THE INFLUENCE OF STRESS ON PERFORMANCE IN A PAIRED-ASSOCIATES TASK

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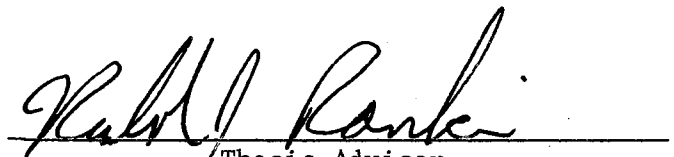

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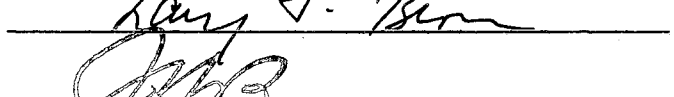

Dean of the Graduate College

PREFACE

It has been demonstrated that Delayed Auditory Feedback (DAF) may be used as a stress variable. Under the traditional distinction between performance and learning, delayed auditory feedback may be regarded as a situationally-produced motivational or stress variable which could affect performance or learning. This study investigated the effects of delayed auditory feedback on performance and learning on a paired-associates verbal learning task. More particularly, this investigation sought to demonstrate that delayed auditory feedback may be used as a stress variable, permitting the investigator to circumvent prior selection of subjects by the use of psychometric devices.

Sincere appreciation is extended to Dr. Richard J. Rankin, who frankly enjoys the experience of research and communicates this feeling to his students. His kind and knowledgeable assistance have added greatly to this study. Also, the author would like to thank Dr. Larry T. Brown for his helpful comments and suggestions. Particular gratitude is expressed by the author to her husband, who has the rarest of all attributes, a genuine respect and regard for the professional aspirations of his wife.

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CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

It has been demonstrated that delayed auditory feedback (DAF) may be used as a stress variable (Pronko and Leith, 1956; Forney and Hughes, 1961). Pronko and Leith defined stress as a set of conditions surrounding a behaving organism as implied in the phrase, "behavior under stress." Within this context stress may be seen as a characteristic of the experimental setting which serves as an unpleasant stimulus in the form of (1) DAF, (2) shock, or (3) failure instructions. Stress is employed in the present study as an independent variable following the usage set forth by Pronko and Leith. This usage is at variance with that employed by Spence (1958) and Deese and Lazarus (1952) where stress is regarded as an internal state such as anxiety, and is consequently classified as an intervening variable.

For the present study subjects were assigned to four groups. Each group received either (1) DAF on all trials, (2) no DAF on any trial, (3) DAF on initial trials, or (4) DAF on final trials, while learning two paired-associates tasks. Mean correct responses on the two paired-associates tasks were plotted over trials. The resulting response curves were interpreted within the learning-performance distinction postulated by Lashley (1929) and Blodgett (1929) and popularized by Tolman (1932; 1959, p. 149). The response curves reflect the influence on performance of the introduction or removal of

an hypothesized performance- or learning-related variable and permit the identification of the variable as being either performance-related or learning-related.

The study of the effect of stress on verbal learning has typically taken the R-R approach. The R-R approach requires prior identification of Ss with low to high potential arousal states of drive, emotionality (re) or anxiety (Korchin and Levine, 1957; Levitt and Goss, 1961; Spence, 1958). The potential arousal states are assumed to be operative later in the experimental setting at their measured strength. Interaction of the internal state assessed by the test with other factors such as levels of paired-associates task difficulty is assumed. The R-R approach consists largely of the assessment and interpretation of interactions.

Difficulty for the R-R approach derives from the fact that prior measurement of strength of potential arousal precludes experimental manipulation of strength of drive, emotionality (re) or anxiety. Further difficulty arises in the interpretation of the interaction of internal states with other factors within the experimental setting. It is incumbent upon the experimenter to demonstrate that (1) the situationally-induced variables do interact differentially with the hypothesized internal states and with no other, and (2) that the psychometric devices do in fact measure the internal states claimed for the instrument (Cronbach and Meehl, 1955).

Purpose of the Study

This study was undertaken to determine if the effects of situationally produced stress on paired-associates tasks may be assessed without the

use of psychometric devices for prior identification of groups possessing weak to strong potential arousal states. DAF has been identified as a stress variable. Identification of DAF as a motivational, performance-related variable within the framework of the Blodgett-Tolman distinction would suggest a broad usage of DAF as a stress variable as an alternative to the R-R approach.

Definition of Terms

The terms employed in this study are defined as follows:

DAF - the hearing of one's own voice through earphones with a delay ranging between .001 and 1 second through the utilization of tape recording; also called delayed sidetone.

Stress - a characteristic of the experimental situation which is assumed to be aversive to S; equivalent to the experiencing of DAF by S.

Non-stress - the removal of, or non-experiencing of DAF by S.

Paired-Associates Task I - paired-associates learning task consisting of eight paired words with one training trial, and eight test trials (see Appendix A). This task is a low complexity task consisting of logically-related pairs (Korchin and Levine, 1957; Ruch, 1934).

