THE EFFECT OF DELAYED AUDITORY FEEDBACK ON THE ACQUISITION AND RETENTION OF EASY AND DIFFICULT PAIRED-ASSOCIATE TRIGRAMS

by

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ABSTRACT

This study investigated the effects of delayed auditory feedback (DAF) on the acquisition and 24 hour retention of paired-associate CVC trigrams. Four pilot studies were carried out to determine optimum procedures and materials.

Experiment 1 employed a 2 x 2, between-groups factorial design. There were two auditory feedback conditions - DAF and normal auditory feedback (NAF), and two difficulty conditions - lists of eight CVC pairs differing in meaningfulness (m'). The lists were labelled easy (E) and difficult (D) on the basis of their average m' values. Subjects were tested using a constant trials anticipation procedure. List E subjects had significantly greater acquisition scores than List D subjects. Type of feedback did not affect acquisition scores. No interaction was observed between feedback condition and list difficulty. It was not possible to determine the average criterion trial of D list groups. Calculation of the average E list criterion trial was possible, and indicated that DAF did not affect the acquisition rate of this list.

Experiment 2 investigated the effect of DAF on the retention of the E list. The procedure was the same as that employed in Experiment 1. However, original learning for the two groups in this study was equated on the basis of the average criterion trial of their counterpart groups in Experiment 1. Subjects returned after 24 hours for a one trial retention test under NAF conditions.

No difference in retention scores of the DAF and NAF groups was observed.

The discussion focussed on procedural limitations, and suggested improvement of the procedures used in this study to better explore the effects of DAF on the acquisition and retention of printed, verbal material.

Examiners [redacted]

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CHAPTER 1

INTRODUCTION

A number of experiments (King, 1963; King & Dodge, 1965; King & Walker, 1965; King & Wolf, 1965; Rankin, 1967; Timmons, 1974) have examined the effects of delayed auditory feedback on learning and retention of verbal material and have obtained differing results. However, limitations in design within some of the experimental studies (e.g., King & Dodge, 1965) make it difficult to interpret their conclusions. Widely varying procedures across a number of the experiments (e.g., King & Wolf, 1965, vs. Rankin, 1967, vs. Timmons, 1974) make a coherent overall view of the various findings difficult to obtain.

Significance of the Study

A study that manipulates what appears to be a key variable, meaningfulness, and controls original learning in order to properly measure retention (Underwood, 1964) provides additional information as to the effects of delayed auditory feedback (DAF) on acquisition and retention of verbal material.

Purpose of the Study

The purpose of this study was to determine the effects of DAF on the acquisition and retention of verbal paired-associates of different levels of meaningfulness.

Limitations of the Study

Students participating in this study were undergraduates of the University of Victoria, Victoria, British Columbia, Canada. Students who had previous experience with DAF and/or paired-associate (PA) learning or obvious speech defects were not allowed to participate in the experiment. Other past experiences of the undergraduates were beyond the researcher's control. The experiments upon which this study is based employed a variety of stimulus materials, methods of presentation, and dependent variables. Conclusions drawn about previous research from the results of this study are limited by the extent to which the variables and procedures of this study coincide with those of previous studies. Time of testing was dependent, to a large extent, on the schedules of the subjects and varied accordingly. The experiment was not "double-blind", i.e., the researcher was aware of the experimental condition for each subject during the procedure.

Meaningfulness (m') of the stimuli was assumed to have the same relative value for the experimental sample as for the original sample on which the stimuli were standardized. While this assumption was not experimentally verified, previous research has found a high correlation ($r = .97$) on m' scores for populations separated by space and time (Noble, Sutker & Jones, 1968). It was beyond the scope of this research to control difficulty of pronunciation while experimentally manipulating meaningfulness.

Definitions

The following terms occur frequently throughout the text:

CVC Trigram: A three letter configuration consisting of a consonant, a vowel, and a consonant, e.g., CAZ.

Decibel (db): A "unit of a logarithmic scale of the ratio of two sound pressures" (Gulick, 1971, p. 239). In this scale 0 db represents a ratio of a unit of the sound being measured to an equal unit of ongoing environmental sound. This unit is only meaningful in relation to a reference level, the standard being a 0 db pressure level of .002 dynes/cm^2 (Wyburn, Pickford & Hurst, 1964, p. 48).

Delayed Auditory Feedback (DAF): The lengthening of the temporal relationship between speech production and its airborne auditory perception.

Meaningfulness (m): "The number of associations provided by a subject to a verbal unit in a specified amount of time, frequently thirty to sixty seconds" (Hall, 1971, p. 69).

Meaningfulness (m'): "The mean ratings of the number of associations a given verbal unit is believed to produce; five categories

have been most often used. Frequencies may be transformed into deviates of the normal curve by the Thurstone-Attneave method of successive intervals" (Hall, 1971, p. 69).

Normal Auditory Feedback (NAF): The existing temporal relationship between speech production and its auditory perception, about .001 seconds (Yates, 1963).

Paired-associate (PA): A configuration of two paired symbols, the first of which is the stimulus, the second the response, e.g., LAZ-BIX.

Hypotheses

1. Experiment 1

   In a given number of trials:

   a. Groups presented easy material will correctly anticipate a significantly greater number of items than those presented difficult material.

   b. Groups learning under normal auditory feedback conditions will correctly anticipate a significantly greater number of items than those learning under delayed auditory feedback conditions.

   c. There will be a significant interaction between feedback condition and difficulty of material as measured by mean number

of items correctly anticipated.

2. Experiment 2

Given that the number of items learned has been equated across groups:

a. There will be no significant difference in mean number of items retained between groups that learned easy material and those that learned difficult material.

b. There will be no significant difference in mean number of items retained between groups that learned under normal auditory feedback conditions and those that learned under delayed auditory feedback conditions.

c. There will be no significant interaction between feedback condition and difficulty of material as measured by mean number of items retained.

Underlying Assumptions

It is assumed that easy material will be learned more quickly than difficult material and that DAF will have an effect on the acquisition and/or retention of printed, verbal material. If these assumptions are true, it would be beneficial to know if DAF affects acquisition, retention, or both, and if there is an interaction between difficulty of material and effect of DAF.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

Introduction

The review within this chapter was restricted to (1) the two experimental variables, DAF and meaningfulness, and (2) those studies examining the effects of DAF on acquisition and/or retention of verbal material.

