NONSPECIFIC TRANSFER EFFECTS IN ASSOCIATIVE MATCHING

A Thesis

Presented to

the Faculty of the Department of Psychology

University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

---

by

Ya-li Lo

August, 1969

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ABSTRACT

This experiment was designed to study the learning to learn effect specific to a matching task. The lists were composed of three-digit numbers as the stimuli and CVC trigrams as the responses. The warm-up effect was assessed with a trial of study-matching test on a list of figure-word pairs. Five experimental groups and one control group were used. The Ss in the experimental groups received either three, six, or nine trials of practice on one training list, or received six or nine trials of practice, three on each of two or three training lists respectively. Except for the group given three trials on each of two lists, the results showed that the learning to learn effects increase as the function of amount of practice regardless of the number of different lists on which these trials of practice were given. Groups given nine trials performed the best and the group given three trials the worst, with the one given six trials in between. The pretrained groups showed the significant advantages of training by the same method on the learning of transfer list. Nevertheless, their divergencies were not present until the late trials of acquisition. One possible explanation was based on the assumption that the learning to learn is subject to interference, forgetting, and recovery, and also that there was interference resulting from a specific stimulus encoding device possibly used by some Ss to learn the training list.

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Chapter I

INTRODUCTION

Transfer of Training

The experience of rote learning tasks will be carried over by the person to the subsequent tasks and influence the efficiency of his learning. Most of the studies of transfer of training have been done with transfer between paired-associate learning tasks or between paired-associate learning and serial learning. Little transfer effect has been found with free recall studies (Murdock 1960, 1962). The influencing effect of the first task on the second is attributed to both specific transfer and nonspecific transfer. The transfer effect is specific when the stimuli and/or responses in the two tasks are related in similarity. Without any particular similarity relationship between the items, the transfer effect is general or nonspecific. The nonspecific practice effect develops in every transfer situation. It is usually positive so that in order to evaluate the positive or negative specific transfer effects, the performance of a control group learning an unrelated list in the training period should be available as a baseline.

Specific Transfer

The specific transfer might be positive or negative in different transfer paradigms. Many studies have been done trying to link the magnitude and direction of transfer results to the similarity relations between the stimuli and responses of the two lists. Osgood (1949), in an attempt to organize the facts found in this area, devised a transfer and retroaction surface. Osgood believed that retroaction and transfer should follow the same law. In his three dimensional diagram, degree of transfer varies as the function of the stimulus similarity and response similarity. The range of the stimulus similarity goes from 'identical' through 'similar' to 'neutral' and that of response similarity goes from 'similar' through 'neutral' to 'opposite.' There have been arguments about the response "opposition" relationship. Some studies (Bastian, 1961; Richardson, 1968) suggested taking the associative relatedness as the axes instead of similarity in meaning. Besides this argument, there are still some discrepancies of observed facts from what will be predicted from the surface. Martin (1965) accounted for these discrepancies by adding two experimentally controllable variables, namely, L_1 (degree of first list learning) and M (response meaningfulness). His transfer theory was based upon the two stages conceptualization (Underwood & Schulz, 1960) and the notion of associative bidirectionality. According to the theory, there are three component transfer effects in each transfer condition. They are transfer of response learning, the transfer of forward association, and the transfer of backward association. The transfer effect in each paradigm is the net effect of these three. Since high degree of first list learning and response meaningfulness will put the emphasis upon the formation of associations and since these associations will interfere with the association formation of the second task, higher L_1 or M will result in the decrease of positive transfer and the increase of negative transfer. Some paradigms appear as the key points on the transfer surface so that they have been adopted in almost all the studies. Among them are the A-B, A-D (old stimuli and new responses); A-B, C-B (new stimuli and old responses); A-B, A-B_r (old stimuli and responses repaired). The effect of L_1 and M in these paradigms can be seen in the studies of Postman (1962b) and Merikle & Battig (1963) respectively. The factor of stimulus-M was not considered that time since its effect was small and unclear. Martin in his recent article (1968) discussed the role of stimuli-M with the encoding variability hypothesis. According to this hypothesis there are more variable ways to encode a low M stimulus and less to encode a high M stimulus. In a negative transfer situation, the second list is composed of new associations to the old stimuli. If the stimulus M is low, the Ss can attain the second list by recoding the stimulus, but they have to unlearn the old ones if the stimulus M is high. It has been suggested that when response learning is equated, stimulus M will exercise a powerful influence on learning, but little evidence has been found to support it (Epstein 1963).