Paired-Associates Task II - paired-associates learning task consisting of eight paired multiplication problems with one training trial and twelve test trials (see Appendix B). This task is a high complexity task consisting of incorrect multiplication formulas (Korchin and Levine, 1957; Ruch, 1934).

Stress on-off Group - Ss for whom DAF is introduced by E for the training trial and the first six test trials and removed for the last

two test trials on Paired-Associates Task I; DAF is introduced for the training trial and first six test trials followed by no DAF on the last six trials on Paired-Associates Task II.

Stress off-on Group - The exact reverse of the Stress on-off Group with no DAF administered for the training trial and first six test trials followed by DAF on the last two test trials on Paired-Associates Task I; no DAF on the training trial and first six test trials followed by DAF on the last six test trials on Paired-Associates Task II.

Non-Stress Group - No DAF is experienced by S for any trial on Paired-Associates Task I or Paired-Associates Task II. This group served in a control capacity.

Stress Group - DAF is experienced by S on every trial on both Paired-Associates Task I and Paired-Associates Task II. This group served in a control capacity.

Hypotheses

Two assumptions underlie the following hypotheses. The first assumption is that DAF is aversive to S. This assumption has been supported by experimental findings (Doehring, 1956; Hanley, et al., 1958; Rankin, 1965; Rankin and Balfrey, 1966).

The second assumption is that DAF is a performance-related variable. Introduction of DAF for a series of trials should result in an immediate decrement of mean correct responses; the removal of DAF should result in an immediate increment in mean correct responses. This assumption falls within the short-term effects of a performance-related variable within the Blodgett-Tolman framework.

The following were hypothesized:

Hypothesis I. There will be no significant differences in mean correct responses between trial 6 and trial 7 under the condition of no DAF on any trial for the Non-Stress Group and for DAF on every trial for the Stress Group on Paired-Associates Task I and Task II.

Hypothesis II. There will be a significant increment in mean correct responses between trial 6 and trial 7 under the condition of removal of DAF at the end of trial 6 for the Stress on-off Group on Paired-Associates Task I and Paired-Associates Task II.

Hypothesis III. There will be a significant decrement in mean correct responses between trial 6 and trial 7 under the condition of the introduction of DAF at the beginning of trial 7 for the Stress off-on Group on Paired-Associates Task I and Paired-Associates Task II.

Review of the Literature

Four general areas of literature may be regarded as relevant to this study: those studies that establish the distinction between learning and performance variables; those that involve the effect of stress on verbal learning; those involving DAF; and those involving paired-associates verbal learning.

Learning-Performance Distinction: The learning performance distinction was set forth independently by Blodgett (1929) and by Lashley (1929). Deese (1958, pp. 34-41) in his historical overview of the learning-performance distinction states that the distinction arose over the issue of whether reinforcement determined what is learned or what is performed. Deese states that Thorndike occupied the position of requiring reinforcement for both learning and performance (Thorndike, 1898). Blodgett experimentally attacked the

Thorndikian position and demonstrated that nonreinforced rats could learn a complex maze. Such learning, however, did not become evident until the introduction of food as reinforcement into the maze. The introduction of reinforcement resulted in an immediate reduction in errors made by the previously non-reinforced rats to a level parallel with a control group which had experienced only reinforced trials. The sudden improvement was interpreted by Blodgett as an indication that learning had taken place during the nonreinforced trials; to such learning he appended the term latent learning (Thistlethwaite, 1951). A consequent distinction between variables requisite for the acquisition of learning and those requisite for the utilization of learning was established. Reinforcement was designated by Blodgett as a performance-related variable necessary for the translation of latent learning into behavior but not requisite for the acquisition of learning. This position was incorporated into Tolman's theory (Tolman, Hall and Brennall, 1932; Tolman, 1959). Deese concluded that most current theorists have come to the view that reinforcement controls what organisms do, but not what they learn.

Deese stated that the "factors that influence behavior are classified by contemporary psychologists into two classes, associative and nonassociative. Both factors are responsible for the performance of any particular act" (1958, p. 103). The nonassociative variables are those which are subject to short-term conditions and are designed as motivational or performance variables. They are exemplified by such factors as fatigue, unfavorable environmental conditions, aversive stimulation, or less or more "desirable" reinforcers. The associative variables are long-term and stable and are regarded as learning

variables. They are exemplified by Hull's construct of habit strength (sHr), Hull, 1943); and Tolman's construct of mean's-end readinesses ($s_1 r_1 \rightarrow s_2$, Tolman, 1959).

Kimble (1961, p. 5) defines learning as a long-term change in behavior potentiality produced by practice. Performance is the translation of learning into behavior. The level of performance is dependent upon both learning and short-term performance variables. Performance is observable; learning is not. Performance is utilized as an index to the unobservable learning. Kimble's treatment follows that of Hull (1943) in that learning is assumed to set an upper limit to performance.

Kimble states that a "large part of the difficulty of studying the course of learning stems...from the fact that learning and performance are difficult to separate. Attempts to untangle their individual contributions have often taken the forms of factorially designed experiments. We should recognize, however, that the factorial method is completely satisfactory only under limited conditions, where the outcome of the experiment provides a clear indication that the variable is a performance variable" (1961, p. 134).

