to be relevant familiarization may have been an irrelevant experience. In this connection Kurtz (1955) found negative transfer when the familiarization stimuli were distinguished by a different property than the test stimuli.

Arnoult (1956) utilized shapes such that Ss were required to attend to the entire figure during familiarization, thus positive transfer occurred.

Other factors were not controlled for in the present experiment; i. e., warm-up or learning to learn per se. Continuation of this work is intended to provide measures of such factors. However, these factors (Arnoult (1957)) appear weak since irrelevant pretraining has been of little aid in studies of stimulus familiarization.

SUMMARY AND CONCLUSION

The effects of three amounts - 0, 20, and 40 - of stimulus familiarization trials on the learning of two paired-associate lists were studied using a transfer of training paradigm. One list had high inter-stimulus similarity; the other list had low interstimulus similarity. During familiarization Ss merely listened to eight Morse Code signals which were later used as stimulus items on a paired-associate list. In the paired-associate transfer task Ss were provided with a list of eight two-digit numbers which served as responses to the Morse Code signals.

In a second transfer task (detection) Ss listened to a series of signals and judged which signals had been presented in the paired-associate task.

The hypotheses were: 1) Ss receiving no familiarization would commit more errors on both the paired-associate task and the detection task than Ss receiving familiarization; 2) performance on the paired-associate list containing low interstimulus similarity would be significantly better than performance on the list containing high interstimulus similarity.

The results supply confirmatory evidence for the above hypotheses. Facilitation of learning on the paired-associate task by stimulus familiarization was independent of the level of interstimulus similarity.

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APPENDICES

APPENDIX A

PERCENT OF INTERSTIMULUS CONFUSIONS ON LOW INTERSTIMULUS SIMILARITY LIST*

	6	Y	K	O	E	l	A	M
6		32	15	13	3	12	6	6
Y			8	20	5	23	8	11
K				28	3	5	14	16
O					5	16	7	8
E						4	5	6
l							2	7
A								24

*Mean percent interstimulus confusion = 11.04. Based on Rothkopf (1957)

COMPOSITION OF LOW INTERSTIMULUS SIMILARITY LIST

Morse Code Response	Stimulus	Paired-Associate Response
6	-.....	24
l	-----	31
Y	..--	46
E	.	57
M	--	68
O	---	79
A	.-	85
K	-.-	93

**PERCENT OF INTERSTIMULUS CONFUSIONS ON HIGH INTERSTIMULUS
SIMILARITY LIST***

	6	Y	K	O	G	B	D	C
6		32	15	13	7	77	18	30
Y			14	20	23	26	15	72
K				28	29	29	77	31
O					79	9	7	14
G						18	39	20
B							40	37
D								17

*Mean percent interstimulus confusion = 29.86. Based on Rothkopf (1957)

COMPOSITION OF HIGH INTERSTIMULUS SIMILARITY LIST

Morse Code Response	Stimulus	Paired-Associate Response
6	-.....	24
G	--.	31
Y	..--	46
D	-..	57
B		68
O	---	79
C	-.-.	85
K	.-.	93

APPENDIX B -- INSTRUCTIONS

Familiarization Task

You will hear eight different Morse Code signals. After a list of eight there will be a brief pause, and then the person on the tape will say "Ready." A second list of the same eight signals will follow, but in a different order. Your job in this first part of the experiment is to listen to these signals and to try to learn them so that you can tell them apart from one another. This is a fairly difficult task and you will have to pay close attention in order to accomplish it. We have found that the best way to remember and distinguish these signals is to develop some sort of memory device or code such as dot-dash, dit-dah, long-short, short-long, or perhaps you can count the longs and shorts in the signals. I will now play these signals for you. Try to distinguish and remember these signals.

Paired-Associate Task

Now you are going to hear some Morse Code signals (the same ones you heard before) and each signal has a number which goes with it. Your job is to learn which number goes with each signal. We shall proceed this way. A signal will be sounded. Then there will be a brief pause. The same signal will be sounded and the number that goes with it will be announced. Then there will be a slight pause and we will go on to the next signal. There are eight signals in each group. After the eighth signal there will be a very short rest, then the person on the tape will say "Ready" and the signals will start again. The signals will be the same but in a different order. Write what you think is the correct number during the pause between the first and second sounding of the same signal. After you have written the number down, listen carefully

to the signal and the number announced. If the number you have written is correct, that is, if it is the same one announced, put a check next to it. If it is wrong, put an X next to it. Put a dash if you happen to leave a blank. After you have filled in the first eight, proceed to the next group immediately to the right. (At this point, the tester demonstrates the order on the response sheet.) When the top row is filled, go to the bottom row. Now we will listen to the first list of eight signals. During this first list I will indicate when you should be writing your answers in and when you should be checking them. Remember: your job is to learn which signals are associated with which numbers. Do not write in the answer after it is announced.

Detection Task

On the other side of your paper, list a column of numbers from one to twenty. Now you are going to hear some more signals. Your job is to determine whether or not each signal is one of those that you have just listened to. The person on the tape will announce the question number and a signal will sound. If you think it is one of those you have just heard, put a check; if it is not, put an X. Now, these come very quickly, so you will have to stay alert.