Nonspecific Transfer

(A) Warm-up and Learning to Learn

There has always been difficulty in distinguishing the two types of nonspecific transfer since they both develop as the result of practice. The warm-up is usually defined as the physical adaptation or postural adjustment to the rhythms of the experimental procedures, while the learning to learn is the learning of some instrumental habits or skills to learn a somewhat similar kind of task. The conventional distinction made between them is based upon their temporal persistence.

It is assumed that, the warm-up will develop and dissipate more quickly with time while the learning to learn will be more enduring. As one can easily see, this temporal distinction is so uncertain and indefinite that it is still a problem for persons who want to investigate the learning to learn effect. Thune (1951) had his Ss learn three lists on each of the five days. The warm-up effect was supposed to take place largely within each session and to be lost during the 24 hours of rest. Meanwhile, the learning to learn was assumed to endure between sessions. With these assumptions, he concluded that the warm-up gain was consistently larger than the general practice effect.

This empirical distinction was questioned (Postman & Schwartz, 1964; Schwenn & Postman, 1967) by proposing that the learning to learn might be interfered with and forgotten, and also warm-up might be conditioned to the experimental condition. Little has been known about how and how much warm-up and learning to learn develop and decline. Schwenn and Postman in 1967, instead of using temporal distinction, gave another comparison of the warm-up and learning to learn. The warm-up task was a number-guessing task which was similar to the paired-associate task but provided no specific practice. With either 4 or 10 training trials on an unrelated list of paired-associates or on a number-guessing task, the speed of acquisition increased with the number of training trials, and the learning to learn task provided more advantage than the warm-up task did. As this study suggested, the learning to learn can occur with only a few trials of training on an unrelated list.

(B) Transfer Between Paired-Associate Learning and Serial Learning

When the S-R elements are common to both, some small amount of transfer has been found from serial learning to paired-associate learning and a large amount from paired-associate learning to serial learning. Jensen (1962) found some significant transfer effects between these two kinds of task. He considered them involving different processes or strategies. The Ss were prone to carry over their old way of learning to the second list and the transfer effects were resulting from this "maintaining" of learning set into the second task. Less transfer effect will be obtained if the situation is designed in the way to keep the Ss from maintaining it. However, when the paired-associate list consisted of nonadjacent members of the serial list, negative instead of positive transfer was obtained (Postman & Stark 1967) from serial to paired-associate learning.

(C) Nonspecific Transfer in Various Specific Transfer Paradigms

Learning to learn is general to all different kinds of paradigms, but its effectiveness will vary with the nature of paradigms. In the study of Postman (1964b), each S learned three sets of two lists conforming to one of four paradigms, viz., A-B, A-B'; A-B, A-C; A-B, A-B_r; and A-B, C-D. He found that, as a function of practice, the positive transfer increased whereas the negative transfer decreased. The increases in positive transfer are more pronounced than the decrease in negative transfer. Keppel & Postman (1966) further extended this study to provide evidence that the effect is independent of the paradigms used in training.

(D) Learning to Learn May Occur in the Associative Stage

The underlying processes responsible for the learning to learn has not been determined or discovered. In Postman and Schwartz's study (1964), three components of interlist practice effects were distinguished:

(1) transfer specific to the method of practice,

(2) transfer specific to the class of materials, and

(3) the situational transfer.

He found that the first one is more pronounced than the second. The most important thing for the present study is that the analysis of the course of acquisition of the paired-associate learning suggested that the practice effect occurred primarily in the associative stage. In their study, the response-recall stage was taken as the trial of first occurrence of response anywhere in the list and the associative stage is taken as the trials between first occurrence and first correct placement of responses. The first measure did not show the difference between the pretrained groups. However, when the second measure was considered, the groups trained by the paired-associate method had a clearly shorter (or no) associative stage than the groups trained by the serial method. It seems that the Ss will perform better on the learning of transfer list if he acquires the specific skills of forming stable associative links between the members of a pair in the learning of training list. In other words, these instrumental skills might be the bases of learning to learn.