Kimble (1961, p. 411) describes the experimental design employed in studying the strength of drive level as a performance variable. "Different groups of subjects are trained initially under two or more different levels of motivation. Then, at some point, each of these groups is subdivided. Some of the subjects continue under the original drive condition; others switch to alternative drive levels." The results of such switching are then assessed as to effect on performance. Kimble (p. 412) indicates that results of such experiments, employing

a factorial design, usually indicate a difference in the column means which assess the effects of the motivational variables. Kimble states that almost all experiments of this sort merely "reflect the point, on which there is no disagreement, that motives influence behavior." Deese and Carpenter (1951) have stated that there may be a residual effect from the earlier drive level which complicates interpretation of the results from the second phase of the experiment following switching of drive levels.

Kimble (1961, p. 124) also states that the results of a factorially-designed learning-performance experiment will be contingent upon that portion of the response curve selected for evaluation. If analysis is made at one point on a curve, a variable may be designated learning-related; if another portion of the response curve is analyzed, the same variable may be identified as performance-related.

The interpretation of response curves to separate performance from learning variables was carried out by Tolman and Honzik (1930), Leeper (1937), and Blodgett (1929) in the following manner. Correct responses, number of errors or per cent correct responses were plotted over trials. At a stipulated point in the trials the drive level, size of reinforcement, or whatever constitutes the hypothesized performance-related variable under study is switched from high to low, eliminated, or introduced. The resulting shift in performance is plotted and interpreted. If there is a sudden, marked shift upward or downward in the performance, then the variable so manipulated is identified as non-associative or performance-related.

Stress and Verbal Learning. The initial work undertaken in the area of stress and verbal learning was undertaken by Spence and his

associates. The primary goal was not the exploration of verbal learning, per se, but the construct validation of the Taylor Manifest Anxiety Scale (MAS) as a measure of drive level, emotionality (re) or anxiety. Spence (1958) reviewed the research employing the MAS with the classically-conditioned eyeblink and with verbal learning. Subjects with high A-scores on the MAS were assumed by Spence to operate under a higher drive level. Performance is determined by the additive effects of drive (D) and habit strength (H). Subjects with high A-scores and hence higher drive should consequently condition to a higher rate in the conditioned eyeblink experimental setting than those Ss with low A-scores. The studies employing the conditioned eyeblink reviewed by Spence tend to support the prediction of higher conditioning levels for Ss with high A-scores.

The performance of high versus low A-score subjects on verbal learning tasks were hypothesized by Spence to be a function of both task and drive characteristics. Levitt and Goss (1961) describe the task and drive formulations set forth by Spence as (1) the drive-dominant initial response analysis and (2) the interference analysis. The drive-dominant analysis developed by Spence predicts that when initial strongly associated responses to the stimulus words are correct the high A-score subjects should score more rapid initial increases in performance than the low A-score subjects. When strong initial responses are incorrect, the high A-score subjects should perform more poorly on initial trials than the low A-score subjects. The interference analysis is based on the assumption that increased drive level as predicted by the A-scores results in the increase of numbers and strength of competing responses simultaneously available to S. The

interference analysis predicts an inverse relationship between learning speed and drive as a function of the arousal of task-irrelevant responses which compete (Child, 1954; Farber, 1955; Spence, 1958; Taylor, 1958). Therefore high A-score subjects will experience greater difficulty on initial trials as a function of the numbers of competing responses which are available above threshold.

These two analyses permit Spence to interpret studies which may demonstrate that drive as measured by A-scores may be facilitatory to acquisition of learning or may in other instances interfere with acquisition. Whether facilitation or interference results becomes a function of the nature of the paired-associates task. Facilitation of performance by high anxiety or drive is predicted when the paired-associates task involves low competitive lists, that is the learning of one pair of words does not interfere with the learning of a second pair under the drive dominant analysis. Interference results from high anxiety or drive when the lists are competitive, that is the learning of one pair interferes with the learning of other pairs.

Experimental findings on MAS-defined groups and paired-associates verbal learning reviewed by Spence in his 1958 article were regarded by him as contradictory. He stated that the implication of an interaction between level of A-score and performance on two kinds of lists, competitive and noncompetitive, was confirmed and provided some support for the drive-dominant analysis. Concerning the interference analysis, Spence stated that we know little about competing task-irrelevant responses. Spence further stated that, "It is clearly evident from the data that differences in level of A-score (and hence level of D), if it is a factor determining performance on such tasks, is a relatively

unimportant one. Certainly individual differences in verbal learning ability play a much more decisive role."

Levitt and Goss (1961) employed MAS-defined high A-score and low A-score groups under stress consisting of failure instructions and assessed the effects on paired-associates learning. They reported no effects attributable to MAS grouping. Stress served to facilitate the acquisition of lists with stimulus members of low similarity when compared to lists of high similarity and served to retard acquisition of lists with stimulus members of high similarity when compared to those of low similarity as predicted by Spence's drive dominant analyses. None of their findings supported the interference analysis which assumes an interaction between MAS groupings and competitive tasks.