The Variables

Delayed Auditory Feedback

Delayed auditory feedback is produced using a magnetic tape recorder with separate record and playback heads. The tape recorder usually is modified so that one of the heads is movable. The subject's voice is recorded and delayed in reproduction by an interval determined by the distance between the record and playback heads, given a constant tape speed. The voice is then transmitted via the playback head to the subject's headphones so that it is heard with the desired delay. Varying delays can be obtained by manipulating the distance between the two heads, altering the tape speed, or both (Yates, 1963).

Physiological changes while speaking under DAF include galvanic skin response decrement (Hanley, Tiffany & Brungard, 1958; King & Wolf, 1965) and significant increases in heart rate (Doehring & Harbolt, 1957). Both indicate increased physiological arousal.

The speech of many subjects is disrupted by DAF. These disruptions include decreased reading rate and increased intensity of utterance (Black, 1951), increased reading errors (Butler & Galloway, 1957) and

reduced rate of production of single speech sounds (Fletcher & Yates, 1971). Increasing the difficulty of pronunciation of stimulus materials magnifies the effects of DAF (Kline, Guze & Haggerty, 1954; Spilka, 1954), as does manipulating delay time and intensity. Delays of .17 to .20 seconds presented at intensities ranging from 75 to 90 db maximize the DAF effects for males (Brokaw, 1966; Butler & Galloway, 1957; Fairbanks, 1955; Fletcher & Yates, 1971; Mahaffey & Stromstra, 1965). Adult females respond differently to DAF than do males, adapting better over time to its effects (Timmons, 1971) and requiring higher intensities before they react (Bachrach, 1964). At 85 to 90 db above speech reception level their reading time of a standardized phrase is maximally prolonged at .27 seconds delay (Mahaffey & Stromstra, 1965).

Meaningfulness

The 'meaning' of a verbal stimulus may be defined as a relationship between a stimulus (S) and a response (R), with increase in meaning being a simple linear function of the number of S-multiple R connections acquired in a particular individual's history (Noble, 1952). Noble's (1952) original index of meaningfulness, or association value, was based on this concept. It was obtained by averaging the number of continued written associations made by a sample of subjects during a specified time interval. He labelled this measure m. While this method is highly reliable (Hall, 1971, pp. 50-51) it is time-consuming, so Noble (1961) devised a scale of rated meaningfulness (m'). He averaged subjects' judgements concerning the number of associations they believed a given

verbal unit would elicit. Rating frequencies were transformed into deviates of the normal curve.

Archer (1960) obtained a different measure of association value that was based on the percentage of subjects who indicated that a verbal item "elicits a 'yes' response on at least one of four questions all related to whether or not the item seems like a word" (Hall, 1971, p. 69).

While there is some disagreement as to whether Noble's (1961) or Archer's (1960) values are the more accurate (Hall, 1971, p. 69), Noble's m' will be considered sufficiently discriminating for the purposes of this study. Noble's m and m' are highly correlated (Hall, 1971, p. 72). The m' scale has high internal reliability for rating CVCs (Noble, 1961; Noble, Sutker & Jones, 1968) as measured by the internal consistency test of Edwards and Thurstone. This test indicates the average error of reproducing the original data from the formula used to transform it into the m' scale ranges from 1.9% to 2.8%. Using the same test, Locascio and Ley (1972b) found the average error to be 2.4% for CVCVCs.

The following studies used m or m' to examine the relationship between meaningfulness and learning under NAF conditions. Mandler and Huttenlocher (1956) and Noble, Stockwell and Pryer (1957) have demonstrated PA learning to be a function of the meaningfulness of the CVCs used. That is, in a PA learning task, the higher the m' value, the greater the percent correct responses on any trial. These results were supported by Cieutat, Stockwell and Noble (1958). Noble, Showell and Jones (1966) found the percent of correct items on any trial of a

serial learning task was a function of the m' value of the CVCs employed. This relationship between meaningfulness as defined by m or m' and learning has been found to hold true using CVCVCs in a free recall task (Locascio & Ley, 1972a) and nouns in a PA learning task (Satz, 1967).

Review of the Literature

Studies examining the effects of DAF on acquisition and retention of verbal, printed stimuli have variously used PA or connected meaningful material. Rankin (1967) presented male and female university undergraduates with two PA lists of eight items each. He used a constant trials, anticipation procedure. One list was defined as "easy" and consisted of logically related familiar words such as "man-boy", while the second list was defined as "complex" and consisted of incorrect multiplication equations such as "5 x 1 = 11". The experimental subjects learned both lists under .27 seconds DAF and the control group learned the two lists under normal auditory feedback (NAF). Both groups learned the easy list equally well, but NAF subjects achieved a significantly higher mean score on the false equations than did the DAF subjects. Rankin concluded that DAF represses learning of a complex task.

The effects of DAF on immediate and 24 hour recall of connected meaningful material by college undergraduates was examined by King (1963), King and Dodge (1965), King and Walker (1965) and King and Wolf (1965). The stimulus material in three of the experiments consisted of a five paragraph, 221 word story about the selection of the first astronauts (King, 1963; King & Dodge, 1965; King & Wolf, 1965), while

the remaining study (King & Walker, 1965) used the astronaut story plus a one paragraph article dealing with the increased use of the oceans. An independent variable in all experiments was type of feedback--.2 seconds DAF versus NAF. Other independent variables included presentation of NAF with and without earphones, prompts before and after oral recall, and prior knowledge of a pending recall test. Dependent variables measured included accuracy on oral and written recall tests, and prompted and unprompted recall scores. In all cases there was less immediate recall by the DAF subjects than by the NAF subjects. However, delayed written recall of subjects who had read the material under DAF was equal to the delayed recall of those who had read it under NAF (King & Wolf, 1965). Delayed oral recall of material read under DAF "showed a marked relative increase" over immediate recall scores when compared to the delayed recall of material read under NAF. However, NAF delayed retention scores were still significantly greater than those of the DAF group (King & Dodge, 1965). These results led King and associates to conclude that material presented under DAF conditions is acquired, but is not available for immediate recall, only for delayed recall.

A differing set of findings was presented by Timmons (1974). She gave immediate and 24 hour retention tests consisting of multiple choice questions to undergraduates who had read a 300 word prose passage under conditions of .2 seconds DAF or NAF. The 1925 passage "was considered difficult due to its unusual topic and large number of rarely used words" (Timmons, 1974). Timmons found that the DAF subjects had significantly lower retention scores on both immediate and

delayed retention tests than did NAF subjects. DAF subjects' immediate and delayed recall was poorer than the NAF subjects' delayed recall. She argued that DAF may interfere with acquisition, and not retention, when difficult material is used.