Originating from this assumption, we designed our present experiment. Instead of the anticipation method usually used in the paired-associate learning, we gave the Ss a matching task. Since the responses as well as the stimuli are presented for the Ss in the matching test, it required only that the Ss form associations. We should be able to attain a large amount of learning to learn effect on the matching task.

Ss in this experiment were given three, six or nine training trials. Those who received six or nine trials may experience two or three different training lists, for we questioned whether Ss trained on more different lists of the same type of work will perform better than those trained on only one list with the same number of trials.

Chapter II

METHOD

Experimental Design

In this experiment, there were five experimental groups and a control group. Four unrelated lists were employed. They were referred to as list A, list B, list C, and list D. The last one was used as a test or transfer list to be learned by every S. The first three were used as training lists. Within each of the experimental groups, there are three subgroups learning different training lists or the same lists in different sequences of order. Figure 1 is shown for the convenience of description.

The control group "G(0)" received no training before learning the test list except that preliminary task which was commonly given to all the Ss as a warm-up task. This warm-up task was one trial of a matching task with a paired-associate list which was composed of figures and words. It would provide no specific practice to Ss since its materials were different from the four main lists.

There is something particular about G(3,3) and G(3,3,3) that should be mentioned. There are three different sequential orders, because there was concern that some particular sequence of learning of the lists might have a unique effect. We assume that the sequence effect, if any, has been controlled by having each of the lists appear once in each sequential position.

Figure 1

Experimental Design

Groups	Subgroups	1st-3rd trial	4th-6th trial	7th-9th trial
G(9)	1	A	A	A
	2	B	B	B
	3	C	C	C
G(6)	1	A	A	
	2	B	B	
	3	C	C	
G(3)	1	A		
	2	B		
	3	C		
G(3,3,3)	1	A	B	C
	2	B	C	A
	3	C	A	B
G(3,3)	1	A	B	
	2	B	C	
	3	C	A	
G(0)				

Lists

A preliminary list was made up of ten pairs of a simple figure and a word (the name of the figure).

For the experimental lists, 40 CVC (consonant-vowel-consonant) trigrams were obtained from Archer's Table (1960), the meaningfulness values ranging from 50 to 55. These trigrams served as responses and were paired with 40 three-digit numbers serving as stimuli to generate the four unrelated lists we have mentioned as A, B, C, D. No combination of digits was repeated within lists and between lists. With this restriction, the 3-digit numbers were found randomly. No first letter of the trigrams was duplicated within one list. The average values of meaningfulness of CVC trigrams were determined for these four lists. They were 51.8, 52.8, 51.7, and 52.6 for list A, list B, list C, and list D respectively.

Procedure

The Ss were given in the very beginning the standard instructions of the experiment. Then the preliminary list was given to every S as a warm-up and a check of total understanding of the instructions.

The preliminary list as well as all the training and test lists were presented on a Memory Drum with a 2 seconds per pair rate. There were three random orders of presentation for each list. As soon as the whole list had been presented, the Ss would be tested with a matching test. On the sheets of matching test, the stimuli were printed in random sequence along the left side. The responses were printed along the bottom. The order of the response list differed randomly for each trial. A digit (1-10) was then assigned to each response and was placed beside it. Ss were instructed to put the sequential digit of that response by the stimulus which he thought was paired with the response in the list. The time permitted for each matching test was one minute. After the matching test was completed, the list was presented to the Ss again in a different order.

Ss were assigned to experimental conditions on the basis of order of arrival at the laboratory and given the study-matching trials according to the group to which he had been assigned. After the last matching test of the training task, there was a rest period of 2 min. 30 sec. during which time E changed the tape on the Memory Drum. The Ss and the E were allowed to talk during this period. The transfer task was carried through with the same procedure. In the groups G(3,3), and G(3,3,3), Ss were informed of the change of new lists.

Subjects

92 students taking the elementary psychology 133 in the University of Houston were employed as Ss. They served in this experiment to satisfy a course requirement.

