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PAIRED-ASSOCIATE TRANSFER AS A FUNCTION OF INTERTASK INTERVAL, PARADIGM OF TRANSFER AND DEGREE OF TASK-1 LEARNING

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AND DEGREE OF TASK-1 LEARNING

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SUMMARY

The present experiment investigated the following hypotheses: (a) Specific transfer in the A-B:C-B and the A-B:A-D paradigms will decrease as the length of the intertask interval is increased in a paired-associate transfer situation; and (b) specific transfer will be less affected by variations in the length of the intertask interval as the degree of Task-1 learning is increased. From a list of Consonant-Vowel-Consonant trigram pairs scaled for associability, low associability pairs were selected to construct paired-associate lists which conformed to the A-B:C-B, the A-B:A-D, and the A-B:C-D transfer paradigms. For each paradigm, Task-1 training was continued until either a 50 percent or a 100 percent correct criterion was reached, and Task-2 was learned after an elapsed time of either 1 minute, 24 hours, or 72 hours to a 100 percent correct criterion. Following Task-2 training all Ss (N = 180) completed a Modified Modified Free Recall Test in order to determine the "fate" of Task-1 forward or backward associations after Task-2 learning.

Due to the fact that specific transfer in the A-B:C-B and the A-B:A-D paradigms was zero in the 1 minute conditions at the termination of Task-2 training, it was not possible to draw any conclusions about the effect of intertask interval on specific transfer in these paradigms. Furthermore, it was not possible to draw any conclusions about the hypothesized effect of degree of Task-1 learning on intertask interval since the two degrees of Task-1 learning investigated did not differentially affect the acquisition of Task-2 in any transfer condition. Suggestions

were made for redesigning the present experiment so that it would be possible to test hypotheses (a) and (b).

CHAPTER I

INTRODUCTION

The Transfer of Verbal Paired-Associates

"Transfer of training is a concept that represents the net or overall effects of performance or experience with one type of task on performance with some subsequent task (Ellis, 1969, p. 381)." In the area of verbal learning, transfer of training is typically studied in paired-associate transfer situations. Transfer in these situations is inferred from the comparative performance of two groups, an experimental group and a control group. The experimental group receives training on two related paired-associate tasks, Task-1 and Task-2, in succession. The control group receives training on Task-2 which may be preceded by either "rest", i.e., experimentally unrelated activity, or training on a paired-associate task which is unrelated to Task-2. The nature of the treatment which the control group receives prior to Task-2 training will depend upon the theoretical interests of E and the kind of inferences E wishes to draw concerning the basis for any observed transfer or lack of transfer.

If the experimental group's performance on Task-2 is superior to the control group's performance on the same task, then it is inferred that positive transfer has occurred. On the other hand, if the experimental group's performance on Task-2 is inferior to that of the control group on Task-2, then it is inferred that negative transfer has occurred. If the performance of the experimental and the control group on Task-2 is not different, it is inferred that the transfer from Task-1 to Task-2 is zero. It is assumed that the experimental and the control groups are equivalent with respect to any factors that may be important in the acquisition of the experimental tasks.

The transfer of verbal paired-associates may be based on several factors. For example, transfer may be a result of the operation of general practice variables such as warm-up and learning-to-learn, or it may be the result of specific task related variables such as the degree of intertask stimulus similarity or the degree of intertask response similarity. Thus in any paired-associate transfer situation observed transfer may be the result of the operation of general factors alone or the operation of both general and specific factors together. Therefore, when _E_ is interested in investigating specific paired-associate transfer it is always necessary for him to use a control group that receives practice on an unrelated paired-associate task prior to Task-2 training. The two-task control group's performance on Task-2 provides a baseline against which the experimental group's performance on Task-2 can be compared to determine the amount and the direction of specific transfer.

General Paired-Associate Transfer

Warm-Up

Hamilton (1950) and Thune (1951) have shown that the acquisition of a verbal paired-associate task can be facilitated by an immediately preceding paired-associate activity when the two tasks are unrelated and that this facilitation is a transitory phenomenon. This general transfer effect is referred to as warm-up and is interpreted to be the result of postural and "attentive" adjustments acquired from practice with Task-1 which transfer to Task-2.

Learning-to-Learn

This general transfer effect is defined as the progressive improvement in performance on a set of unrelated tasks of the same general class which occurs as a consequence of practice on these tasks. This improvement is generally reflected in an increased acquisition rate on the successive tasks. A study by Thune (1951) provides an example of this phenomenon for paired-associate tasks. Thune had Ss learn three unrelated paired-associate lists on each of five successive days. The lists were not differentially difficult and were presented to different Ss in different orders. Performance on these tasks improved with each successive list within any given day and performance on the first list of each day showed an improvement over time. That is, as the Ss received more and more experience with tasks of the same class, the acquisition of these tasks became less and less difficult for them. The usual interpretation given to the learning-to-learn effect is that Ss in learning successive tasks which are unrelated but are of the same class acquire general methods of attack and establish "sets" which are appropriate for the acquisition of the experimental tasks.

Specific Paired-Associate Transfer

It was indicated above that paired-associate transfer may be a function not only of general factors but also of specific factors. The literature of paired-associate transfer suggests that the two most important task related variables involved in specific paired-associate transfer are the degree of intertask stimulus similarity and the degree of intertask response similarity (Ellis, 1969; Jung, 1968; Martin, 1965). In fact variations in the degree of intertask stimulus and/or intertask response similarity serve to define the basic transfer paradigms investigated in paired-associate transfer of training.

For example, if both the degree of intertask stimulus similarity and the degree of intertask response similarity are minimal, the A-B:C-D (C-D) transfer paradigm is defined. In this situation Ss must learn to make a new response to a new stimulus during Task-2 training. Under these conditions any observed transfer must logically be based on general factors alone since the two experimental tasks are minimally similar to each other. Thus, the C-D paradigm is the appropriate control for nonspecific transfer effects in experimental situations where E is interested in the assessment of specific transfer.

Another basic paradigm used in the study of paired-associate transfer is the A-B:C-B (C-B) transfer paradigm. This paradigm is obtained when the degree of intertask stimulus similarity is minimal and the degree of intertask response similarity is maximal. In this situation Ss must learn to make an old response to a new stimulus during Task-2 training. Specific transfer in this paradigm is usually either slightly positive or slightly negative.

Finally there is the A-B:A-D (A-D) transfer paradigm which describes the situation where intertask stimulus similarity is maximal and intertask response similarity is minimal. Under these conditions Ss must learn to make a new response to an old stimulus during Task-2 training. Specific transfer in this paradigm is typically negative.

Martin (1965) has recently summarized the major findings concerning the specific transfer of verbal paired-associates and has organized these results into a theoretical framework. Basic to his analysis was the assumption that paired-associate learning is a two stage process. For a given pair within a paired-associate list Ss first learn the response term as a response; i.e., they engage in response learning. During the second stage Ss associate the stimulus term with the response term; i.e., they engage in forward and/or backward association learning. Experimental evidence supporting this conceptualization of paired-associate acquisition has been reported by Underwood, Runquist, and Schulz (1959) and the Underwood and Schulz (1960). These factors led Martin to conclude that at the termination of Task-1 learning in a paired-associate transfer situation there are at least three specific Task-1 effects available for transfer to Task-2 (response learning, forward association learning, and backward association learning); and it is some combination of these Task-1 components which transfer and affect Task-2 performance. Martin (1965) also demonstrated that the transfer of these components appears to be greatly dependent upon the degree of Task-1 learning and the degree of Task-1 response meaningfulness.

From Martin's component analysis of paired-associate transfer it is reasonably clear that specific transfer in the C-B paradigm is the net resultant of positive response learning effects and negative backward association learning effects acquired during Task-1 training. Task-1 response learning should facilitate the acquisition of Task-2 in this paradigm since the responses in the two tasks are the same. However, Task-1 backward association learning should inhibit the acquisition of Task-2 since the Task-1 backward associations if they are elicited during Task-2 training would tend to interfere with the learning of Task-2 backward associations. Since Task-2 involves new stimuli which are minimally related to the Task-1 stimuli, Task-1 forward association learning should not be a factor in Task-2 acquisition. Thus, specific transfer in the C-B paradigm will depend upon the availability of Task-1 response learning and Task-1 backward association learning at the time Task-2 training is begun and the magnitude of these effects relative to each other. If response learning effects only are present during Task-2 training, specific transfer in the C-B paradigm should be positive during the response learning phase of Task-2 training and zero during the association learning phase of this training. If both response learning and backward association learning effects are present during Task-2 training, specific transfer in the C-B paradigm should be positive during the Task-2 response learning phase and negative during the association learning phase of this training. These predictions are based on the assumption that Task-2 acquisition is a two stage process with response learning occurring first followed by association learning.

Specific transfer in the A-D paradigm Martin suggests is based solely on the transfer of Task-1 forward association learning and its subsequent interference with Task-2 forward association learning. Since the Task-1 and Task-2 responses in this paradigm are minimally similar, Task-1 response learning and Task-1 backward association learning should not be factors in Task-2 acquisition in the A-D paradigm. Thus, specific transfer in this paradigm should always tend to be negative. The extent to which it is negative will depend upon the availability of the Task-1 forward association learning at the time Task-2 training is begun and the magnitude of this effect at that time. If few Task-1 forward associations are available for transfer at the beginning of Task-2 training, specific transfer in the A-D paradigm will be only slightly negative or possibly even zero. If many of these Task-1 forward association learning effects are available for transfer at the beginning of Task-2 training, then specific transfer in the A-D paradigm will be very negative. Furthermore, specific transfer in this paradigm should be zero during the early phases of Task-2 training when response learning is occurring and negative during the latter phases of Task-2 training when association learning is occurring.