The results of these studies appear to be disparate. King and associates concluded that DAF affects immediate recall, based on the increased delayed recall scores of DAF subjects over their immediate retention scores. Timmons concluded that DAF affects acquisition as DAF subjects exhibited a loss in retention with the passage of time. However, it may be that two as-yet-unexplored factors could have influenced the outcomes of the above experiments. These two factors are difficulty of material used, defined in terms of meaningfulness, and control of original learning when measuring retention.

It has been repeatedly demonstrated that meaningfulness affects learning (L'Abate, 1959; Mandler & Huttenlocher, 1956; Noble, 1957), yet none of the studies using DAF have experimentally manipulated this variable. Rankin's (1967) use of incorrect multiplication equations as his complex stimuli may have confounded the effects of materials difficulty with the process of proactive interference. Timmons (1974) arbitrarily called her material 'difficult', and King (1963) labelled the astronaut story 'somewhat fanciful'. None of these variables appears to coincide with the conventional concept of meaningfulness.

The importance of equating original learning across groups before measuring differences in retention among those groups has been discussed by Underwood (1964) and others (e.g., Battig, 1965; Shuell & Keppel, 1970).

However, none of the three studies discussed above that measured retention (King & Dodge, 1965; King & Wolf, 1965; Timmons, 1974) controlled for possible differences in original learning.

Summary of the Review of the Literature

The review of the literature presented a number of studies examining the effects of DAF on the acquisition and retention of verbal material. The studies reviewed (King, 1963; King & Dodge, 1965; King & Walker, 1965; King & Wolf, 1965; Rankin, 1967; Timmons, 1974) employed a variety of procedures and materials. The review indicated that the effects of DAF on acquisition and retention seems to vary in relationship to these factors. In addition, two uncontrolled factors - meaningfulness and equation of groups on original learning - may be responsible for the varying outcomes that have been reported.

Conclusion

While DAF appears to have some effect on learning and/or retention, it is difficult to state what that effect is, and under what conditions it occurs.

Thus it seems appropriate to ask two questions. What is the effect of DAF on acquisition of verbal material when meaningfulness is experimentally manipulated, and what is the effect of DAF on retention when meaningfulness has been experimentally manipulated and original learning has been equated across the experimental groups? A PA learning task using CVC trigrams as the verbal material can be used to explore these questions. This procedure readily lends itself to control of original

learning (Underwood, 1964) and difficulty of material is easily determined using the rated meaningfulness scores of Noble (1961).

CHAPTER III

SUMMARY OF THE PROPOSED EXPERIMENTS AND PILOT STUDIES

It was intended that two major experiments would be conducted to determine the effect of DAF on acquisition and retention of CVC PAs. Both experiments would employ a 2 x 2 factorial design. That is, two conditions of feedback (DAF trained vs. NAF trained) x two levels of meaningfulness (easy vs. difficult PAs).

Experiment I

Subjects would be tested individually using a PA anticipation procedure with eight PAs being presented at a 2:2 rate with a four second intertrial interval (ITI) for 11 learning trials. A 2 x 2 analysis of variance then could be used to compare the four experimental groups on total items correctly anticipated. The acquisition scores would be used to determine the average number of trials (n) it took the subjects in each group to learn five out of eight items correctly; this information then being used in Experiment 2 to equate original learning among groups by using differential numbers of trials, a procedure based on Underwood's (1964) single-entry projection technique.

Experiment 2

Day 1: The same procedure as for Experiment 1 would be followed. However, after the subject was assigned to one of the four experimental conditions, he would be given n-1 learning trials. This would be determined by the n of the corresponding Experiment 1 acquisition group,

where n represents the learning that occurred on trial n-1.

Day 2: Subjects would return 24 hours after their Day 1 training to receive a one trial retention test, all subjects performing this recall task under NAF conditions. A 2 x 2 analysis of variance would be used to compare the groups on number of items retained.

The alpha level for all statistical tests of significance was to be set at .05.

The Pilot Studies

Four pilot studies were carried out. Their purpose was to refine procedures, to find two eight-item lists that differed in difficulty and to determine the number of presentation trials necessary for all subjects to reach a criterion of five out of eight correct anticipations.

Ninety-eight male and female undergraduate students at the University of Victoria took part in the four studies. These subjects were volunteers obtained by inviting the participation of students at the University. Students who had previous experience with DAF or PA learning experiments were excluded from the studies.

There were three lists of stimuli. Each consisted of eight CVC pairs. The lists were labelled very easy (VE), easy (E) and difficult (D), based on their respective mean m' values of 4.78, 3.87 and 1.86. The lists are presented in Appendix A and the procedure for choosing the list items is presented in Chapter IV.

Subjects were tested individually under DAF or NAF conditions using PA anticipation-learning procedures. The pilot studies each employed two lists, i.e., the E and D lists or the VE and E lists. Item present-

ation rate varied from study to study as did the instructions and number of presentation trials.

There were a number of important findings from these pilot studies. Requiring subjects to pronounce the items "letter-by-letter" maximized DAF effects, but prevented subjects from reaching criterion. Therefore, subjects in Experiments 1 and 2 were required to pronounce the items as syllables. The D list was more difficult to learn than E and VE lists, which appeared to be of equal difficulty for both the DAF and the NAF groups. Twenty presentation trials were necessary to insure that all subjects reached criterion on the D list, while 20 trials on the VE list appeared to bore them. As a result, it was decided that subjects in Experiment 1 would receive 20 trials on either the E or D lists. A 1:1 presentation rate did not give subjects enough time to anticipate the R-item, while a 4:4 rate allowed too much time for uncontrolled silent rehearsal. Since a 2:2 presentation rate allowed subjects enough time to anticipate the R-item and minimized the time available for silent rehearsal, the items were presented at this rate for subjects in Experiments 1 and 2. Subjects in the pilot studies exhibited a great deal of anxiety upon entering the laboratory and experiencing DAF for the first time. It was hypothesized that this anxiety might be masking any DAF effect on the experimental task. Therefore, the experimenter modified his behaviour to reduce this anxiety for subjects in Experiments 1 and 2. Pilot subjects exhibited wide variations in their pronunciation of D list CVCs, so it was decided that in Experiments 1 and 2 subjects would listen to the researcher pronounce the PAs on the first presentation trial.