Chapter III

RESULTS

Criterion of Learning

The theoretically probable number of correct matchings by guessing would be 10*(1/10) each trial since there were 10 paired associates in one list. The Ss were considered failing to learn if his number of correct matchings on nine trials on the test list was 9 or less. Under this consideration, two Ss were discarded because of failure to learn, and they were replaced by two new Ss drawn from the remaining subject pool randomly.

Training List Learning

The groups could be compared only on the first three matching tests of the training task. The mean numbers of correct matchings were 5.87, 5.47, 5.87, 5.8, 6.53, and 5.8 for G(0), G(3), G(6), G(9), G(3,3), and G(3,3,3) respectively. The Ss in the six groups did not differ significantly in their performance on the first three trials of practice.

Performances of G(3), G(6), and G(9)

Figure 2 shows the performances of G(3), G(6), and G(9) on the training list. The Ss in G(6) learned faster than those in G(9). When their numbers of correct matchings on the first six trials were compared, a significant difference was found [$t(28)=2.67$] at the .05 level. This was not expected since Ss were assigned randomly to these groups.

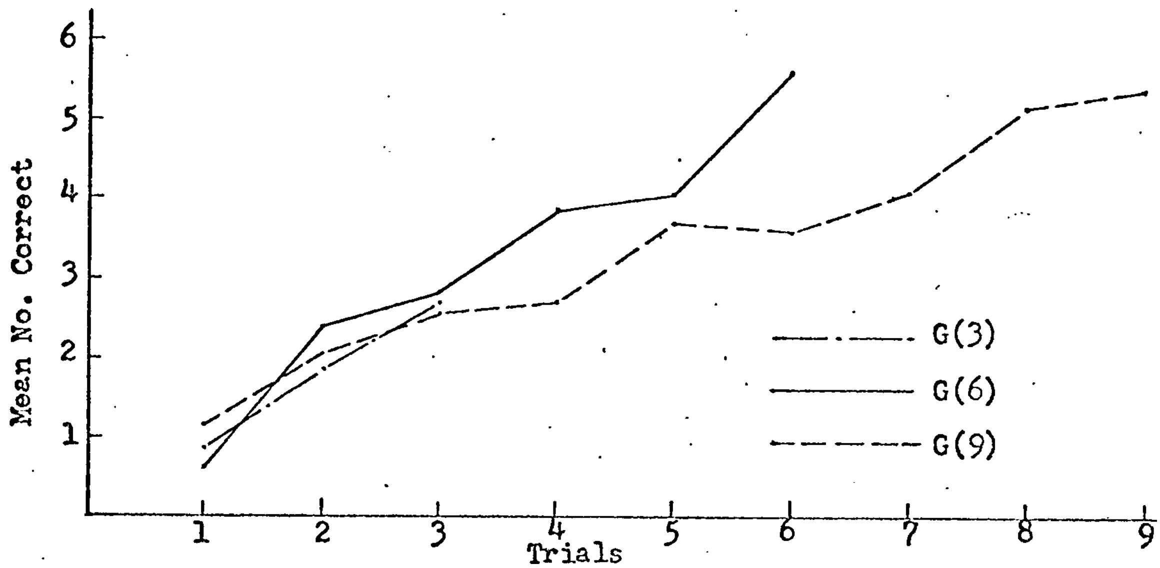

Fig. 2. Acquisition Curves of the Training List for G(3), G(6), and G(9)

Performances of G(3,3) and G(3,3,3)

Figure 3 shows the mean numbers of correct matchings each trial on the successive training lists of G(3,3) and G(3,3,3). There were clear and steady improvements of these two groups over the training lists. The mean numbers of correct matchings on the corresponding trials increased from the first list to the second for G(3,3) and G(3,3,3), and also increased from the second to the third for G(3,3,3).