Finally, the lack of any specific transfer in the C-D paradigm appears to be based on the fact that both the stimuli and the responses of Task-2 are minimally related to those of Task-1. As a consequence, neither Task-1 response learning effects, nor Task-1 forward and backward association learning effects should transfer to Task-2 in this paradigm. Thus, any transfer in C-D paradigm must be based on general factors. Therefore, the C-D paradigm is the appropriate one to use for assessment of non-specific transfer in experimental situations where E is interested in the effects of certain variables on specific transfer.

It was discussed above that whether or not specific transfer in the C-B paradigm is positive or negative and whether or not specific transfer in the A-D paradigm is slightly negative or very negative depends upon the availability of the Task-1 transfer components at the beginning of Task-2 acquisition. Martin's analysis of paired-associate transfer (1965) suggests that the availability of these components at the beginning of Task-2 training is primarily a function of the degree of Task-1 learning and/or the degree of Task-1 response meaningfulness.

As either degree of Task-1 learning and/or degree of Task-1 response meaningfulness is increased, specific transfer in the C-B paradigm becomes less positive, zero, and then negative (Bruce 1933; Jung, 1962; Jung, 1963; Dean & Kausler, 1964; Postman, 1962). Specific transfer in the A-D paradigm becomes more and more negative under conditions of increasing Task-1 learning and/or increasing Task-1 response meaningfulness (Bruce, 1933; Jung, 1962; Jung, 1963; Merikle & Battig, 1963; Postman, 1962; Spiker, 1960). Martin suggested that these results occur because under the conditions of increasing Task-1 learning and/or increasing Task-1 response meaningfulness Ss are able to engage in more association learning in the C-B and the A-D paraeigms. As more of the Task-1 components which interfere with Task-2 acquisition are acquired in these paradigms, specific transfer in the C-B paradigm should become less positive and then negative while specific transfer in the A-D paradigm should become more negative.

Martin's analysis of paired-associate transfer therefore suggests that the major findings of research in this area are explainable in terms of a component model of transfer which includes the variables of intertask stimulus similarity, intertask response similarity, degree of Task-1 learning, and degree of Task-1 response meaningfulness. However, his model is not necessarily the last word since there are other variables whose effects on specific paired-associate transfer have not been investigated to any great extent. For example little systematic research has attempted to determine the effect of intertask interval on paired-associate transfer. Although the effect of intertask interval in the C-D and the C-B transfer paradigms has been investigated (Bunch &

McCraven, 1938; Ellis & Burnstein, 1960; Ellis & Hunter, 1960, 1961a, 1961b), both paradigms were never included in the same experiment. And as far as the present author has been able to determine, no study has investigated the effect of intertask interval in the A-D transfer paradigm. However, Newton and Wickens (1956) have reported data that relate to this problem.

Furthermore, all of the studies which have investigated the intertask interval variable have held the degree of Task-1 learning constant. In light of the evidence that degree of Task-1 learning is an important determinant of the magnitude and direction of specific paired-associate transfer (Ellis, 1969; Martin, 1965), it is likely that this variable would modify any effects of intertask interval on specific transfer.

Therefore, it appears that there are at least two problems concerning the effect of intertask interval on paired-associate transfer that need investigation. First, the effect of variations in the length of the intertask interval on specific transfer in the C-B and the A-D paradigms should be determined. Second, the possibility that degree of Task-1 learning is a modifier of intertask interval effects should be examined. The purpose of the present study way to investigate these problems.

Review of the Intertask Interval Literature

Typically paired-associate transfer is investigated in situations where the time between Task-1 and Task-2 is at most a few minutes. Several studies (Bunch & McCraven, 1938; Ellis & Burnstein, 1960; Ellis & Hunter, 1960, 1961a, 1961b), however, have investigated transfer in situations where the time interval between Task-1 and Task-2, i.e., the intertask interval, was varied. Bunch and McCraven (1938) using lists of paired-associate consonant-vowel-consonant (CVC) trigrams in a C-D paradigm found that non-specific transfer did not show a reliable decrease as the intertask interval was increased up to 90 days. However, the retention of Task-1 over the intertask intervals investigated did show a reliable decrease. More recently Ellis and Hunter (1961b) have replicated these results for the C-D paradigm using paired-associate lists with Gibson visual patterns as the stimulus terms and Glaze nonsense syllables (53 percent level) as the response terms. These findings suggest that non-specific transfer which is based primarily on learning-to-learn effects is independent of the length of the intertask interval in paired-associate transfer situations.

Ellis and Burnstein (1960) found that as the intertask interval increased, transfer in the C-B paradigm showed a reliable decrease. Task-1 and Task-2 in this experiment were paired-associate tasks consisting of Gibson visual patterns as the stimulus terms and Glaze nonsense syllables as the response terms. These Es concluded that their result was due to the loss of the response terms of Task-1 over the intertask interval. This conclusion was based on the typical observation that nonsense materials learned in the laboratory are forgotten quite rapidly.

In subsequent studies, Ellis and Hunter (1960, 1961a) found that when highly meaningful responses (words) or predifferentiated responses (nonsense syllables) were used, transfer in the C-B paradigm did not decrease as the intertask interval increased. These Es concluded that when the conditions are such that the responses in the C-B paradigm are likely to be retained over time, transfer in this paradigm will remain relatively independent of the length of the intertask interval.

A search of the literature revealed no evidence of a direct investigation of the effect of intertask interval on specific transfer in the A-D paradigm. Only one study (Newton & Wickens, 1956) reports data related to this problem. In Experiment I of this study three groups of Ss learned lists of paired-associate adjectives under the conditions of an A-D transfer paradigm while in Experiment II three other groups of Ss learned similar paired-associate lists of adjectives under the conditions of a C-D paradigm. Task-1 training in both experiments was continued until a 100 percent correct criterion was reached and Task-2 was learned after an elapsed time of either 1 minute, 24 hours, or 48 hours to a 100 percent criterion. The mean trials to the Task-2 criterion was reported for each group. Percent specific transfer estimates for the A-D conditions at each intertask interval were calculated by the present author using the Murdock's formula (1957)

$$PST = ((C - E) / (C + E)) \times 100 \qquad (1)$$

where PST equals percent specific transfer, C equals the mean number of trials to criterion on Task-2 for the appropriate intertask interval C-D group and E equals the mean number of trials to criterion on Task-2 for the appropriate A-D group. For intertask intervals of 1 minute, 24 hours, and 48 hours percent specific transfer was -27.2, -12.6, and +4.6, respectively. These estimates show that as intertask interval increased, negative transfer in the A-D paradigm decreased. Since negative transfer in the A-D paradigm is supposedly due to the interference of Task-1 forward association learning (e.g., Martin, 1965), it appears that the above decreases in negative transfer resulted from the loss of Task-1 forward association learning over the longer intertask intervals.

The findings of Newton and Wickens (1956) and those of Ellis and his colleagues (Ellis & Burnstein, 1960; Ellis & Hunter, 1960, 1961a, 1961b) suggest the following conclusion: Specific transfer in the C-B and the A-D paradigms will tend to decrease as the intertask interval is increased, if, and only if, there is a loss over the intertask interval of Task-1 response learning and/or Task-1 backward association learning in the C-B paradigm, and a loss of Task-1 forward association learning in the A-D paradigm. On the other hand, if there is no loss of the Task-1 transfer components over time, then specific transfer should not decrease as the intertask interval is increased.

As stated earlier, all of the studies that have investigated transfer as a function of intertask interval have held the degree of Task-1 learning constant. Since Martin (1965) has demonstrated that variations in the degree of Task-1 learning modify specific transfer in the C-B and A-D paradigms, it is likely that this variable would also modify the effects of intertask interval. Related to this point is the demonstration by Underwood and Keppel (1963) that the degree of retention of verbal material learned in the laboratory is a positive function of the degree to which the material is learned. This finding leads to the expectation that Task-1 transfer effects acquired at higher degrees of Task-1 learning would show less retention loss over time than Task-1 transfer effects acquired at lower degrees of Task-1 learning. Consequently, at higher degrees of Task-1 learning, specific transfer should be less affected by variations in the length of the intertask interval than at lower degrees of Task-1 learning.

Research Hypotheses

The present experiment investigated the following research hypotheses: (a) Specific transfer in the C-B and the A-D transfer paradigms will decrease as the length of the intertask interval is increased in a paired-associate transfer situation; and (b) specific transfer will be less affected by variations in the intertask interval as the degree of Task-1 learning is increased.

CHAPTER II

TASK LISTS AND APPARATUS

Construction of the Task-1 and Task-2 Lists

The verbal materials used in the present study were four lists of six paired-associate items (see Appendix A). Stimulus and response terms were taken from Montague and Kiess's (1968) lists of CVC trigram pairs scaled for associability. Associability was defined as the ease of linking some stimulus with some response. A sample of 39 CVC pairs scaled for associability were selected such that the following requirements were met: (a) Each pair had an associability value between 30 and 40 percent on the male norms; and (b) Each CVC had an association value (AV) between 30 and 50 percent on the Archer (1960) norms. Meaningfulness (*m*') as measured by Noble (1962) for these CVC's ranged from 1.3 to 3.1 on a scale of 0.0 to 5.0.