Summary of the Implications of the Pilot Studies

It was determined that subjects participating in Experiments 1 and 2 would be required to learn the items of either the E or the D list as single units; the items would be presented at a 2:2 rate for 20 trials for subjects in Experiment 1; the experimenter would modify the instructions to insure fairly similar pronunciation of the items across subjects, and he would modify his behaviour to reduce situational anxiety.

CHAPTER IV

EXPERIMENT 1: ACQUISITION

The purpose of this study was to determine the effect of DAF on the acquisition of easy and difficult CVC paired-associates.

It was hypothesized that in a given number of trials:

a. Groups presented easy material would correctly anticipate a significantly greater number of items than would groups presented difficult material;

b. Groups learning under NAF would correctly anticipate a significantly greater number of items than those learning under DAF conditions; and

c. There would be a significant interaction between feedback condition and difficulty of material, as measured by the mean number of items correctly anticipated.

The study employed a 2 x 2 factorial design to test the hypotheses, i.e., two conditions of feedback (DAF trained vs. NAF trained) x two levels of meaningfulness (easy vs. difficult PAs).

Method

Subjects: Fifty-four subjects, 27 males and 27 females, were tested. Their ages ranged from 18 to 41, with a mean of 20.6. About one-half of the subjects received course credit for participating. Subjects were randomly assigned to groups within the restriction of maintaining an equal number of men and women in each condition. Four of the 54

subjects were rejected due to equipment failure, failure to follow instructions, and/or failure to co-operate. One subject was randomly discarded from the DAF-D group and one from the DAF-E group to maintain an equal number of subjects per cell. There were 12 subjects, six men and six women, in each condition.

Setting and Apparatus: Experiment 1 took place in a 10' x 14' room illuminated by overhead fluorescent lighting. The apparatus that produced both delayed and synchronous auditory feedback was a Korting Constellation 88 tape-recorder with a movable playback head that allowed for production of a wide range of delay times. Subjects spoke into an AKG #D24M microphone of 150 ohms impedance, and heard their voices through a Sharpe 660 headset of 8 ohms nominal impedance. The delay times used (.09, .18, .27 and .36 seconds) varied slightly due to equipment limitations. Sound intensity level was nominally 77 db SPL above background noise level as measured by a BMK Büell & Kjoer impulse precision sound level meter #2209, but there was some variation in sound intensity due to differences in individual subjects' voice level. PAs were presented via a Lafayette 303B2 memory drum. A digital clock with start, stop and recycle capabilities was used to time subjects' responses to the different delays. The apparatus remained constant throughout Experiments 1 and 2.

The Stimuli: The trigrams were taken from Noble's (1961) list of the 2100 CVCs of the English alphabet. Those CVCs defined as "difficult" (D) for the purpose of this study were chosen from the 95 with m' values

of 1.80 to 1.91 inclusive, and those CVCs defined as "easy" (E) were chosen from the 90 with m' values of 3.63 and 3.84 inclusive. These corresponded to the upper end of the "below average" associations category and the "above average" associations category respectively.

The ranked CVCs of the D category were alternately divided into two groups labelled Stimulus (S) and Response (R). Constraints were placed on the selection of the CVCs to lessen the probability of subjects making "clang" associations or associations based on visual similarities. These constraints were placed on the selection of items for the S and the R list separately and on the pairing of the items. There could be no formal similarity in the first consonant of the items of the S or the R list, or across the two lists. Each vowel had to occur twice only within each S and R list. No pair could consist of an S-item that ended in the same consonant with which the R-item began (e.g., BET-TIP). No vowels could be duplicated in any pair (e.g., MOF-DOQ). There could be no alphabetical sequence of consonants from S-item to R-item (e.g., DEB-CAT).

Eight CVCs that met the within-list constraints were selected from those CVCs in the R category. As choice of R-items automatically limited the choice of S-items, those items no longer acceptable were discarded. Within the constraints listed above, eight CVCs from those remaining in the S category were paired with the R-items. The same procedure was followed to construct the E and VE lists. For the reasons discussed in Chapter III, the VE list was not used in this experiment.

The eight pairs making up List D were CIX-BOQ, NID-HUW, LOZ-JEG, QAR-MIF, DUH-PIQ, SAJ-VED, WUT-FOP, ZOL-YUR. The CVCs making up the

pairs have an average m' value of 1.86. The eight pairs making up List E were NAG-TON, DOC-FED, GEM-CAP, JAP-KIT, LOV-BEG, WEB-HIS, PIT-ROB, MIS-VAN. The CVCs making up these pairs have an average m' value of 3.78. The m' values of the individual pairs are presented in Appendix A.

Procedure: All subjects were tested individually. Subjects were randomly assigned to one of the four main experimental groups prior to their entry into the laboratory. The four groups were: DAF trained-D list (DAF-D); DAF trained-E list (DAF-E); NAF trained-D list (NAF-D) and NAF trained-E list (NAF-E).

As the student entered the laboratory he was thanked for coming and seated in front of the memory drum. The experimenter talked with him briefly, asked a few questions about age and participation in previous research, then requested that he put on the microphone and headset. He only assisted in this if the subject appeared to be having difficulty, but informed the subject of his intention to assist before leaving his seat. The microphone rested on the subject's chest six to eight inches from his mouth, suspended by a cord going around his neck. The warm-up task was then introduced. It consisted of a 26 word sentence that the subject was required to read four times (Appendix B). During each reading, the subject experienced a different delay--.09, .18, .27, and .36 seconds. The order in which the delay times were experienced varied from subject to subject according to a table of random numbers (Appendix C). The experimenter timed each reading using the digital clock. The delay producing the longest reading time was considered the optimal delay for the subject, and was used during the experiment if the subject was in a DAF condition. Optimal delay times obtained in this study and in Experiment 2 are presented in Appendices D and E respectively.