Korchin and Levine (1957) employed two MAS defined low A-score and high A-score groups and also a group consisting of psychiatric patients. The paired-associates task employed consisted of adaptation from an experiment performed by Ruch (1934). The two paired-associates tasks designed by Ruch consisted of (1) a list of extremely easy and logically associated words, and (2) a list of incorrect multiplication formulas which require the subject to overcome overlearned habits (see Table I, p. 19). The first list of easy, logically associated words may be seen to be analogous to Spence's non-competitive list. The second list is analogous to the competitive list set forth by Spence in that initial responses to the stimulus numbers will be incorrect. Korchin and Levine reported no significant differences between the MAS groups on either task. Differences between the MAS-defined groups and the psychiatric group appeared as a function of massed as opposed to distributed trials on the two tasks, with the psychiatric group

performing more poorly under massed trials on both tasks.

Delayed Auditory Feedback: Yates (1963) provided an excellent, comprehensive overview of the general area of delayed auditory feedback. Further coverage is provided by Balfrey (1965). In general, the studies reviewed explore abnormal patterns of speech under DAF. Yates states that the dependent variables included (1) the time taken to read a standard phrase (Black, 1951; Hanley and Tiffany, 1954); (2) intensity of utterance (Atkinson, 1953; Black, 1951; Spilka, 1954); (3) fundamental frequency rise (Fairbanks, 1955); (4) intelligibility (Adkinson, 1954; Davidson, 1959); (5) articulatory changes, including repetition of syllables and continuant sounds (Atkinson, 1953; Fairbanks and Guttman, 1958; Lee, 1951; Tiffany and Hanley, 1956); (6) mispronunciations (Atkinson, 1953); (7) omissions (Fairbanks and Guttman, 1958; Tiffany and Hanley, 1956); (8) substitutions (Fairbanks and Guttman, 1958); (9) number of word endings omitted (Korowbow, 1955); and (10) percentage of correct words (Fairbanks and Guttman, 1958).

In the studies reviewed by Yates and Balfrey, S was required to perform under DAF utilizing skills already acquired. The task might vary from single words (Chase, Harvey, Standfast, Rapin and Sutton, 1959) to the recitation of nursery rhymes (Beaumont and Foss, 1957). Typically, disruption of performance under DAF and not the effect of DAF on the acquisition learning was assessed. The present study may be seen as not directly analogous to those reviewed by Balfrey and Yates for the acquisition of responses under DAF is required, not a rehearsal of verbal tasks ordinarily with the reportoire of S.

Other studies have explored adaptation to DAF (Atkinson, 1953; Winchester, et al., 1959, Tiffany and Hanley, 1956; Beaumont and Foss,

1957; Hanley, et al., 1958; Leith and Pronko, 1957). DAF has also been studies in terms of verbal facility (Atkinson, 1954; Beaumont and Foss, 1957).

Tests employed in the measurement of personality traits in interaction with DAF include the California Test of Personality, Secondary Series, Guilford's STDCR, the Total E Scale, and the Paranoia and Schizophrenia sub-tests of the M.M.P.I. (Spilka, 1954). Korowbow (1955) employed an 852 item personality test. In the Spilka and Korowbow studies, an increase in vocal amplitude under DAF was associated with negative self-attitudes, paranoid-tendencies and rigidity. Beaumont and Foss (1957) found a positive relationship between poor performance under DAF and perseveration on the Luchins Einstellung test.

Physiological changes under DAF have been reported as increase in forearm and head muscle action potentials and heart rate (Doehring, 1956; Doehring and Harbold, 1957) and GSR disturbance (Hanley, et al., 1958). Developmental studies have been reported by Goldfarb and Braunstein (1958) and Chase, First, Sutton, and Zubin (1961).

Sensorimotor skills such as rhythmical hand clapping (Denes, Fry and Kalmus (1955); tapping (Chase, et al., 1959; Harvey, 1961; Lee, 1951; Rapin, Standfast and Sutton, 1961); and whistling (Hanley and Tiffany, 1954) have also been explored.

The implication that break-up under DAF is related to stammering has also been widely explored (Birch and Lee, 1955; Cherry and Sayres, 1956; Lee, 1951; Neely, 1961; Sutton and Chase, 1961; Weinstein, 1959). Goldiamond (1965) employed a sample of S afflicted by stammering; S was required to read aloud under DAF and stammering was employed as a discriminative stimulus to signify relief from DAF.

Pronko and Leith (1956) and Forney and Hughes (1961) successfully identified DAF as a stress variable. Pronko and Leith required S to read aloud instructions for the manipulation of switches under DAF; effects of disruption under DAF on the reading of instructions and performance of the manual task were assessed. Forney and Hughes employed DAF as a stress variable utilizing Ss who had consumed ethanol in the form of Vodka. The effects of alcohol and stress under DAF on arithmetic problems and counting backward were assessed.

Paired Associates. The tape recorder was first marketed in 1949, and Lee (1950) reported the first study employing DAF. A review of the Psychological Abstracts beginning in 1950 and extending through 1965 revealed no studies on paired-associates learning under delayed auditory feedback. No attempt was made in the present study to explore the parameters of paired-associate verbal learning, i.e., length of list, meaningfulness, rate of presentation and ability (Carroll and Burke, 1965). Review of the paired-associates literature apart from delayed auditory feedback was therefore not regarded as relevant to this study.