The four paired-associate lists were derived from the sample of CVC pairs scaled for associability so that they conformed to the three conditions of transfer investigated in the present experiment (C-D, C-B, and A-D). Martin (1965) has proposed that the axes of Osgood's (1949) transfer surface realistically represent associative relatedness between stimuli, or responses, rather than stimulus, or response similarity. If this is true then variations in intertask stimulus, and intertask response associability should produce results similar to those produced by variations in intertask stimulus, and intertask response similarity in the traditional transfer paradigms. Following this view, the various transfer paradigms were constructed by varying intertask stimulus, and intertask response associability. Twelve CVC pairs (see Appendix B) were selected from the sample set of CVC pairs described above. Six of the selected pairs were used to provide the stimulus terms for Task-1 and Task-2, while the remaining six pairs were used to provide the response terms for the two tasks. The first members of each of the stimulus pairs became the C terms in the Task-1 C-D and C-B lists, while the second members of these pairs became the A terms in the Task-1 A-D list and the Task-2 A-B list. The first members of each of the response pairs became the D terms in the Task-1 A-D and C-D lists, while the second members of each of these pairs became the B terms in the Task-1 C-B list and the Task-2 A-B list. These procedures resulted in four lists of paired-associates wherein intertask stimulus associability was minimal (C-B), intertask response associability was minimal (A-D), or both intertask stimulus and response associability were minimal (C-D).

Apparatus

Subjects were seated before a rear-projection screen in a semi-sound proof room out of sight of E. A Kodak 800 Carousel slide projector was used to project the practice list and the Task-1 and Task-2 lists onto the screen. The presentation rate of the paired-associates was controled by a Lafayette timer. The verbal materials were typed on 34 X 37 mm. pieces of K & E smooth vellum and mounted in Pegco Easymount 35 mm.-DF slide holders.

CHAPTER III

METHOD

Design

A 2x3x3 factorial design was employed with two levels of Task-1 learning (3/6 and 6/6), three transfer paradigms (C-D, C-B, and A-D), and three intertask intervals (1 minute, 24 hours, and 72 hours). A fixed effects model of the analysis of variance was assumed with independent data in each experimental condition. The experimental design is summarized in Table 1.

Subjects

The Ss were 180 male Georgia Institute of Technology students, whose participation in this experiment was voluntary. Those students enrolled in Psychology courses (N = 166) were rewarded for their participation with 2 percent credit toward their final grade in the Psychology course. The remaining students (N = 14) were recruited from the campus dormitories and were promised that if they enrolled in a Psychology course within three quarters after they completed the experiment, 2 percent credit toward their final grade in this course would be granted to them for their participation in the present experiment. Subjects' native language was English, and none had previously participated in a paired-associate learning experiment. Forty-three percent of the Ss were enrolled in the College of Industrial Management, 37 percent were enrolled in the Engineering College, and the remaining 20 percent were enrolled in the General College. The Ss were run in blocks of 18 so that for each successive block of 18 Ss that appeared in the laboratory, one was assigned to each of the experimental conditions.

Subjects and their data were discarded for the following reasons: (a) equipment failure (N = 2), (b) E error (N = 4), (c) refusal of S to follow E's instructions (N = 1), and (d) failure of S to return for Task-2 training after the appropriate intertask interval had elapsed (N = 6). When a S and his data were discarded, the position this S occupied in the experiment was filled with the next S who volunteered for the experiment.

Procedure

Learning was by the method of anticipation and was conducted at a 2:2 second rate with a 4 sec. intertrial interval. Serial learning was minimized by varying the sequence in which the list items were presented on each learning trial. Six different counterbalanced orders of item position were constructed. These orders were then arranged in a semi-random sequence of 18 trials with the restrictions that a particular order could not follow or precede itself, and that no orders with the same first and last item could follow each other. All Task-1 and Task-2 lists were presented to Ss according to this sequence. If more than 18 trials were needed to reach criterion, the sequence was repeated until criterion performance was reached.

Prior to Task-1 training, Ss were instructed in the experimental task and were given three practice trials on an unrelated paired-associate task. The practice list for this task was composed of the names of six months (March, April, May, June, July, and August) as the stimuli,

Table 1. Schematic of the Experimental Design

Task-1 Criterion	Transfer Paradigm	Intertask Interval		
		1 min.	24 hrs.	72 hrs.
3/6	C-D : A-B	10 Ss	10 Ss	10 Ss
	C-B : A-B	10 Ss	10 Ss	10 Ss
	A-D : A-B	10 Ss	10 Ss	10 Ss
6/6	C-D : A-B	10 Ss	10 Ss	10 Ss
	C-B : A-B	10 Ss	10 Ss	10 Ss
	A-D : A-B	10 Ss	10 Ss	10 Ss

and the numbers 1 - 6 as the responses. The pairing of months and numbers was nonsystematic.

Subjects learned either a C-D, a C-B, or an A-D list to either a 50 percent correct (3/6) or a 100 percent correct (6/6) criterion in Task-1 training. Subjects in the 1 minute intertask interval conditions were told upon completion of Task-1 that there would be a 1 minute wait before Task-2 training began. Subjects in the 24 hour and 72 hour intertask interval conditions were told upon completion of Task-1 to return after the appropriate intertask interval had elapsed for Task-2 training. In view of the ambiguous effects of anti-rehearsal instructions (Underwood and Keppel, 1962), Ss in the 24 hour and 72 hour intertask interval conditions were not instructed to refrain from rehearsing the Task-1 list over the intertask interval.

In Task-2 all Ss learned the same A-B list until a 6/6 criterion was attained. Thus, Ss in the different transfer conditions learned different Task-1 lists and the same Task-2 list. This procedure insured that any differences in performance on Task-2 could be attributed to the various transfer effects (assuming that the various Task-1 lists were not differentially difficult) and not to differential Task-2 difficulty. Since the Task-1 lists were derived from verbal material which was relatively homogeneous, there was no reason to suspect that these lists were not equally difficult.

After Task-2 training was completed, Ss completed a Modified Modified Free Recall (MMFR) test. All Ss in the A-D transfer conditions and half of the Ss in the C-D transfer conditions recalled both Task-1 and Task-2 forward associations during the MMFR test. All Ss in the C-B transfer conditions and the remaining Ss in the C-D transfer conditions recalled both Task-1 and Task-2 backward associations during this test. The primary purpose of the MMFR test was to determine the "fate" of Task-1 forward and backward associations during the acquisition of Task-2.

The Barnes and Underwood (1959) MMFR procedure was followed. Subjects in the A-D transfer conditions received a sheet of paper on which the six stimulus terms were typed in a vertical column. These stimuli appeared in the order Ss would have received them if one more trial on Task-2 had been necessary for the attainment of the Task-2 criterion. Subjects were then instructed to recall all Task-1 and Task-2 responses they could in any order they wished. Subjects were given up to 4 minutes for recall. Using similar procedures, Ss in the C-B transfer conditions received a sheet of paper with the six response terms and were asked to recall Task-1 and Task-2 stimuli.

Subjects in the C-D transfer conditions who were asked to recall Task-1 and Task-2 responses received a sheet of paper containing the 12 Task-1 and Task-2 stimulus terms. Six different random orders of the A-B and C-D list stimuli were prepared prior to the experiment. The particular random order which these Ss received during MMFR was determined by a prearranged schedule which provided that each random order would be used equally often. Subjects in the C-D transfer conditions who were asked to recall Task-1 and Task-2 stimuli received a sheet of paper containing the 12 Task-1 and Task-2 responses. Six different random orders of A-B and C-D list responses were prepared prior to the experiment, and the presentation of these orders during recall was determined by a prearranged schedule which insured their equal use. Otherwise, recall procedures for forward and backward associations in the C-D transfer conditions were identical to those of the other transfer conditions.

CHAPTER IV

RESULTS

Task-1 Learning

Since Ss trained on different Task-1 lists in each of the transfer conditions, the possibility that these lists were differentially difficult could not be ruled out. An F_{max} test demonstrated that the Task-1 trials to criterion (TTC) data did not display homogenity of variance, F_{max} (9, 18) = 41.2, $p < .01$. But a $\log_{10}$ (X + 1) transformation removed this heterogenity, F_{max} (9, 18) = 5.51, $p > .05$. An analysis of variance of the transformed data failed to reveal any significant transfer paradigm main effect, or any significant transfer paradigm interaction. It can, therefore, be concluded that the Task-1 lists were not differentially difficult. The analysis did reveal that the difference between the two degrees of Task-1 learning was reliable, F (1, 162) = 246.64, $p < .01$. For Ss who practiced on Task-1 until a 3/6 criterion was reached, the mean transformed TTC was 0.7556 (4.70 trials). For Ss who practiced until a 6/6 criterion was reached, the mean was 1.1998 (14.84 trials). The intertask interval main effect and the remaining interaction (Intertask Interval X Degree of Task-1 learning) were not reliable.

Task-2 Learning

It has been demonstrated that the acquisition of a paired-associate list is a relatively difficult task when both the stimulus and response terms of each pair are medium m' CVC's (Cieutat, Stockwell, & Noble, 1958).

Since the Task-2 list was composed of medium m' CVC's, it was expected that the acquisition of this list would also be relatively difficult, despite the fact of prior Task-1 experience.

Weitz (1961, 1964) has shown that difficult learning tasks require a more lenient criterion to reveal the effects of an independent variable. In view of this finding, transfer to Task-2 was measured at two levels: (a) the 50 percent correct response level (50 PL), and (b) the 100 percent correct response level (100 PL).