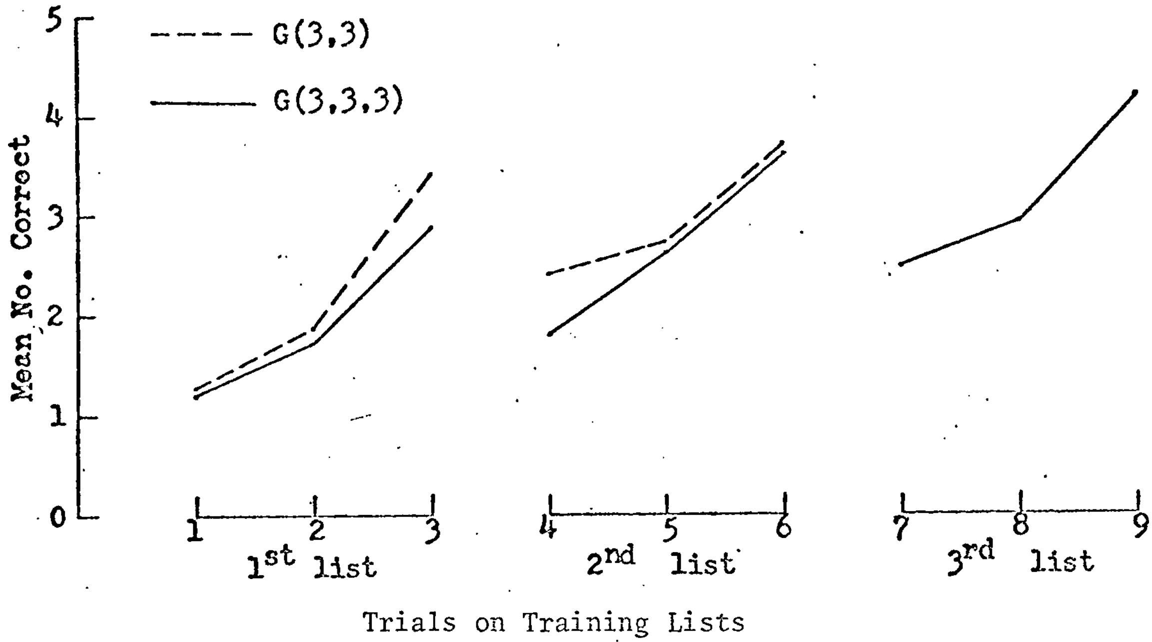

Fig. 3. Acquisition Curves of the Training Lists for G(3,3) and G(3,3,3)

Transfer List Learning

Learning of Subgroups

Since there were three subgroups learning different training lists or the same training lists in different sequential orders within each pretrained group, we should first examine, before comparing the performances of these groups, the effect, if any, specific to the training lists or sequential orders of lists occurred. This was done with the analysis of variance of the mean numbers of correct matchings on the transfer list for each pretrained group. All the results show no significant differences between three subgroups ($F<1$ in all cases) and no significant interaction between trials and the lists, while the differences between subjects and between trials are significant. In other words, the training lists A, B, C were equivalent to each other and the sequences of them did not cause any differences on the learning of the transfer list. The subgroups were then combined across lists and the performances of fifteen Ss were averaged to generate the results of each group. In Figure 4, the average number of correct matchings for each trial on the transfer list was plotted for each group.

Early Transfer

The early transfer effects were assessed with the mean numbers of correct matchings on the first three trials of the transfer task. Since the groups were compared previously and found not different from one another on the first three trials of training, the groups were again compared on the first three trials on the transfer task. The analysis of variance shows a significant effect of pretraining. The over-all F is 2.62 and is significant at the .05 level.