Summary

The R-R approach to the study of paired associates and stress has required use of a psychometric device. Strength of drive, emotionality (r_e) or anxiety is measured by a device such as the Taylor Manifest Anxiety Scale. The strength of the internal state is assumed to interact differentially with other factors in the experimental situation. The measured strength of the internal state may not be experimentally manipulated. Further, construct validation of the psychometric device employed becomes a part of the task of the experimenter who uses this

approach. The experimental results of this approach have been inconclusive and suggest the need to explore other methods for assessing the effect of stress on paired-associates.

An alternative approach to the study of the effects of stress on paired-associates would entail the exchange of stress as an internal state of drive, emotionality or anxiety to a characteristic of the experimental setting as suggested by Pronko and Leith. DAF has been demonstrated to be a stress variable and may be extensively manipulated. If DAF is to be useful as a motivational or performance-related variable, it must be identified as such. The approach utilized by Blodgett and Tolman for the separation of performance from learning variables was employed within the present study to identify DAF as being performance-related or learning-related.

CHAPTER II

METHODOLOGY

Varying conditions of stress or non-stress where stress is defined as delayed auditory feedback (DAF) were administered to four groups while learning two paired-associates tasks. Ss were selected and assigned to groups at random, with no prior screening on the basis of personality or intelligence test scores. The only requirements for participation were that (1) S be between 18 and 24 years of age and (2) be experimentally naive with reference to DAF. Mean age of Ss was 18.18 years for females; 19.18 years for males. Subjects were students enrolled in Introductory Psychology at Oklahoma State University during the spring semester of 1966. The study sample consisted of 40 males and 40 females, with ten males and ten females assigned to each of the four groups. All groups were controlled for sex to preclude the possibility that differences might arise between groups as a function of sex differences in response to DAF or levels of task difficulty.

Pilot Study

A pilot study was conducted in advance of the study proper to ascertain operating efficiency of all equipment and for refinement of instructions. Ten male Ss and ten female Ss were employed. The pilot study resulted in the disclosure of a critical variable in the instructions. It was ascertained that the non-stress group, which

experienced no DAF over trials on any task, performed poorly on Paired-Associates Task II unless the instructions specifically provided a set for a more difficult task following Paired-Associates Task I. Instructions were modified to provide such a set and standardized. In the study proper all groups received the same instructions though the set for a second, more difficult task appeared to be crucial only to the performance of Ss in the non-stress group.

Equipment

S was seated in a chair in front of a Lafayette memory drum which was programmed to reveal stimulus words to S at a rate of one per 4 seconds. The memory drum was lighted by a goose-neck student lamp angled to provide maximum visibility. Immediately to the right of S was a Electro-Voice 644 Dynamic microphone mounted on a stand. Oral responses made by S while performing the two paired-associates tasks were picked up by the microphone and conveyed to a Bell and Howell tape recorder located in an adjacent room. Volume on the tape recorder was fixed and retained at the same level for all S under all conditions. The recorded responses were conveyed back to S via a Koss SP 3x headset of 8 ohms nominal impedance. Delayed auditory feedback was controlled by a low impedience power amplifier, Lafayette Model PA 420, with a second amplifier serving to match impedance of the channel provided by the first amplifier. The two amplifiers were situated on low tables to the right of S and against the wall of the experimental chamber. Equipment was arranged so that E, by standing just to the right and back of the S had ready accessibility to the on-off switches of the microphone and memory drum and to the delay-no delay switch on the Model 420

amplifier.

Procedure

The experimental chamber consisted of an 8 x 8 foot room, painted flat black and nearly soundproof. When S entered he was instructed to sit in the chair in front of the memory drum. E remained standing at all times. E first recorded S's name, the date, Introductory Psychology section number, and inquired whether S had ever participated in an experiment involving DAF. No student reported such an experience; if he had, he would have been excused from the experiment at this point. The experimental condition for S was determined by a coin flip prior to the arrival of S, and was noted on the data sheet. Then, instructions were given. See Appendix C.

S then went through the one training trial and eight test trials on Paired-Associates Task I. E recorded S's responses while standing unobtrusively just back and to the right of S. At the completion of the last test trial, E turned off the microphone and memory drum and covered the first task on the drum with metal flaps attached for that purpose. The metal flaps which concealed Paired-Associates Task II were lifted and E gave further instructions. See Appendix D.

S then went through the training trial and twelve test trials. E recorded the second task in the same fashion as the first. After the eighth test trial, there was a standardized 20-second delay while E manually turned the drum to provide for the additional four trials required. E said only:

> We have not finished. I must turn the drum for your last four trials. Just continue as before.

At the conclusion of the second task, S was excused and thanked for his assistance. If S seemed distressed by the DAF experience, he was reassured that this was not at all uncommon. Questions regarding the intent of the study were handled by E stating that it was a learning-performance study. If S persisted, E replied that information would be available on the results of the study at the end of the semester upon S's request.