The 50 PL Analysis

A $\log_{10}$ (X + 1) transformation removed the heterogenity of variance displayed by the 50 PL data, F_{max} (9, 18) = 9.73, $p > .05$. An analysis of variance of the transformed data (Table 2) revealed that the differences among intertask intervals were reliable, F (2, 162) = 11.39, $p < .01$. Tukey's HSD test for pair-wise comparisons among means (Kirk, 1968) showed that the 1 minute condition ($\bar{x}$ = 0.6320) differed reliably ($p < .01$) from both the 24 hour and 72 hour conditions ($\bar{x}$ = 0.7894 and 0.7504, respectively) but that the two latter conditions did not differ from each other ($p > .10$). The differences among paradigms were also significant F (2, 162) = 14.40, $p < .01$. Tukey's HSD test revealed that the C-B paradigm ($\bar{x}$ = 0.6176) differed reliably ($p < .01$) from both C-D and A-D paradigms ($\bar{x}$ = 0.7818 and 0.7724, respectively), but that the two latter paradigms did not differ from each other ($p > .10$). Degree of Task-1 learning was not a significant factor in Task-2 performance, $F < 1$, and none of the interactions were significant.

Summing across both degrees of Task-1 learning, it is clear from Fig. 1 that all paradigms displayed a general decrement in performance, as

Table 2. ANOVA for Effects of Intertask Interval, Degree of Task-1 Learning, and Transfer Paradigm on the Task-2 TTC (Criterion - 50 PL)

Source	df	MS	F
Intertask Interval (II)	2	0.4034	11.39 *
Degree of Task-1 Learning (DTL)	1	0.0106	0.30
Transfer Paradigm (TP)	2	0.5099	14.40 *
II X DTL	2	0.0588	1.66
II X TP	4	0.0106	0.30
DTL X TP	2	0.0436	1.23
II X DTL X TP	4	0.0164	0.46
Within Cell Error	162	0.0353	
Total	179		

*$p < .01$

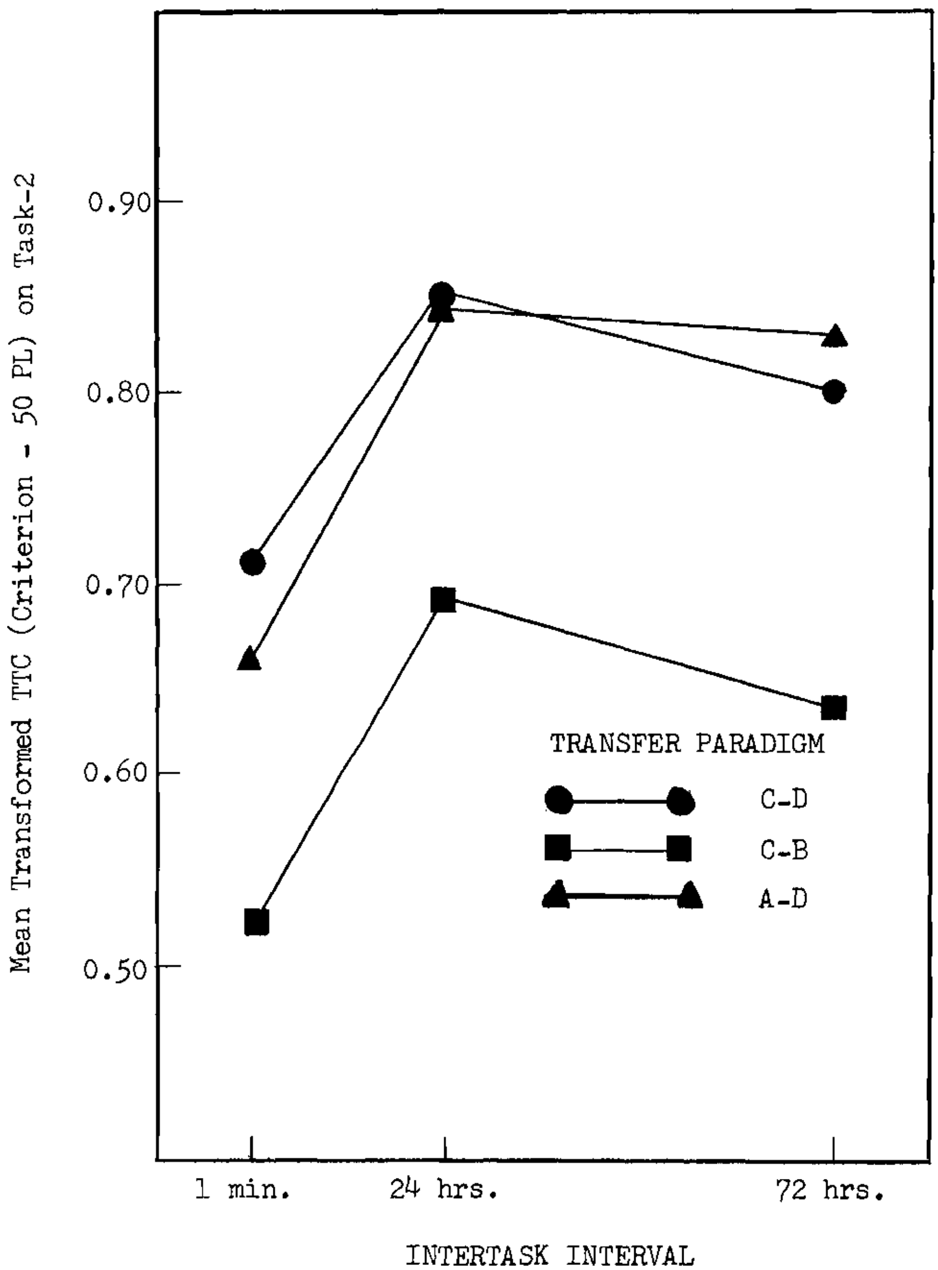

Figure 1. Mean Transformed TTC (Criterion - 50 PL) on Task-2 as a Function of Intertask Interval and and Transfer Paradigm.

the intertask interval was increased. For each interval, the C-B paradigm showed positive specific transfer. Dunnett's test for comparisons involving a control mean (Kirk, 1968) showed that these specific transfer estimates were significantly greater than zero ($p < .05$, one tail test).

For the 1 minute and 24 hour intervals, the A-D paradigm displayed a slight amount of positive transfer, while at the 72 hr. interval, this paradigm displayed some negative transfer. Dunnett's test revealed that none of these specific transfer estimates was significantly greater than zero ($p > .05$, one tail test).

For both the C-B and A-D paradigms, the magnitude of transfer decreased as the intertask interval was increased (Fig. 2). However, Scheffe's $\underline{S}$ test, as modified by Davis (1969), showed that statistically these decreases were not reliable ($p > .05$ for all comparisons).

The 100 PL Analysis

A $\log_{10}$ (X + 1) transformation removed the heterogenity of variance displayed by the 100 PL data, F_{max} (9, 18) = 9.73, $p > .05$. An analysis of variance of the transformed data (Table 3) revealed that the differences among intertask intervals were significant, F (2, 162) = 19.37, $p < .01$. Tukey's HSD test revealed that the differences among intervals followed the same pattern that they had in the 50 PL analysis. The 1 minute condition ($\bar{x}$ = 0.9953) differed reliably ($p < .01$) from both the 24 hour and 72 hour conditions ($\bar{x}$ = 1.2011 and 1.1466, respectively), but the two latter conditions did not differ from each other ($p > .10$).

The differences among paradigms were also reliable F (2, 162) = 3.56, $.01 < p < .05$. Tukey's HSD test showed that these differences displayed a different pattern from the one obtained in the 50 PL criterion an-