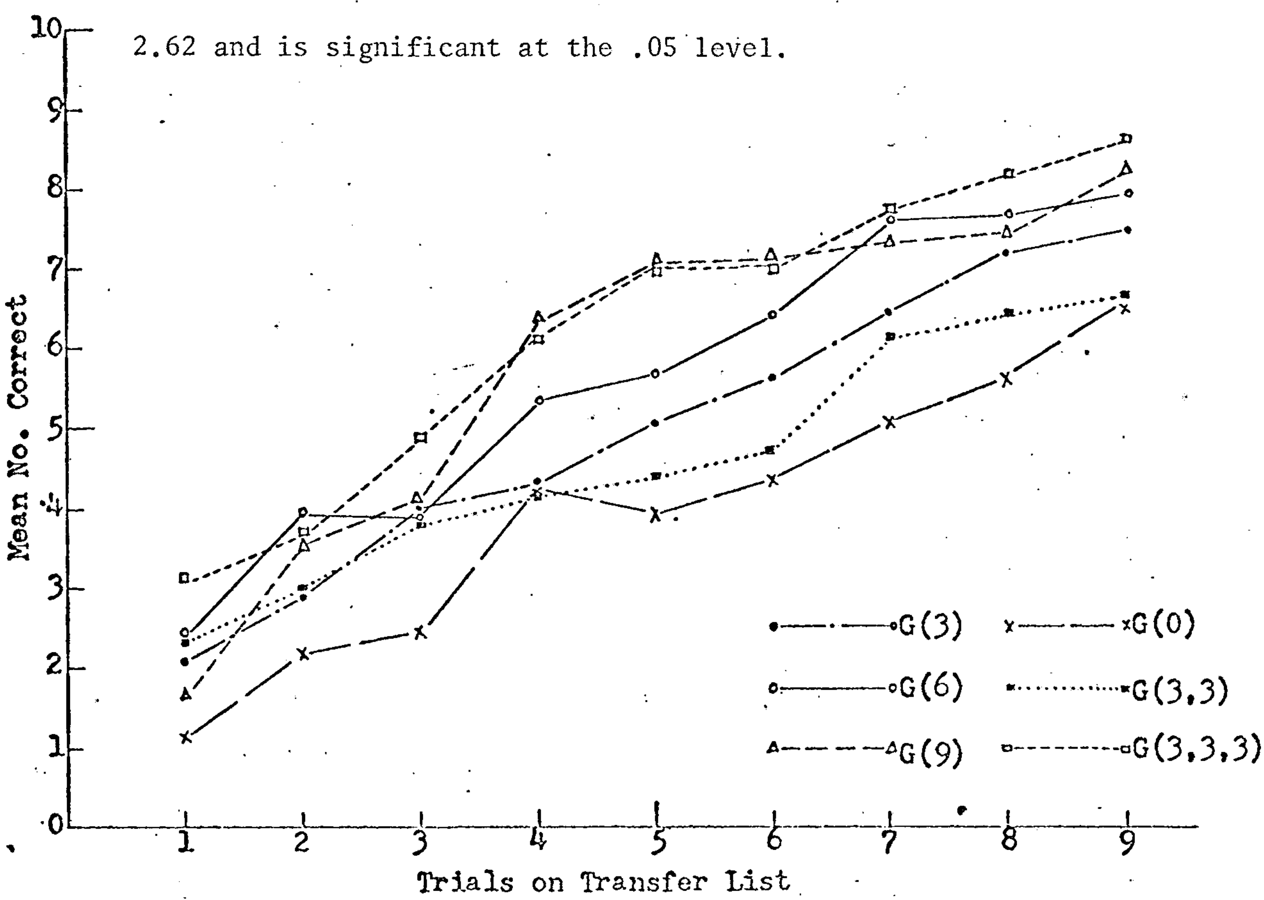

Fig. 4. Acquisition Curves of the Transfer List for All Groups

Table I

Differences Among the Means of the Number of Correct Matchings on the First Three Trials of the Transfer List

	G(0)	G(3)	G(3,3)	G(9)	G(6)	G(3,3,3)
G(0) = 5.87		3.06*	3.20*	3.46**	4.26**	5.80**
G(3) = 8.93			0.14	0.40	1.20	2.74
G(3,3) = 9.07				0.26	1.06	2.60
G(9) = 9.33					0.80	2.34
G(6) = 10.13						1.54
G(3,3,3) = 11.67						

**p < 0.01
*p < 0.05

For the purpose of keeping the error rate controlled experimentwise, Tukey's HSD Test (Kirk, 1968) was used to do the multiple comparisons between means of the six groups. Table 1 indicates that all the pretrained groups performed better than the control group. They were significantly different from the latter though no difference was found between any two of them.

<u>Correct Matchings on the Transfer List</u>

The same procedure of statistical analysis was carried out on the performances of the six groups on all nine trials of transfer list learning. The analysis of variance shows an over-all significant difference between groups [$F(5,84)=3.23$]at the .05 level. These six means, listed in order of size, are given in Table 2. As shown in the table, nine pairwise comparisons exceed the critical value of Tukey's HSD at the .01 level. The performances of the pretrained groups showed the divergence rather late in the acquisition of transfer list associations.