After acknowledging the difficulty of the warm-up task in a sympathetic manner, the experimenter proceeded to read the PA learning instructions to the subject. He was asked to listen to the experimenter pronounce the CVCs during the first trial, to insure fairly similar pronunciation of items across subjects. For the remaining trials he was told to read aloud the S-item and orally recall the R-item before it appeared in the memory drum slot. The subject was encouraged to guess at the R-item if uncertain. If he could not guess, or guessed incorrectly, he was instructed to read the R-item aloud when it appeared. To insure that the subject understood the instructions, the experimenter asked him to repeat back to him what was understood after hearing the instructions. If the subject was correct, he responded with "That's right", and briefly reiterated the instructions using a sample pair. If the subject was incorrect, he responded with "That's not quite it", and used the sample pair to re-explain the procedure. The verbatim instructions are presented in Appendix F. PAs were presented at a 2:2 rate with a four second ITI for 20 trials. That is, the S-item was presented for two seconds, followed by the S-and R-items together for two seconds. Due to equipment limitations there was an eight second ITI between Trials 11 and 12. The order of PA presentation within each trial was randomized (Appendix G) to avoid any serial learning. No adjacent trials started or ended with the same pair. Trials 12 to 20 were a repetition of the first 9 trials. At the conclusion of Trial 20 the student was asked to remove the microphone and headset. The purpose of the experiment was explained, he was thanked for his cooperation and asked not to discuss

the details of the experiment with others.

The experimenter sat slightly behind and to the left of each subject to score the responses. A sample score sheet is presented in Appendix H.

Results

Total Items Correct: Means and variances for total items correct are presented in Table 1. A parametric analysis of the data was considered appropriate after an F-max test indicated that the hypothesis of homogeneity of variance could not be rejected (F-max/ .99/3, 12 = 1.84, n.s.). As shown in Table 2, an analysis of variance found a significant difference due to meaningfulness. There was no difference as a result of feedback condition, and no observed interaction between difficulty and feedback condition.

Table 1

Mean Total Correct Anticipations and Variances for the Two Conditions of Feedback and Two Levels of Meaningfulness

	Group			
	DAF-D	NAF-D	DAF-E	NAF-E
Mean	55.06	58.75	88.75	102.42
Variance	719.72	819.48	529.66	974.08

Table 2

Analysis of Variance of Correct Anticipations for Two Conditions of Feedback and Two Levels of Meaningfulness

Source	df	SS	MS	F	p	%variance
Feedback	1	901.33	901.33	1.18	.28	1.71
Meaningfulness	1	17941.33	17941.33	23.58	<.001	34.10
Feedback x Meaningfulness	1	300.00	300.00	0.39	.53	0.57
Within	44	33472.33	760.73			
Total	47	12614.99				

Trials to Criterion: Four of the 12 subjects in both NAF-D and DAF-D conditions failed to reach criterion. Therefore, it was not possible to determine the trial at which subjects learning the D list reached criterion without seriously biasing the results. All subjects learning list E reached criterion. Mean trials to criterion and variances for the two groups are presented in Table 3. A parametric comparison of the two groups was considered appropriate since an F-max test indicated that the hypothesis of homogeneity of variance could not be rejected (F-max/.99/1, 12/ = 2.03, n.s.). The analysis of variance presented in Table 4 found no significant difference between the groups.

Table 3

Mean Trials to Criterion for the Two Conditions of Feedback and One Level of Meaningfulness

	Group	
	DAF-E	NAF-E
Mean	8.08	7.92
Variance	8.27	16.81

Table 4

Analysis of Variance of Trials to Criterion for the Two Feedback Conditions and One Level of Meaningfulness

Source	df	SS	MS	F	p	% variance
Feedback	1	0.17	0.17	0.01	.91	0.06
Within	22	275.83	12.54			
Total	23	276.00				

Discussion

The first hypothesis was supported; the second and third were not. The predicted difference due to list difficulty was obtained, but neither the hypothesized difference due to feedback condition, nor the interaction between list difficulty and feedback condition was observed.

The difference due to item difficulty observed in this experiment corresponds to the NAF findings of L'Abate (1959), Mandler and Huttenlocher (1956), Noble (1957) and others.

The lack of difference due to feedback condition and the absence of any interaction should not be seen as a finding discrepant from those of Timmons (1974) and King and associates (King & Dodge, 1965; King & Wolf, 1965). The use of discrete syllables, as opposed to connected material, may have prevented the occurrence of any DAF effect. That is, the researcher observed that the speech of DAF subjects was often greatly disrupted while reading the warm-up sentence, but it was not so affected during the learning task. It appears that DAF affects the flow of speech, but not the pronunciation of discrete syllables. If this is the case, then this study's findings can be related to Rankin's (1969) study which found an interaction between DAF and list complexity. His results may have been affected by an artifact in his lists, and not complexity or lack of it, since his "complex" list consisted of phrases, while his "easy" list consisted of discrete syllables.

The failure of 33% of the subjects in both the NAF-D and DAF-D conditions to reach criterion may reflect the wide within-group variance across all groups. This was observed in trials to criterion of E list subjects, and total items correct for all subjects. It must be assumed that fast and slow learners were randomly, and fairly equally, distributed across all groups (Shuell & Keppel, 1970). It was hypothesized that those subjects failing to reach criterion on the D list were slow learners within the particular constraints of this experiment.

The inability of the D list subjects to reach criterion might be remedied by constructing a new D list with an m' value greater than that employed in this study. Experiment 1 could then be repeated using this new D list and the original E list. However, to do so was beyond the scope of this research.

Failure to obtain a difference between feedback conditions may have been an artifact of the procedure. However, it still remained possible that DAF does not affect acquisition but does affect retention (King & Dodge, 1965; King & Wolf, 1965). For this reason it was considered worthwhile to proceed with a limited version of Experiment 2, and examine the effect of DAF on retention of E list material only.

CHAPTER V

EXPERIMENT 2: RETENTION

The purpose of this study was to determine the effect of DAF on the retention of easy CVC paired-associates.

It was hypothesized that if original learning has been equated across groups, there will be no significant difference in mean number of items retained between subjects learning under NAF and those learning under DAF conditions.

A one-factor design was employed to test this hypothesis, i.e., one level of meaningfulness (E list PAs) with two feedback conditions (DAF trained vs. NAF trained).

Method

Subjects: Twenty-seven students, 14 men and 13 women, took part in the experiment. Their mean age was 20.7, and they ranged in age from 18 to 42. All subjects were volunteers who received course credit for taking part.

Three of the 27 subjects were rejected, two from the DAF-E condition for equipment failure and failure to follow instructions. One NAF-E male was randomly discarded to maintain an equal number of subjects (six men and six women) per cell.

Setting and Apparatus: As previously described in Chapter IV.

The Stimuli: The E list described in Chapter IV was employed. Its items had an average m' value of 3.78.

Procedure: This study required all subjects to be tested on two successive days.