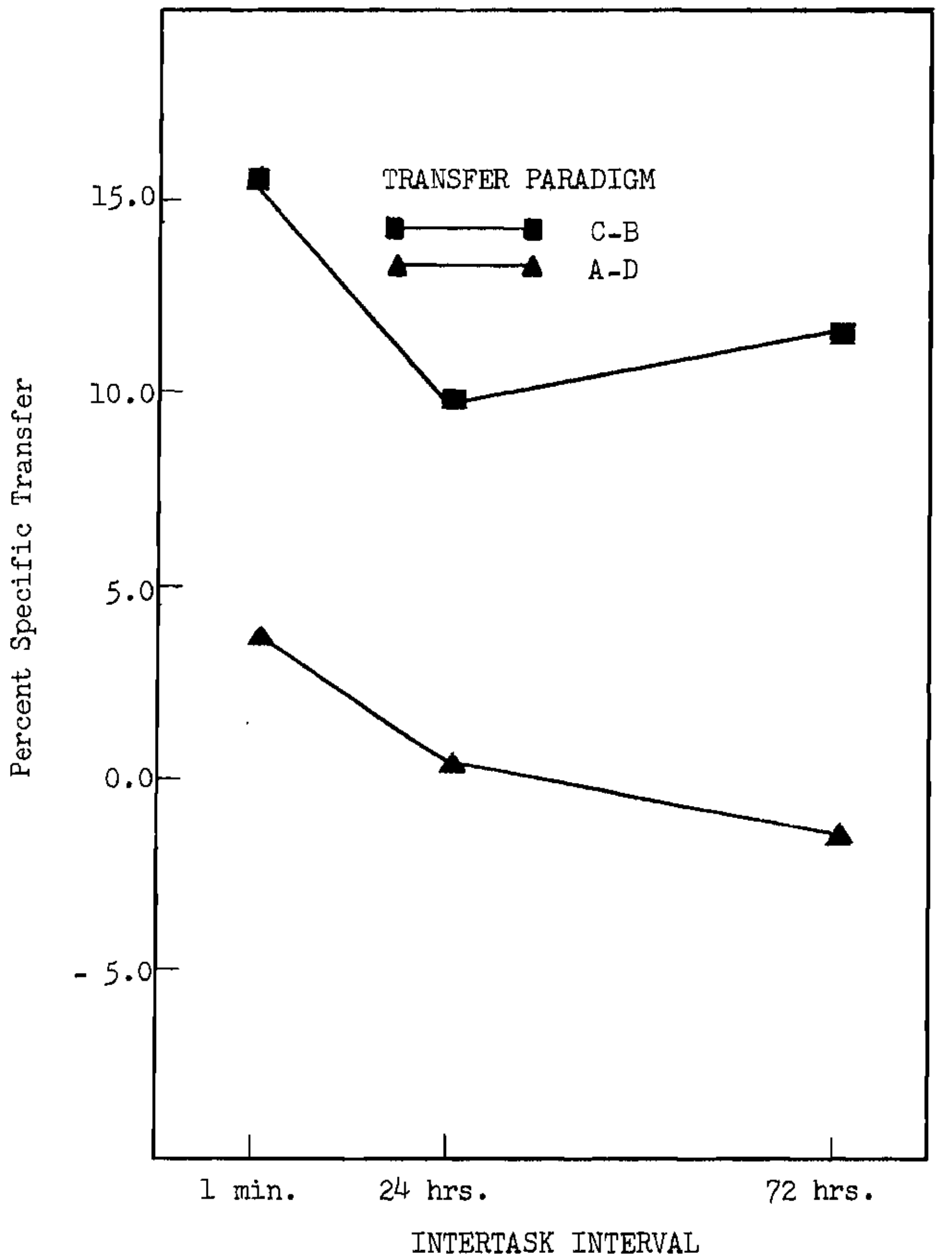

Figure 2. Percent Specific Transfer (Formula 1) as a Function of Intertask Interval and Transfer Paradigm for Task-2 50 PL Criterion Analysis.

Table 3. ANOVA for Effects of Intertask Interval, Degree of Task-1 Learning, and Transfer Paradigm on the Task-2 TTC (Criterion - 100 PL)

Source	df	MS	F
Intertask Interval (II)	2	0.682	19.38**
Degree of Task-1 Learning (DTL)	1	0.009	0.26
Transfer Paradigm (TP)	2	0.125	3.56*
II X DTL	2	0.031	0.90
II X TP	4	0.012	0.34
DTL X TP	2	0.020	0.57
II X DTL X TP	4	0.010	0.28
Within Cell Error	162	0.035	
Total	179		

*$p < .05$

**$p < .01$

alysis. The A-D paradigm ($\bar{x} = 1.1672$) was reliably different ($.05 < p < .10$) from both the C-D and C-B paradigms ($\bar{x} = 1.0869$ and 1.890, respectively), but the two latter paradigms did not differ from each other ($p > .10$). Degree of Task-1 learning was not a significant factor in Task-2 performance $F < 1$, and none of the interactions were significant.

Summing across both degrees of Task-1 learning, it can be observed in Fig. 3 that all transfer paradigms showed a general decrement in performance as the intertask interval increased, just as in the 50 PL analysis. However, in contrast to the results of the 50 PL analysis, the C-B paradigm displayed only slight amounts of specific transfer at each intertask interval. On the other hand, the A-D paradigm showed moderate amounts of negative specific transfer at each intertask interval. Dunnett's test revealed that none of the transfer estimates taken at each intertask interval were significantly greater than zero ($p > .05$, one tail test). For the C-B paradigm, transfer decreased then increased as the intertask interval was increased, while in the A-D paradigm, it showed a general increase as the intertask interval increased (Fig. 4). Scheffe's modified S test revealed that the above trends were not statistically reliable ($p > .05$ for all comparisons).

Modified Modified Free Recall

In the MMFR test, which followed the completion of Task-2, Ss were required to recall either Task-1 or Task-2 forward associations (A-D and C-D paradigms), or Task-1 and Task-2 backward associations (C-B and C-D paradigms). Since the cell sizes in the forward and backward association analyses were unequal but proportional ($n = 10$ for the A-D and C-B paradigms, and $n = 5$ for the C-D paradigm), a modified form of analysis

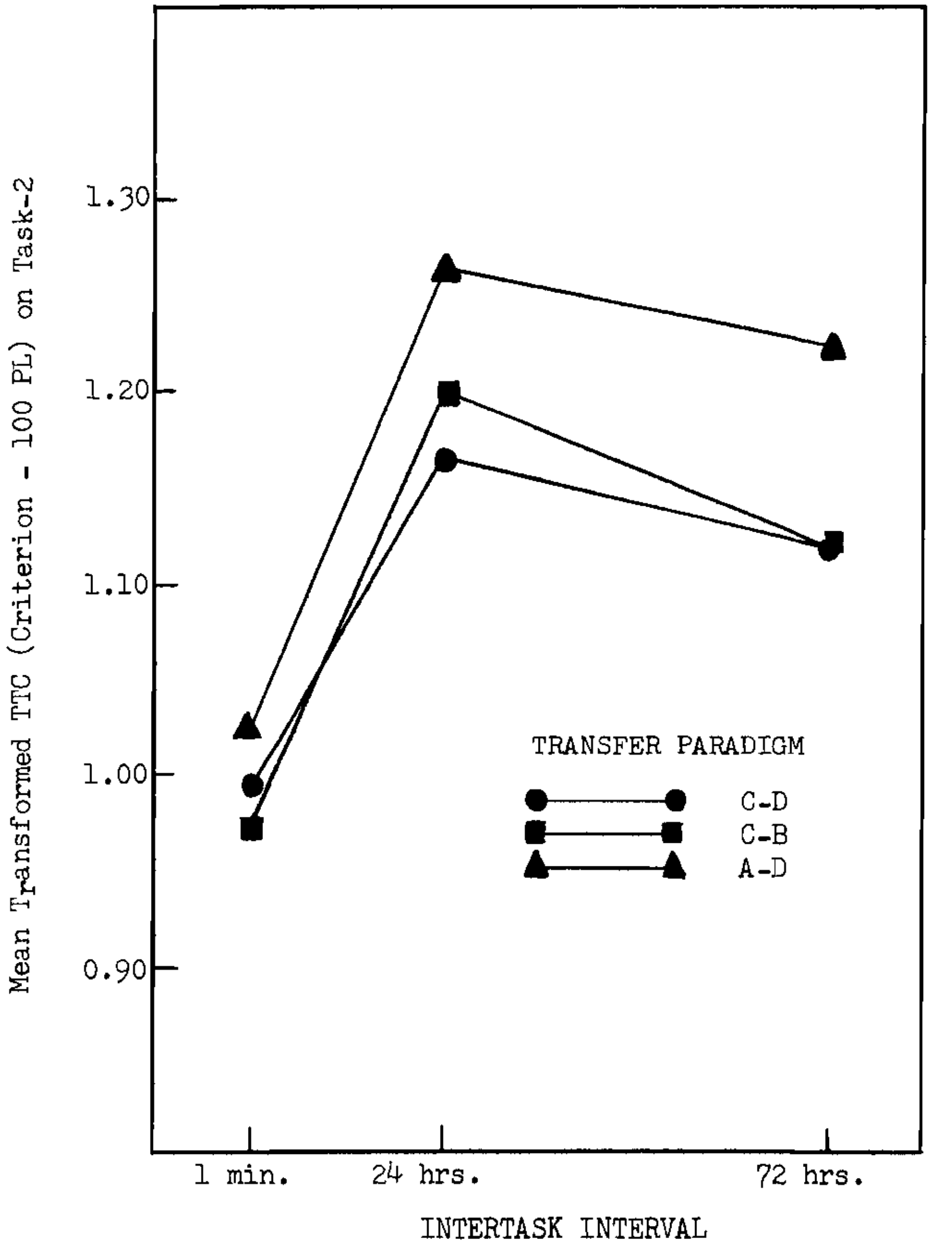

Figure 3. Mean Transformed TTC (Criterion - 100 PL) on Task-2 as a Function of Intertask Interval and and Transfer Paradigm.