Paired-Associates Tasks

The list of stimulus words and numbers are adapted from an early study of Ruch (1934) and employed in a later study by Korchin and Levine (1957). Each consisted of eight paired-associates, presented in random order for each test trial. Paired-Associates Task I served primarily as a "warm-up" task. See Appendix A for an exact copy of each trial for both tasks.

TABLE I

STIMULUS RESPONSE PAIRS FOR PAIRED-ASSOCIATES TASKS

Paired-Associates Task I	Paired-Associates Task II
Soft-Chair	3 x 1 = 1
Room-Light	5 x 1 = 7
Stem-Bud	2 x 5 = 8
Walk-Car	3 x 4 = 2
White-Pink	2 x 4 = 9
Nest-Owl	5 x 5 = 11
Tree-Flag	3 x 3 = 4
House-Visit	6 x 3 = 5

Statistical Treatment of the Data

The data consisted of a number of correct responses to the stimulus words on the paired-associates tasks. The identification of a DAF as being performance-related or learning-related was based upon differences between the trial immediately preceding and the trial immediately following a shift in the DAF condition.

Trial 6 was designated as the pre-shift trial for both tasks with trial 7 serving as the post-shift trial. The Non-stress group experienced no DAF on any trial and the Stress group received DAF on all trials; both served as control groups. The Stress on-off group received DAF on all trials to pre-shift trial 6; no DAF was experienced from the beginning of trial 7 and for the remaining trials on each task. The Stress off-on group received no DAF to and including trial 6; DAF was experienced from the beginning of trial 7 and during the remaining trials.

The parametric *t*-test for correlated observations was employed to test for significant differences between trial 6 and trial 7 for all groups (Winer, 1962, pp. 40-41).

CHAPTER III

RESULTS AND DISCUSSION

A significant rise in numbers of correct responses to the stimulus words of the paired-associates tasks following removal of DAF at the end of trial 6 would suggest that acquisition of learning had taken place but that DAF had depressed performance. A significant drop in numbers of correct responses upon the introduction of DAF at the beginning of trial 7 would also indicate that DAF is serving to depress performance. Differences may occur as a function of (1) learning over trials or (2) random fluctuation. The two control groups, Non-stress and Stress, provide means of assessing learning over trials and random fluctuation.

Mean correct responses over trials on Paired-Associates Task I for all groups appear in Figure I. Examination of the response curves reveal a slight but nonsignificant drop in performance for the Stress off-on group. The other three groups were performing at near asymptote of perfect trials from trial 6 through trial 8. The simplicity of the task enabled S to perform well under the disruptive effects of DAF which was evidenced by "break-up" and elongation of syllables.

Mean correct responses plotted over trials on Paired-Associates Task II for all groups appear in Figure II. Examination of the response curves reveals a sharp rise in performance for the Stress on-off group between trial 6 and trial 7 which suggests that DAF was serving to