The performance of G(3,3,3) was significantly superior to those of any other group except G(9). The most unusual finding was that G(3,3) did the poorest of the pretrained groups. It performed better than the control group though the difference between them was not significant.

Table 2

Differences Among the Means of the Number of Correct Matchings on the Nine Trials of the Transfer List

	G(0)	G(3,3)	G(3)	G(6)	G(9)	G(3,3,3)
G(0) = 35.7		5.7	9.3**	14.77**	17.03**	20.63**
G(3,3) = 41.4			3.6	9.7**	11.33**	14.93**
G(3) = 45.0				5.47	7.73**	11.33**
G(6) = 50.47					2.26	5.86
G(9) = 52.73						3.60
G(3,3,3) = 56.33						

** $p < 0.01$
* $p < 0.05$

Chapter IV

DISCUSSION

A large amount of nonspecific transfer effects appeared on the acquisition of the transfer list. Even in the early stage, the pretrained groups performed far better than the control group.

The differential effects of the pretraining conditions did not appear in the early stage of transfer list learning. Instead, their divergencies appear in the later trials of acquisition of the transfer list.

As one might expect, the more practice one has on the training list, the better one should perform on the test list. When we take the results of the groups given three, six, and nine trials on one list of training into consideration, our results give support to this point, although the difference between G(9) and G(6) was not significant.

The Ss in G(6) learned faster than those in G(9) the training list, while the direction is reversed on the learning of the test list. Since we have, possibly, faster learners in G(6) than in G(9), the fact that G(9) was not significantly different from G(6) is possibly due to a learning superiority in G(6).

The group G(3,3,3) which was given three trials on each of three different lists performed the best of all the groups except G(9). It seems that the amount of learning to learn is a negatively accelerated positive function of the number of trials of previous experience, regardless of whether they are given on one list or several different lists.

There are at least two factors that might have caused the late divergence of the curves for the experimental groups:

1. The learning to learn effect having received interference and having been forgotten during the interlist interval, recovers with time.

2. Some Ss encode the stimulus as the first digit number and associate it with the response. This has been found by inquiring the Ss after the experiment of the method they were using to learn the lists. This is an example of "stimulus selection" that has been shown (Underwood, 1963) to operate in a wide number of learning paradigms. This kind of encoding may be a most efficient way to learn the list if it were not for the fact that there are repeated first digit numbers within and between lists. There are interfering forward associations as in the A-B, A-D paradigm. The first digit numbers used to be associated with old CVC trigrams in the training list are now associated with the new trigrams in the transfer list. In other words, these Ss have to unlearn the old associations.

With these two antagonistic effects, e.g., the learning to learn and the interference working contemporarily together, the facts we have found in this experiment suggest the following hypothesis.

The more practice one S has received, the larger the amount of learning to learn effect should be obtained. The learning to learn manifests itself by counteracting and overriding the interference effect. In addition, we assume that interfering associates from the training lists are unlearned during the transfer list learning. The experimental groups, having learned from previous training the special skills to chain the stimulus and response members of a pair, performed better than the control group (one which received no training before the learning of the transfer list). However, they are in the meanwhile possibly affected by the interference due to previous associations. We do not know the exact relative contributions of these two effects in the various conditions. It seems that from the present results, we can infer that the interference due to additional trials of training almost counterbalanced the learning to learn from additional trials of training in the early period of transfer list learning. Thus, the advantages of larger amounts of training did not show up to make the experimental groups diverge in the early transfer period. It apparently takes 3-4 trials for these two counteracting effects to diverge in the learning of transfer list. The Ss become better at differentiating the new associates from the old ones. The interfering effects decreased and let the learning to learn dominate so that the experimental groups started to diverge.

It is possible that we had more Ss using the first digit number to encode the stimulus in G(3,3) than we did in other groups. The largest amount of interfering associations caused the worst performance of G(3,3). However, no definitive evidence exists for this reference.

It is suggested that further work can be done to investigate the learning to learn with the adoption of different materials of stimuli in the transfer list. Thus, controlling the specific interference effect to its minimum, the learning to learn effect will become clearer.

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