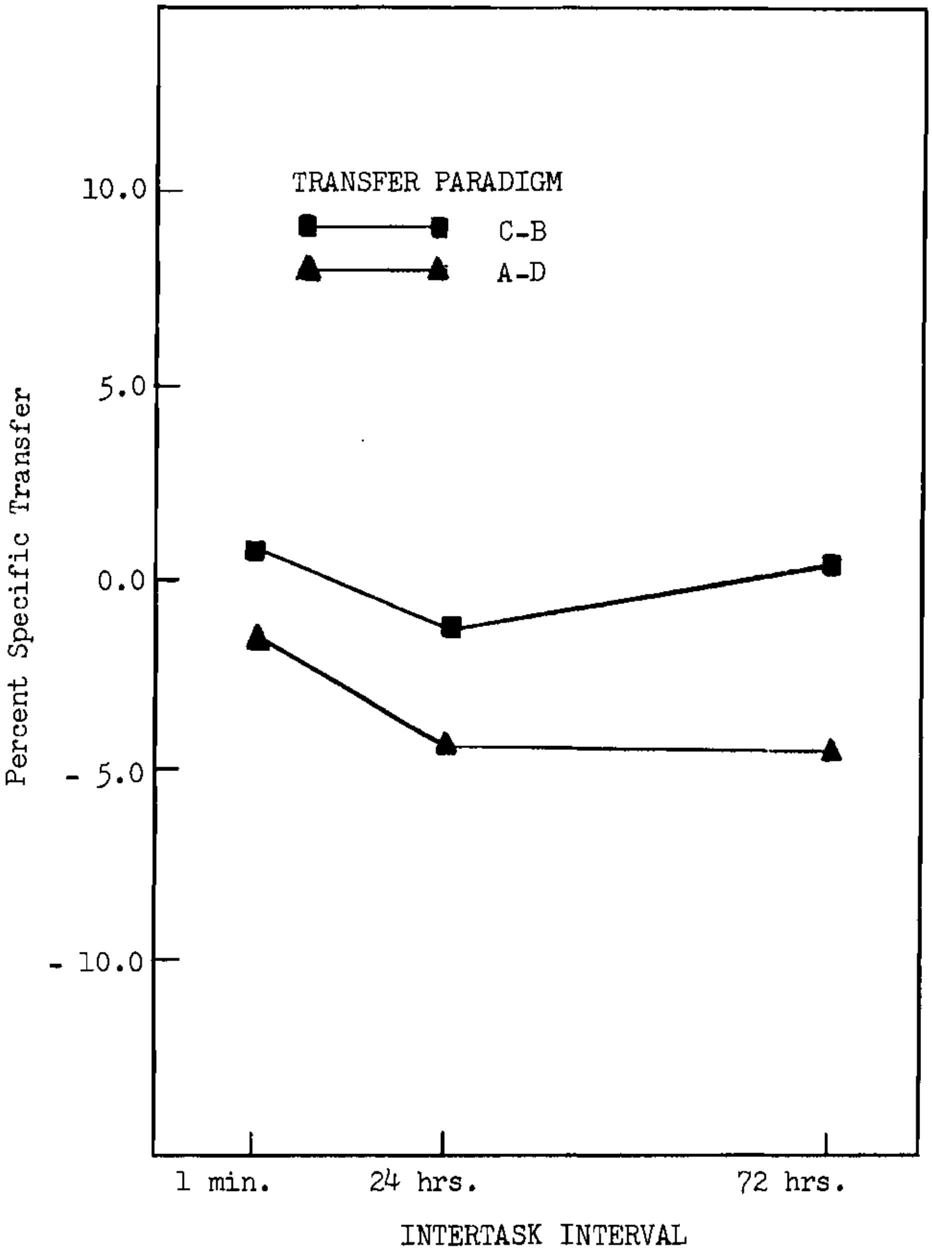

Figure 4. Percent Specific Transfer (Formula 1) as a function of Intertask Interval and Transfer Paradigm for Task-2 100 PL Criterion Analysis.

of variance (Snedecer, 1956, pp. 281 - 284) was used to analyze the recall date.

Forward Association Recall

Analysis of variance of the number of correctly recalled Task-1 forward associations revealed that there was no significant difference in the mean number of associations recalled by Ss in the A-D and C-D paradigms, ($\bar{x}$ = 1.10 and 2.06, respectively), F (1, 78) = 2.44, p > .10. However, as the intertask interval was increased, recall first decreased and then increased, F (2, 78) = 4.42, p < .05. Tukey's HSD test revealed that the 24 hour interval ($\bar{x}$ = 1.16) differed reliably (p < .05) from both the 1 minute and the 72 hour intervals ($\bar{x}$ = 2.10 and 2.00, respectively), but that the two latter intervals did not differ from each other (p > .10). As the degree of Task-1 learning was increased, recall increased ($\bar{x}$ = 1.04 and 2.46 for the 3/6 and 6/6 degrees of Task-1 learning, respectively), F (1, 78) = 25.54, p < .01. The only significant interaction was between intertask interval and degree of Task-1 learning, F (2, 78) = 4.20, p < .05. In Fig. 5 it can be seen that the recall of Task-1 forward associations for both degrees of Task-1 learning decreased at the same rate as the intertask interval was increased from 1 min. to 24 hrs.. However, as the interval was increased to 72 hrs., recall increased at the higher degree of Task-1 learning while it remained at the 24 hour recall level at the lower degree of Task-1 learning.

An analysis of variance of the number of Task-2 forward associations correctly recalled revealed a significant paradigm main effect, F (1, 78) = 5.63, p < .05. Subjects in the A-D conditions recalled a mean of 5.60 Task-2 associations, while these in the C-D conditions recalled a mean of

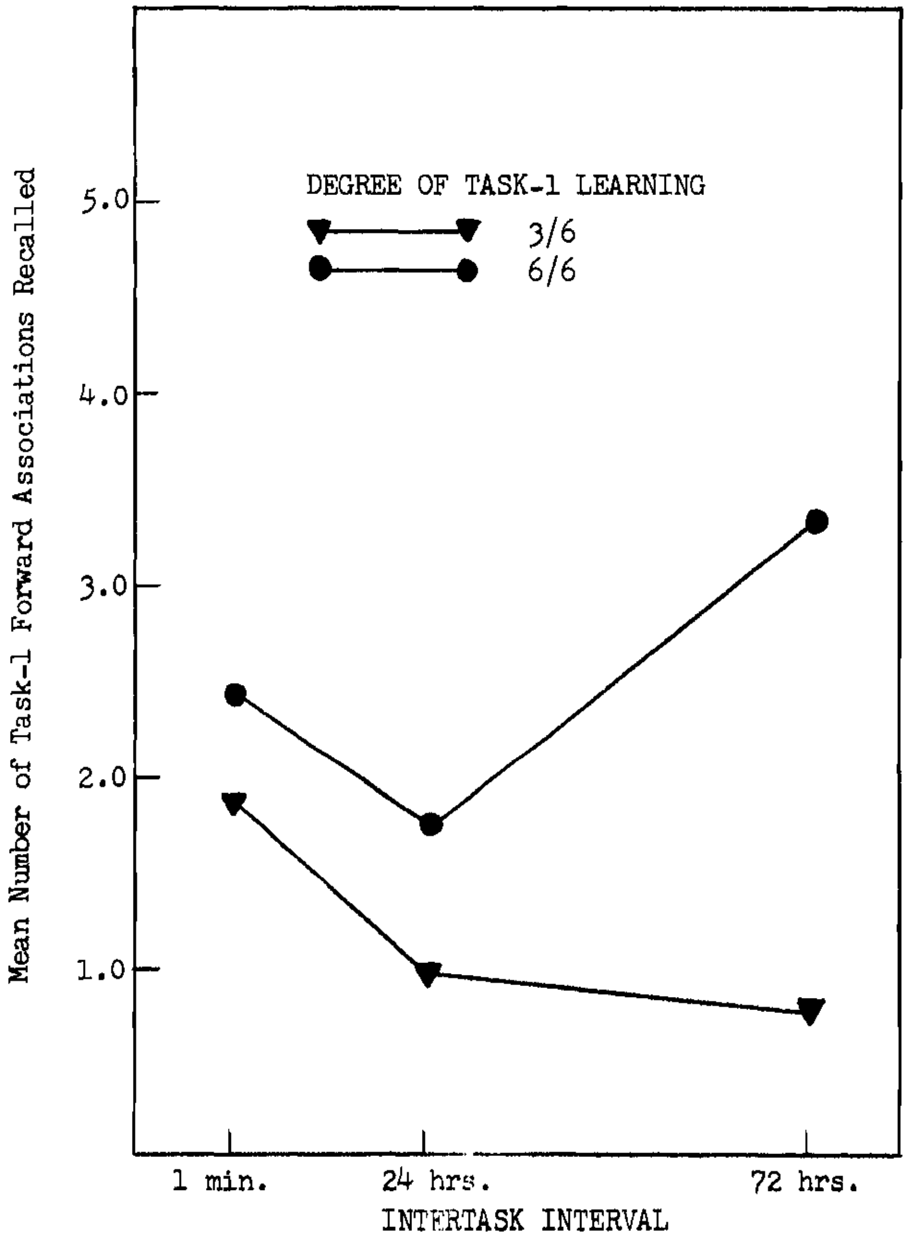

Figure 5. Mean Number of Task-1 Forward Associations Correctly Recalled During MMFR as a Function of Intertask Interval and Degree of Task-1 Learning.

5.10 associations. No other main effect, and none of the interactions were significant.

Backward Association Recall

Fig. 6 presents recall of Task-1 backward associations as a function of degree of Task-1 learning and transfer paradigm. An analysis of variance of the number of correctly recalled Task-1 backward associations showed that as the degree of Task-1 learning was increased, the recall of these associations increased, F (1, 78) = 5.04, $p < .05$. Furthermore, Ss in the C-D conditions recalled more Task-1 backward associations than Ss in the C-B conditions, F (1, 78) = 4.94, $p < .05$. The intertask interval main effect and none of the interactions were significant. Analysis of variance of the recall of Task-2 backward associations revealed that none of the main effects or interactions were significant.