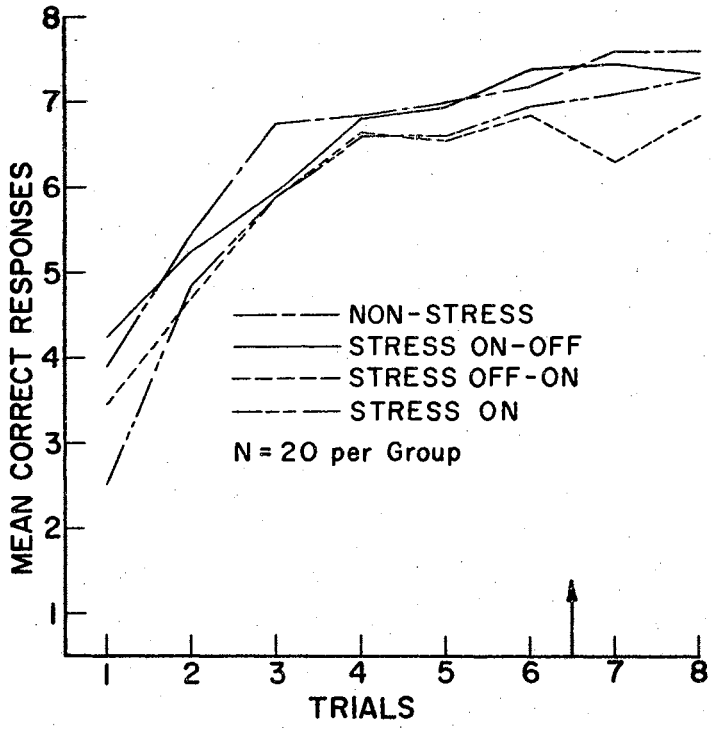

Figure 1. Mean Correct Responses on Paired-Associates Task I

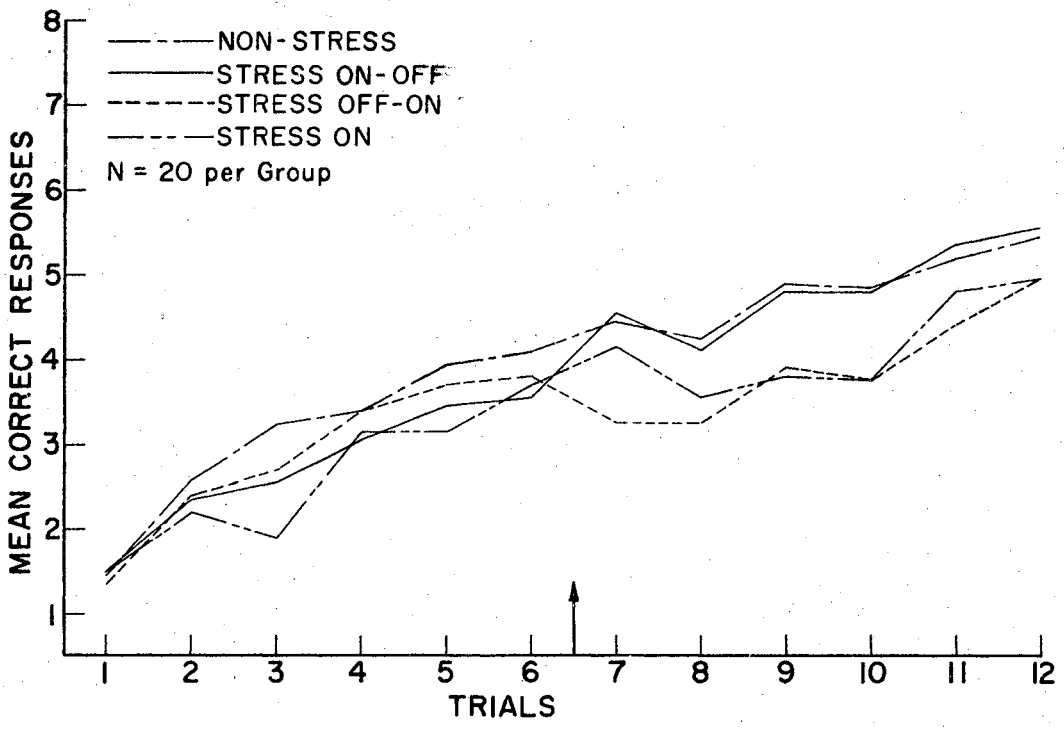

Figure 2. Mean Correct Responses on Paired-Associates Task II

depress performance. A drop in the performance of the Stress off-on group also suggests that DAF is serving to depress performance.

The results of the statistical test employing the t-test for correlated observations between trial 6 and trial 7 appear in Table II.

TABLE II

T-TESTS FOR SIGNIFICANCE OF DIFFERENCES BETWEEN MEAN CORRECT RESPONSES ON TRIALS 6 AND 7

Task and Condition	N	Mean of Diff. Scores Between Trials 6-7	S. E. Diff.	T ratio
Task I				
Non-Stress	20	.40	.2175	1.84
Stress On-Off	20	.05	.2461	.203
Stress Off-On	20	-.55	.3680	1.49
Stress	20	.15	.2835	.52
Task II				
Non-Stress	20	.35	.2436	1.44
Stress On-Off	20	1.00	.2623	3.81*
Stress Off-On	20	-.55	.3033	1.81
Stress	20	.45	.2563	1.76

*Significant at $P \leq .005$ level, one-tailed, 19 d.f.

The t-test for correlated observations between trial 6 and trial 7 for the Stress on-off group is seen to be highly significant. Hypothesis III, which states that there will be a significant increment in mean correct responses between trial 6 and trial 7 under the condition of removal of DAF at the end of trial 6 for the Stress on-off Group on Paired-Associates Task I and Paired-Associates Task II, may be accepted at the .005 level for Paired-Associates Task II.

Within the Blodgett-Tolman distinction between performance-related and learning-related variables, DAF may therefore be tentatively

identified as a performance-related variable which serves to depress performance. Alternative interpretations might be that differences arose as a function of (1) learning over trials alone, or (2) differences due to individual differences in verbal learning ability. Neither of the two control groups, one of which experienced no DAF and one which experienced DAF over all trials, showed significant differences between trial 6 and trial 7 as a function of trials. This study was conducted with the purpose of omitting the use of psychometric devices; therefore, differences as a function of verbal learning ability alone would require further experimentation beyond the scope of this study.

It might be assumed that treatment of the subjects resulted in "jamming", where "jamming" consists of disruption which is a function of the experiencing of noise through the earphones. A check could have been provided by the inclusion of a control group which experienced noise through the earphones in lieu of DAF. However, studies conducted by Butler and Galloway (1957), Winchester and Gibbons (1958) and Peters (1956) have demonstrated that noise in the form of garbled speech does not serve to disrupt performance of S in the same manner as DAF. What the speaker hears is a critical variable.

The interaction of task variables with stress is suggested by the wide differences in performance by all groups on Paired-Associates Task I as compared to performance on Task II (see Table III).