Day 1: The procedure used in Experiment 1 was employed. However, two changes were made to meet the requirements of this study. Firstly, subjects received only seven presentation trials, based on the average value of n-1 in Experiment 1. That is, DAF-E and NAF-E subjects in Experiment 1 reached criterion on Trial 8, which represents the learning that occurred on Trial 7. Secondly, at the end of Trial 7 the student was thanked for coming, reminded to return the following day for a different test, and told that the experiment would be explained at the conclusion of the second day's testing.

Day 2: The subject returned to the laboratory 24 hours after Day 1 training. As he entered the laboratory he was again welcomed by the experimenter, seated and asked to put on the headset and microphone. He then was informed that he would be shown the same set of letters as on the previous day and that he should try to orally recall as many as he could. One trial of the items was presented via the memory drum and responses were recorded. Verbatim instructions are presented in Appendix F. All subjects performed the recall task under NAF conditions.

Results

All subjects tested on Day 1 returned on Day 2. Mean items retained, and variances of the groups, are presented in Table 5. As the observed value of the F-max statistic for homogeneity of variance was less than the critical value for an .01 level test, the hypothesis of homogeneity of variance was not rejected (F-max/.99/1,1 = 1.35, n.s.). A parametric analysis was considered to be an appropriate test of significant differences. The one-way analysis of variance presented in

Table 6 found no significant difference between NAF-E and DAF-E subjects.

Table 5

Mean Correct Responses and Variances for the Two Feedback Conditions and One Level of Meaningfulness

	Group	
	DAF-E	NAF-E
Mean	3.08	4.83
Variance	8.08	5.97

Table 6

Analysis of Retention Scores for the Two Conditions of Feedback and One Level of Meaningfulness

Source	df	SS	MS	F	p	% variance
Feedback	1	18.38	18.38	2.62	.12	10.62
Within	22	154.58	7.03			
Total	23	172.96				

Discussion

It was hypothesized that feedback condition would not affect

retention if original learning was equated across the DAF and NAF groups. This hypothesis was not rejected, but it should not be inferred that DAF might not affect retention in other circumstances. The procedural limitations discussed in Experiment 1 were applicable to this study as well. Subjects appeared to be unaffected by DAF on the experimental task. Furthermore, it may be assumed that the within-group variance on the retention trial reflects the variance in learning on the last acquisition trial (Underwood, 1964). If this is so, then the averaging procedure used in this study to determine the criterion trial may be inadequate for the proper equation of original learning among the different experimental groups. That is, while some of the variance may be due to differences in the learning rates of fast and slow learners (Shuell & Keppel, 1970), it may also reflect the inability of the equating procedure to control for the fluctuation of individual subject's scores from trial to trial.

For these reasons, it does not seem appropriate to discuss the disparate retention findings of Timmons (1974), and King and associates (King & Dodge, 1965; King & Wolf, 1965) with regard to this study's negative finding.

It may be recalled that at the conclusion of Day 1 testing subjects were told to return the following day for a "different" test. At the end of Day 2 testing, the experimenter queried the subjects to determine if this deception had prevented them from rehearsing. The majority of subjects indicated they had had a strong suspicion that Day 2 would be a retention test, and that they had done some rehearsing. It appears that a more elaborate deception may be necessary to reduce

this occurence.

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH

This chapter is limited to (1) a summary of Experiments 1 and 2 and (2) the procedural changes necessary to better explore the effect of DAF on the acquisition and retention of verbal, printed material.

Summary of Experiments 1 and 2

Experiment 1 employed an anticipation learning procedure to examine the effect of DAF on the acquisition of E list and D list CVC paired-associates. Subjects learning the E list achieved significantly higher acquisition scores than subjects learning the D list. There were no other significant effects. All subjects reached criterion on the E list. There was no difference due to feedback condition. It was not possible to determine the criterion trial of D list subjects.

Experiment 2 examined the effect of DAF on retention of the E list. Original learning was equated for the two feedback groups using a modification of Underwood's (1964) single-entry projection technique. No difference was observed between DAF and NAF groups on a one trial retention test.

There were two major findings: a PA task that requires subjects to pronounce discrete syllables such as "GEM-CAP" is inappropriate for the exploration of the effect of DAF on the acquisition and retention of verbal, printed material; and large within-group variances in these experiments may reflect inadequate control of confounding variables.

Implications for Future Research

Any study attempting to examine DAF effects must employ a procedure that requires subjects to produce a flow of speech. A serial learning task with a rapid rate of item presentation might be appropriate for exploring the effect of DAF on the acquisition and retention of verbal, printed material. This procedure could control meaningfulness (Nobel, Showell & Jones, 1966) or other important variables such as difficulty of pronunciation (Black, 1951; Spilka, 1954).

Several steps might be necessary to prevent the recurrence of the large within-group variances observed in Experiments 1 and 2. The first of these would be the standardization of the stimuli on a local population, either for m' or difficulty of pronunciation. The second would require a pre-experimental task to separate fast and slow learners (Shuell & Keppel, 1970). If this task were similar to the experimental task then any possible confounding of DAF with "learning-to-learn" would be avoided.

Finally, Underwood's (1964) single-entry projection technique might be used to equate the original learning of retention groups. It permits a more accurate calculation of the criterion trial than does the average trials to criterion approach used in the studies reported here.

Summary of the Experiments and Their Implications

Two experiments were carried out to determine the effect of DAF on the acquisition of easy and difficult CVC PAs, and on the retention of easy CVC PAs. Evidence has been offered to suggest that the PA

learning task used in this study was inappropriate for the examination of the effect of DAF on the acquisition and retention of verbal, printed material.

Suggestions for future research included procedural changes to insure a DAF effect and reduce within-group variance.

BIBLIOGRAPHY

Archer, E. J. Re-evaluation of the meaningfulness of all possible CVC trigrams. Psychological Monographs, 1960, 74, No. 497.

Bachrach, D. L. Sex differences in reactions to delayed auditory feedback. Perceptual and Motor Skills, 1964, 19, 81-82.

Battig, Wm. F. Procedural problems in paired-associate learning research. Psychonomic Monograph Supplements, 1965, 1(1).

Black, J. W. The effect of delayed sidetone upon verbal rate and intensity. Journal of Speech and Hearing Disorders, 1951, 16, 56-60.

Blommers, P., & Lindquist, E. F. Elementary statistical methods in psychology and education. Boston: Houghton Mifflin Co., 1960.

Butler, R. A., & Galloway, T. F. Factoral analysis of the delayed speech feedback phenomenon. Journal of the Acoustical Society of America, 1957, 29(5), 632-635.