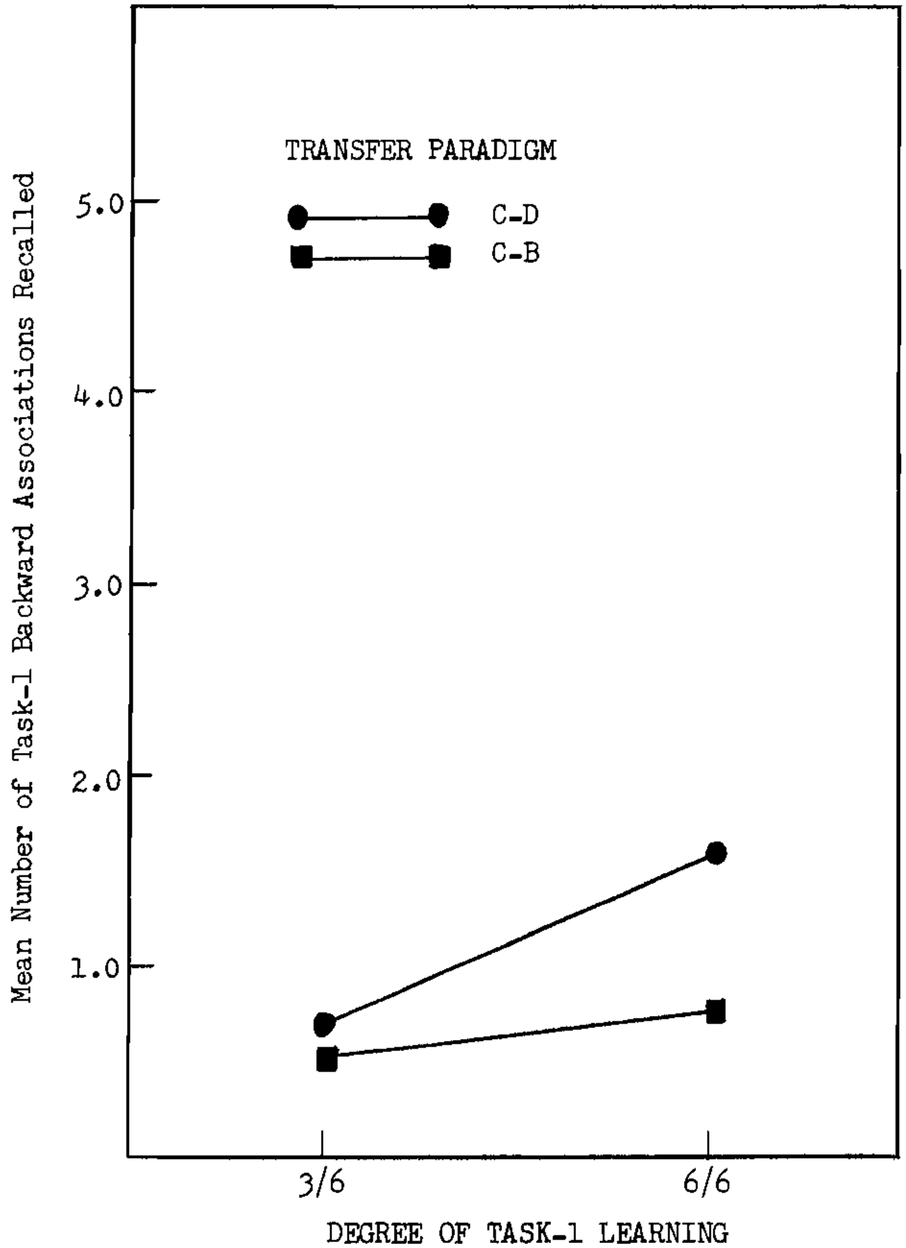

Figure 6. Mean Number of Task-1 Backward Associations Correctly Recalled During MMFR as a Function of Degree of Task-1 Learning and Transfer Paradigm.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Effect of Degree of Task-1 Learning

It was hypothesized in Chapter I that, as the degree of Task-1 learning was increased, variations in the intertask interval would have less of an effect on specific paired-associate transfer. It was not possible to test this hypothesis in the present experiment since the two degrees of Task-1 learning investigated did not differentially affect the course of Task-2 training in any transfer paradigm. The fact that the degree of Task-1 learning was not a significant factor in Task-2 performance can be explained if it is assumed that the Ss who practiced on Task-1 to the 6/6 criterion were at that time still engaging primarily in response learning and only secondarily in association learning. Under these conditions at the completion of Task-1 learning only response learning effects would be available for transfer to Task-2 at both degrees of Task-1 learning. As a consequence, degree of Task-1 learning would not be a significant factor in Task-2 performance.

Support for this assumption comes from two sources. First, specific transfer in the C-B:1 minute and the A-D:1 minute conditions at both degrees of Task-1 learning was zero at the termination of Task-2 training. Second, the Paradigm X Degree of Task-1 learning interaction was not significant in either the Task-1 forward association recall analysis or in the Task-1 backward association analysis. If an effective amount of association learning had occurred during Task-1 training in the C-B:1 minute condition and in the

A-D:1 minute condition at the 6/6 criterion, then specific transfer in these conditions would have been negative instead of zero (Martin, 1965). The fact that specific transfer in these conditions was zero implies that an effective amount of association learning did not occur in these conditions. Assuming that paired-associate acquisition is a two stage process, it is reasonable to conclude that at the time Task-1 training was terminated in the 6/6 Task-1 learning conditions, Ss in these conditions were engaging primarily in response learning and only secondarily in association learning.

Furthermore, the Paradigm X Degree of Task-1 Learning interaction in the Task-1 forward and backward association analyses would have been significant, if an effective amount of Task-1 association learning had occurred during Task-1 training in the A-D and C-B transfer conditions at the 6/6 criterion. That is, recall in the A-D and the C-B transfer conditions at the higher degree of Task-1 learning would have been significantly lower than in the C-D transfer conditions while at the lower degree of Task-1 learning recall in the A-D and C-B transfer conditions would have been at the same level as recall in the C-D transfer conditions. Such a result would have implied that Task-1 forward and backward associations were present and interfering with Task-2 forward and backward association formation in the A-D and C-B transfer conditions, respectively. The fact that this interaction was not significant in either of the Task-1 recall analyses implies that only a few Task-1 forward and backward associations were available for transfer during Task-2 training in the A-D and C-B transfer conditions at the 6/6 criterion. Thus, this analysis suggests that during Task-1 training Ss who practiced on Task-1 until a 6/6 criterion was reached did not engage in an effective amount of association learning. This conclusion implies that these Ss engaged primarily in response learning and only secondarily in association learning during Task-1 training.

If the Ss who trained on Task-1 until a 6/6 criterion engaged primarily in response learning then it is reasonable to conclude that the Ss who trained on Task-1 until a 3/6 criterion was reached also engaged primarily in response learning during Task-1 training. Therefore, it is not unreasonable to assume that Task-1 training at both degrees of Task-1 learning was taken up mainly with response learning. Under these conditions it would be unlikely that degree of Task-1 learning would be a significant factor in Task-2 learning.

Assuming that Task-1 training was taken up mainly with response learning at both degrees of Task-1 learning, it should follow that the Task-2 response learning phase in the C-B:1 minute conditions would be minimal compared to that of the A-D:1 minute and the C-D:1 minute conditions. As a consequence, the Task-2 association learning phase in the C-B:1 minute conditions would be expected to begin and end sooner than that of the A-D:1 minute and the C-D:1 minute conditions during Task-2 training. Therefore, Ss in the C-B:1 minute conditions would be expected to reach the Task-2 terminal criterion in fewer trials than Ss in either the A-D:1 minute or the C-D:1 minute conditions. These results were not obtained in the present study. Subjects in the C-B:1 minute conditions did not take significantly fewer trials to reach the terminal Task-2 criterion than Ss in the other 1 minute interval conditions. Thus this finding may be interpreted as evidence against the assumption that Task-1 training was raken up primarily with response learning at both degrees of

Task-1 learning. However, in light of the other evidence (which was discussed above) that supported this assumption, it is the opinion of the present author that the weight of this evidence is in favor of the assumption, and as a consequence, that the results of the present study can best be explained if it is assumed that Task-1 training was primarily taken up with response learning at both degrees of Task-1 learning.

Since it is a typical finding that a 100 percent correct criterion usually results in negative transfer in the A-D and C-B paradigms when the intertask interval is approximately 1 minute (e.g., Postman, 1962), the question that remains to be answered is why did this criterion not produce the typical result in the present experiment? Martin's analysis of paired associate transfer (1965) suggests a possible answer to this question. He observed that when response meaningfulness was low and for a given degree of Task-1 learning, Task-1 acquisition would be taken up primarily with response learning. The Task-1 and Task-2 responses of the present study all had a low or moderate meaningfulness (<u>m</u>') value. Thus, it appears that the 100 percent correct criterion failed to result in negative transfer in the A-D and C-B transfer conditions at the 1 minute intertask interval because the Task-1 and Task-2 responses were low in meaningfulness.

Effect of Intertask Interval

It was hypothesized in Chapter I that specific transfer in the C-B and the A-D transfer paradigms would decrease as the intertask interval was increased. Due to the fact that specific transfer in the C-B and the A-D paradigms in the 1 minute conditions at both degrees of Task-1 learning was zero at the termination of Task-2 training, it was not possible to draw any conclusions about the effect of intertask interval on terminal specific transfer in these paradigms. These results, however, support the contention made in the previous section that Ss at both degrees of Task-1 learning engaged primarily in response learning during Task-1 training.

When specific transfer was measured during the early stages of Task-2 training, it was found that the significant positive transfer occurred in the C-B conditions at each intertask interval and that this transfer did not decline as the intertask interval increased. Assuming that Task-1 learning was taken up mainly with response learning, it is reasonable to conclude that this positive transfer was based on the transfer of Task-1 response learning. The fact that the positive transfer did not decrease as the intertask interval increased implies that there was little forgetting of the Task-1 response learning over time. Underwood and Keppel (1963) have shown that the extent to which laboratory learned material is retained over time is a positive function of the extent to which it is learned. This result suggests that Task-1 response learning was retained in the present study at high level because it was well practiced. Assuming that Task-1 training was taken up primarily with response learning, it would be expected that the Task-1 response learning would be highly practiced and therefore quite resistant to forgetting. This constancy of transfer in the C-B paradigm thus tends to support the conclusion of Ellis and Hunter (1960, 1961a) that transfer in the C-B paradigm will remain relatively constant when the conditions are such that the Task-1 response learning is not likely to be forgotten over time.

In general then, the present study failed to provide the conditions necessary for an adequate test of the hypothesis that specific transfer in the C-B and A-D paradigms will decrease as the intertask interval is increased. Specific transfer in the C-B:1 minute and A-D:1 minute conditions was zero at the termination of Task-2 training. This result implied that all Task-1 transfer components were not available for transfer to Task-2 at the end of Task-1 training and for possible loss over the intertask interval. As a consequence it was not possible to assess the effect of intertask interval on specific transfer in the C-B and A-D transfer paradigms.

Interpretation of the Results

In the above discussion of the results of the present experiment it was assumed that during Task-1 training at both degrees of Task-1 learning Ss engaged primarily in response learning and only secondarily in association learning. Theoretically this assumption is not unwarranted since response meaningfulness was low in both Task-1 and Task-2. Martin's analysis of verbal paired-associate transfer (1965) suggests that when response meaningfulness is low, Task-1 acquisition will be taken up mainly with response learning even when the Task-1 criterion is moderately high. Therefore it would appear that the results of the present study can be interpreted in terms of the extant theory of paired-associate transfer.

The fact that positive transfer which was observed to occur during Task-2 training in the C-B paradigm did not decrease as the intertask interval increased is consistent with present interpretations of forgetting. It was inferred that this transfer was based on Task-1 response learning. The fact that this transfer did not reliably decrease as the intertask interval increased would imply that this Task-1 response learning was highly resistant to the variables that influence the forgetting of laboratory learned materials. Assuming that Ss engaged primarily in response learning during Task-1 training, it would be expected that the Task-1 responses would be highly practiced and therefore quite resistant to forgetting. Thus, this result tends to support the interference theorists' finding that well learned laboratory materials are unlikely to be unlearned outside the laboratory.

Even though the results of the present study can be explained from a theoretical point of view, the fact remains that the present experiment did not provide the conditions necessary for testing the hypotheses set forth in Chapter I. The basis for this failure appears to be due to the fact that the Degree of Task-1 Learning main effect was not a significant factor in Task-2 training. This result suggests that the present experiment should be redesigned in one of two ways. First, the 6/6 criterion could be increased so that this main effect would be significant. Second, the meaningfulness of the verbal materials could be increased so that the response learning required in Task-1 training would be less than in the present study. Under either one of these procedural changes, it would be expected that at the higher Task-1 criterion Ss would be able to engage in an effective amount of association learning. As a consequence, at the termination of Task-1 training all transfer components would be present for transfer to Task-2 in the higher Task-1 criterion conditions. Under these conditions the hypotheses of Chapter I could be tested.

APPENDIX A

TASK-1 AND TASK-2 LISTS

	Stimulus (S)	Response (R)	S AV	S m'	R AV	R m'
C-D List	RIQ	KEV	38	1.7	46	1.8
	CEK	TIQ	40	1.5	41	1.8
	YOT	DOY	38	1.8	39	1.9
	XAM	SOZ	38	1.6	38	1.4
	LIQ	BEQ	46	2.4	41	1.5
	TEZ	ZUT	38	1.8	38	1.3
			$\bar{x}$ 39.7	1.8	40.5	1.6
C-B List	RIQ	GOZ	38	1.7	45	2.3
	CEK	VAY	40	1.5	43	1.5
	YOT	QAC	38	1.8	47	1.8
	XAM	NID	38	1.6	44	1.8
	LIQ	HUN	46	2.4	41	3.1
	TEZ	REJ	38	1.8	39	2.3
			$\bar{x}$ 39.7	1.8	43.2	2.1
A-D List	JAT	KEV	41	1.7	46	1.8
	WOG	TIQ	38	2.1	41	1.8
	PUH	DOY	42	1.5	39	1.9
	GEB	SOZ	42	2.2	38	1.4
	VOX	BEQ	46	1.8	41	1.5
	KAG	ZUT	41	1.8	38	1.3
			$\bar{x}$ 43.3	1.8	40.5	1.6
A-B List	JAT	GOZ	41	1.7	45	2.3
	WOG	VAY	38	2.1	43	1.5
	PUH	QAC	42	1.5	47	1.8
	GEB	NID	42	2.2	44	1.8
	VOX	HUN	46	1.8	41	3.1
	KAG	REJ	41	1.8	39	2.3
			$\bar{x}$ 43.3	1.8	43.2	2.1

APPENDIX B

INTERTASK STIMULUS ASSOCIABILITY (AS)

CVC Pair	AS
RIQ - JAT	36
CEK - WOG	35
YOT - PUH	33
XAM - GEB	40
LIQ - VOX	38
TEZ - KAG	33
	$\bar{x}$ 35.8

INTERTASK RESPONSE ASSOCIABILITY (AS)

CVC Pair	AS
KEV - GOZ	33
TIQ - VAY	35
DOY - QAC	32
SOZ - NID	38
BEQ - HUN	36
ZUT - REJ	33
	$\bar{x}$ 34.5

BIBLIOGRAPHY

Archer, E. J., A re-evaluation of the meaningfulness of all possible CVC trigrams. Psychological Monographs, 1960, 74 (10, Whole No. 497).

Barnes, J. M., & Underwood, B. J., "Fate" of first-list associations in transfer theory. Journal of Experimental Psychology, 1959, 58, 97-105.

Bruce, R. W., Conditions of transfer of training. Journal of Experimental Psychology, 1933, 16, 343-361.

Baunch, M.E., & McCraven, V., Temporal course of transfer in the learning of memory material. Journal of Comparative Psychology, 1938, 25, 481-496.

Cieutat, V. J., Stockwell, F. E., & Noble, C. E., The interaction of ability and amount of practice with stimulus and response meaningfulness (m, m') in paired-associate learning. Journal of Experimental Psychology, 1958, 56, 193-202.

Davis, D. J., Flexibility and power in comparisons among means. Psychological Bulletin, 1969, 71, 441-444.

Dean, M. G., & Kausler, D. H., Degree of first-list learning and stimulus meaningfulness as related to transfer in the A-B, C-B paradigm. Journal of Verbal Learning and Verbal Behavior, 1964, 3, 330-334.

Ellis, H. C., Transfer: Empirical findings and theoretical interpretations. In M. H. Marx (Ed.), Learning: Processes. Toronto, Ontario: MacMillian, 1969, pp. 416-419.

Ellis, H. C., & Burnstein, D. D., The effect of stimulus similarity and temporal factors in perceptual transfer of training. Technical Report No. 1, 1960, Sandia Corporation, Albuquerque, New Mexico.

Ellis, H. C., & Hunter, J. E., Response meaningfulness and the temporal course of transfer. Technical Report No. 2, 1960, Sandia Corporation, Albuquerque, New Mexico.

Ellis, H. C., & Hunter, J. E., The effect of response familiarization on the temporal course of transfer. Technical Report No. 3, 1961a, Sandia Corporation, Albuquerque, New Mexoci.

Ellis, H. C., & Hunter, J. E., A comparison of the temporal course of retention and non-specific transfer. Technical Report No. 4, 1961b, Sandia Corporation, Albuquerque, New Mexico.

Hamilton, C. E., The relationship between length of interval separating two learning tasks and performance on the second task. Journal of Experimental Psychology, 1950, 40, 613-621.

Jung, J., Transfer of training as a function of degree of first-list learning. Journal of Verbal Learning and Verbal Behavior, 1962, 1, 197-199.

Jung, J., Effects of response meaningfulness (m) on transfer of training under two different paradigms. Journal of Experimental Psychology, 1963, 65, 377-384.

Jung, J., Verbal learning. New York, N. Y.: Holt, Rinehart, & Winston, 1968.

Kirk, R. E., Experimental Design:Procedures for the behavioral sciences. Belmont, California: Brooks/Cole Publishing Company, 1968.

Martin, E., Transfer of verbal paired-associates. Psychological Review, 1965, 72, 327-343.

Merikle, P. M., & Battig, W. F., Transfer of training as a function of experimental paradigm and meaningfulness. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 485-488.

Montaque, W. E., & Kiess, H. O., The associability of CVC pairs. Journal of Experimental Psychology, 1968, 78 (Monogr. Suppl. 2).

Murdock, B. B., Jr., Transfer designs and formulas. Psychological Bulletin, 1957, 54, 313-326.

Newton, J. M., & Wickens, D. D., Retroactive inhibition as a function of the temporal position of the interpolated learning. Journal of Experimental Psychology, 1956, 51, 149-154.

Noble, C. E., Meaningfulness of association value (a), rated associations (a'), and scaled meaningfulness (m') for the 2100 CVC combinations of the English alphabet. Psychological Reports, 1961, 8, 487-521.

Osgood, C. E., The similarity paradox in human learning: A resolution. Psychological Review, 1949, 56, 132-143.

Postman, L., Transfer of training as a function of experimental paradigm and degree of first-list learning. Journal of Verbal Learning and Verbal Behavior, 1962, 1, 109-118.

Snedecor, G. W., Statistical methods applied to experiments in agriculture and biology. Ames, Iowa: Iowa State University Press, 1956, pp. 281-284.

Spiker, C. C., Associative transfer in verbal paired-associate learning. Child Development, 1960, 31, 73-87.

Thune, L. E., Warm-up effect as a function of level of practice in verbal learning. Journal of Experimental Psychology, 1951, 42, 250-256.

Underwood, B. J., & Keppel, G., An evaluation of two problems of method in the study of retention. American Journal of Psychology, 1962, 75, 1-17.

Underwood, B. J., & Keppel, G., Retention as a function of degree of learning and letter-sequence interference. Psychological Monographs, 1963, 77 (4, Whole No. 567).

Underwood, B. J., Runquist, W. N., & Schulz, R. W., Response learning in paired-associate lists as a function of intralist similarity. Journal of Experimental Psychology, 1959, 58, 70-78.

Underwood, B. J., & Schulz, R. W., Meaningfulness and verbal learning. New York: Lippincott, 1960.

Weitz, J. Criteria for criteria. American Psychologist, 1961, 16, 228-231.

Weitz, J., The use of criterion measures. Psychological Reports, 1964, 14, 803-817.