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.

Doehring, D. G., & Harbolt, G. J. The relation between speech disturbance and psycho-physiological changes resulting from delayed speech feedback. U.S. Navy School of Aviation Medicine Research Report, 1957, Project No. NM 13 01 99, No. 5.

Fairbanks, G., & Guttman, N. Effects of delayed auditory feedback upon articulation. Journal of Speech and Hearing Research, 1958, 1, 12-22.

Fletcher, J. F., & Yates, A. J. The repetition of single speech sounds under delayed auditory feedback. British Journal of Psychology, 1971, 62(1), 73-79.

Gulick, W. L. Hearing: Physiology and Psychophysics. New York: Oxford University Press, 1971.

Hall, J. F. Verbal learning and retention. Philadelphia: Lippincott, 1971.

Hanley, C. N., Tiffany, W. R., & Brungard, J. M. Skin resistance changes accompanying the sidetone test for auditory malingering. Journal of Speech and Hearing Research, 1958, 1, 286-293.

King, D. J. Immediate memory of connected meaningful material practiced under delayed auditory feedback. Psychological Reports, 1963, 13, 91-96.

King, D. J., & Dodge, A. M. The influence of oral recall on immediate and delayed memory for meaningful material practiced under delayed auditory feedback. Journal of Psychology, 1965, 59, 141-147.

King, D. J., & Walker, H. J. Effect of prompting on the immediate recall of meaningful material practiced under delayed auditory feedback. Perceptual and Motor Skills, 1965, 21, 483-488.

King, D. J., & Wolf, D. The influence of delayed auditory feedback on immediate and delayed memory. Journal of Psychology, 1965, 59, 131-139.

Kline, M. V., Guze, H., & Haggerty, A. D. An experimental study of the nature of hypnotic deafness: Effects of delayed speech feedback. Journal of Clinical and Experimental Hypnosis, 1954, 2, 154-156.

L'Abate, L. Manifest anxiety and the learning of syllables with different associative values. American Journal of Psychology, 1959, 72, 107-110.

Locascio, D., & Ley, R. Associative reaction time, meaningfulness, and mode of study in free recall. Journal of Experimental Psychology, 1972, 95, 460-462. (a)

Locascio, D., & Ley, R. Scaled-rated meaningfulness of 319 CVCVC words and paralogs previously assessed for associative reaction time. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 243-250. (b)

Mahaffey, R. B., & Stromstra, C. P. The effects of auditory feedback as a function of frequency, intensity, time and sex. De Therapia Vocis and Loquela, 1965, 2, D44.

Mandler, G., & Huttenlocher, J. The relation between associative frequency, associative ability, and paired-associate learning. American Journal of Psychology, 1956, 69, 424-428.

Noble, C. E. The role of stimulus meaning (m) in serial verbal learning. Journal of Experimental Psychology, 1952, 43, 437-446.

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

Noble, C. E., Showell, F. A., & Jones, H. R. Serial CVC learning with varied m' but equal a values. Psychonomic Science, 1966, 4, 217-218.

Noble, C. E., Stockwell, F. E., & Pryer, M. W. Meaningfulness (m') and association value (a) in paired-associate syllable learning. Psychological Reports, 1957, 3, 441-452.

Noble, C. E., Sutker, P. B., & Jones, H. R. On the sigmoidal law relating association value (a) and scaled meaningfulness (m'). Perceptual and Motor Skills, 1968, 26, 375-386.

Rankin, R. J. Delayed auditory feedback as a method of manipulating anxiety in a paired-associate learning task. Perceptual and Motor Skills, 1967, 25, 273-277.

Satz, E. Thorndike-Lorge frequency and m of stimuli as separate factors in paired-associates learning. Journal of Experimental Psychology, 1967, 73, 473-478.

Shuell, T. J., & Keppel, G. Learning ability and retention. Journal of Educational Psychology, 1970, 61(1), 59-65.

Spilka, B. Some vocal effects of different reading passages and time delays in speech feedback. Journal of Speech and Hearing Disorders, 1954, 19, 37-47.

Timmons, B. A. Sex as a factor influencing sensitivity to delayed auditory feedback. Perceptual and Motor Skills, 1971, 32, 824-826.

Timmons, B. A. Delayed auditory feedback as a factor influencing retention. Perceptual and Motor Skills, 1974, 38, 399-402.

Underwood, B. J. Degree of learning and measurement of forgetting. Journal of Verbal Learning and Verbal Behavior, 1964, 3, 112-129.

Wyburn, G. M., Pickford, R. W., & Hurst, R. J. Human senses and perception. Toronto: University of Toronto Press, 1964.

Yates, A. J. Delayed auditory feedback. Psychological Bulletin, 1963, 60, 213-232.

APPENDIX A

Rated Meaningfulness Values (m') for the Paired-Associates Lists

LIST VE:

m'	Stimulus	Response	m'
4.01	JET	WIN	4.01
4.40	CAN	LOG	4.16
4.07	DAY	FOR	4.08
4.20	GOD	SET	3.89
4.31	MEN	BAR	4.45
4.01	NUT	HIT	4.01
3.89	RUM	PAL	3.85
4.10	TOM	VET	3.95

LIST E:

m'	Stimulus	Response	m'
3.72	NAG	TON	3.83
3.75	DOC	FED	3.80
3.70	GEM	CAP	3.83
3.77	JAP	KIT	3.72
3.72	LOV	BEG	3.79
3.76	WEB	HIS	3.75
3.84	PIT	ROB	3.83
3.77	MIS	VAN	3.66

LIST D:

m'	Stimulus	Response	m'
1.90	CIX	BOQ	1.89
1.80	NID	HUW	1.89
1.91	LOZ	JEG	1.82
1.84	QAR	MIF	1.91
1.91	DUH	PIQ	1.89
1.84	SAJ	VED	1.80
1.89	WUT	FOP	1.89
1.80	ZOL	YUR	1.84

APPENDIX B

Sentence Read During Warm-Up Exercise

In considering our fellow man, we should remember his good qualities and realize that his faults only prove that he is, after all, a human being.

APPENDIX C

Randomized Order of Delayed Auditory Feedback Times During Warm-Up Test

Subject	Delay Time			
	.09	.18	.27	.36
1	2	3	1	4
2	2	1	4	3
3	2	3	1	4
4	3	2	4	1
5	1	3	4	2
6	4	2	1	3
7	4	1	2	3
8	1	4	2	3
9	1	4	2	3
10	3	4	1	2
11	1	4	2	3
12	3	1	2	4
13	2	4	1	3
14	3	1	4	2
15	4	1	3	2
16	4	2	3	1
17	4	1	3	2
18	2	3	4	1
19	2	4	3	1
20	2	1	4	3
21	2	3	1	4
22	2	4	3	1
23	2	3	4	1
24	3	1	2	4
25	3	2	1	4
26	3	1	4	2
27	1	3	4	2
28	4	2	1	3
29	3	1	4	2
30	3	4	1	2
31	3	1	2	4
32	2	1	4	3
33	3	1	2	4
34	1	2	3	4
35	1	3	4	2
36	4	3	1	2
37	3	1	4	2
38	4	2	3	1

Subject	Delay Time			
	.09	.18	.27	.36
39	1	2	4	3
40	2	1	4	3
41	4	2	3	1
42	2	4	3	1
43	4	1	3	2
44	2	1	3	4
45	3	2	1	4
46	3	2	1	4
47	3	2	1	4
48	1	4	3	2
49	3	1	4	2
50	2	1	4	3
51	4	2	3	1
52	2	3	1	4
53	1	4	3	2
54	4	3	2	1
55	3	4	2	1
56	1	4	2	3
57	3	4	1	2
58	4	2	1	3
59	3	2	1	4
60	1	4	2	3
61	2	1	3	4
62	3	4	1	2
63	1	3	2	4
64	4	2	3	1
65	1	2	4	3
66	3	4	1	2
67	2	3	4	1
68	3	4	2	1
69	1	4	2	3
70	4	1	2	3
71	4	3	2	1
72	4	2	1	3

APPENDIX D

Delayed Auditory Feedback Times Obtained By Experiment 1 Warm-Up Task

Group	Delay Time			
	.09	.18	.27	.36
Men				
DAF-D	1	3	2	-
DAF-E	-	1	4	1
NAF-D	-	4	2	-
NAF-E	1	2	1	2
Total	2	10	9	3
Women				
DAF-D	1	4	-	1
DAF-E	1	2	2	1
NAF-D	1	3	1	1
NAF-E	1	1	3	1
Total	4	10	6	4

APPENDIX E

Delayed Auditory Feedback Times Obtained By Experiment 2 Warm-Up Task

	Delay Time			
Group	.09	.18	.27	.36
Men				
DAF-E	-	2	2	2
NAF-E	-	3	3	-
Total	-	5	5	2
Women				
DAF-E	-	2	1	3
NAF-E	2	3	1	-
Total	2	5	2	3

APPENDIX F

Verbatim Instructions to Subjects

Day 1: This is an experiment to see how well you can learn pairs of syllables. Before we begin, however, I want to do a short warm-up exercise with you, so that you will be familiar with the equipment. To do that, please put on the microphone and earphones. Make sure they're comfortable. I'm going to give you a short sentence to read. I want you to read it aloud four times. I'll tell you when to begin each time. You'll hear your voice coming back to you with a slight delay - just read at a normal reading rate.

Now we'll do the experiment. As I said, your job will be to memorize pairs of syllables. This apparatus is a memory drum. In the open slots is a sample pair similar to the pairs I'll ask you to memorize. I want you to memorize the right hand syllable that goes with the left hand one. There are eight pairs like these to memorize. As you see the left and right member of each pair for the first time, I will read them aloud to you so you'll know how to pronounce them. As you see and hear them, try to associate them in your mind so that the next time you see and read aloud the left hand syllable you can recall out loud its right hand mate before it appears in the slot. That way I'll know you've learned them. If you're uncertain, make a guess. If you guess wrongly, read the right hand syllable aloud when it does appear. The pairs will keep re-occuring in different orders. Remember - memorize the right hand syllable that goes with the left hand one, and always read the left hand one aloud first. I'll be sitting behind you scoring your

answers. Now tell me what it is you have to do.

Day 2 (Experiment 2 only): Please put on the microphone and earphones and make sure they're comfortable. Today I want to find out how well you remember the pairs that you learned yesterday. The pairs will be presented the same way they were yesterday. When you see and read aloud the left hand syllable, try and recall out loud the right hand syllable before it appears in the slot. Let's begin.

APPENDIX G

Randomized Order of CVCs

Trial #1	Trial #2	Trial #3	Trial #4
7	1	6	8
1	4	7	3
4	8	2	5
3	6	1	4
8	5	8	1
5	3	5	2
6	2	3	6
2	7	4	7

Trial #5	Trial #6	Trial #7	Trial #8
1	3	2	5
7	5	7	1
2	7	1	6
5	4	5	2
8	1	3	3
6	8	6	4
3	2	4	8
4	6	8	7

Trial #9	Trial #10	Trial #11	Trial #12 (Retention Trial)
4	5	7	7
5	7	8	1
8	3	6	4
2	4	1	3
1	6	4	8
3	8	2	5
6	1	5	6
7	2	3	2

Where:

LIST VE	LIST E	LIST D
JET-WIN = 1	NAG-TON = 1	CIX-BOQ = 1
CAN-LOG = 2	DOC-FED = 2	NID-HUW = 2
DAY-FOR = 3	GEM-CAP = 3	LOZ-JEG = 3
GOD-SET = 4	JAP-KIT = 4	QAR-MIF = 4
MEN-BAR = 5	LOV-BEG = 5	DUH-PIQ = 5
NUT-HIT = 6	WEB-HIS = 6	SAJ-VED = 6
RUM-PAL = 7	PIT-ROB = 7	WUT-FOP = 7
TOM-VET = 8	MIS-VAN = 8	ZOL-YUR = 8

From: Blommers, P., & Lindquist, E. F. Elementary statistical methods in pyschology and education. Boston: Houghton Mifflin Co., 1960. Table V, pp. 512-515.

APPENDIX H

Sample Score Sheet

S's name _____ Expt. I DAF E DATE: _____

Sex: M _____ F Expt. II NAF D TIME: _____

Delay time .09___sec. .18___sec. .27___sec. .36___sec.

Trial #2	Trial #5	Trial #8	Trial #11
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8

Trial #3	Trial #6	Trial #9	Trial #12
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8

Trial #4	Trial #7	Trial #10	Trial #13
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8

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Title of Thesis

THE EFFECT OF DELAYED AUDITORY FEEDBACK ON THE ACQUISITION AND RETENTION OF EASY AND DIFFICULT PAIRED-ASSOCIATE TRIGRAMS

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