TABLE III

MEAN CORRECT RESPONSES AND STANDARD DEVIATIONS

Task and Condition	N	Mean	Standard Dev.
Task I (Low complexity			
Non-Stress	20	6.5438	1.8056
Stress On-Off	20	6.3625	1.5392
Stress Off-On	20	5.9063	2.0007
Stress	20	5.9750	2.0614
Task II (High complexity)			
Non-Stress	20	3.9875	1.7736
Stress On-Off	20	3.8000	1.9773
Stress Off-On	20	3.4042	1.8414
Stress	20	3.3833	1.9090

Recommendations for Further Research

Further research should include a broader sample of tasks ranging between the low complexity of Task I and the high complexity of Task II. Of particular interest would be the study of the paired-associates lists employed by Spence and his associates.

A statistical design which permits the assessment of interaction of various delay intervals and levels of task difficulty would further verify the feasibility of using DAF as a stress variable and, consequently avoiding psychometric devices.

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APPENDICES

APPENDIX A

PAIRED-ASSOCIATES TASK I

Training Trial:

Stem-Bud
Tree-Flag
Nest-Owl
Room-Light
White-Pink
Soft-Chair
House-Visit
Walk-Car

Test trial one:

Soft-Chair
Room-Light
Stem-Bud
Walk-Car
White-Pink
Nest-Owl
Tree-Flag
House-Visit

Test trial two:

White-Pink
House-Visit
Soft-Chair
Tree-Flag
Stem-Bud
Walk-Car
Room-Light
Nest-Owl

Test trial three:

Tree-Flag
Nest-Owl
White-Pink
Stem-Bud
House-Visit
Soft-Chair
Walk-Car
Room-Light

Test trial four:

Room-Light
White-Pink
Soft-Chair
Tree-Flag
Stem-Bud
Walk-Car
House-Visit
Nest-Owl

Test trial five:

House-Visit
Nest-Owl
Stem-Bud
Soft-Chair
Walk-Car
White-Pink
Room-Light
Tree-Flag

Test trial six:

Stem-Bud
White-Pink
Nest-Owl
House-Visit
Soft-Chair
Tree-Flag
Walk-Car
Room-Light

Test trial seven:

Soft-Chair
Room-Light
Stem-Bud
Walk-Car
White-Pink
Nest-Owl
Tree-Flag
House-Visit

Test trial eight:

Room-Light
Soft-Chair
White-Pink
Tree-Flag
Stem-Bud
Nest-Owl
House-Visit
Walk-Car

APPENDIX B

PAIRED-ASSOCIATES TASK II

Training Trial:

2 x 5 = 8
3 x 3 = 4
5 x 5 = 11
5 x 1 = 7
2 x 4 = 9
3 x 1 = 1
6 x 3 = 5

Test trial one:	Test trial four:	Test trial seven:	Test trial ten:
3 x 1 = 1	5 x 1 = 7	3 x 1 = 1	2 x 4 = 9
5 x 1 = 7	2 x 4 = 9	5 x 1 = 7	6 x 3 = 5
2 x 5 = 8	3 x 1 = 1	2 x 5 = 8	3 x 1 = 1
3 x 4 = 2	3 x 3 = 4	3 x 4 = 2	3 x 3 = 4
2 x 4 = 9	2 x 5 = 8	2 x 4 = 9	2 x 5 = 8
5 x 5 = 11	3 x 4 = 2	5 x 5 = 11	3 x 4 = 2
3 x 3 = 4	6 x 3 = 5	3 x 3 = 4	5 x 1 = 7
6 x 3 = 5	5 x 5 = 11	6 x 3 = 5	5 x 5 = 11

Test trial two:	Test trial five:	Test trial eight:	Test trial eleven:
2 x 4 = 9	6 x 3 = 5	5 x 1 = 7	3 x 3 = 4
6 x 3 = 5	5 x 5 = 11	2 x 4 = 9	5 x 5 = 11
3 x 1 = 1	2 x 5 = 8	3 x 1 = 1	2 x 4 = 9
3 x 3 = 4	3 x 1 = 1	3 x 3 = 4	2 x 5 = 8
2 x 5 = 8	3 x 4 = 2	2 x 5 = 8	6 x 3 = 5
3 x 4 = 2	2 x 4 = 9	3 x 4 = 2	3 x 1 = 1
5 x 1 = 7	5 x 1 = 7	6 x 3 = 5	3 x 4 = 2
5 x 5 = 11	3 x 3 = 4	5 x 5 = 11	5 x 1 = 7

Test trial three	Test trial six:	Test trial nine:	Test trial twelve:
3 x 3 = 4	2 x 5 = 8	3 x 1 = 1	5 x 1 = 7
5 x 5 = 11	2 x 4 = 9	5 x 1 = 7	2 x 4 = 9
2 x 4 = 9	5 x 5 = 11	2 x 5 = 8	3 x 1 = 1
2 x 5 = 8	6 x 3 = 5	3 x 4 = 2	3 x 3 = 4
6 x 3 = 5	3 x 1 = 1	2 x 4 = 9	2 x 5 = 8
3 x 1 = 1	3 x 3 = 4	5 x 5 = 11	3 x 4 = 2
3 x 4 = 2	3 x 4 = 2	3 x 3 = 4	6 x 3 = 5
5 x 1 = 7	5 x 1 = 7	6 x 3 = 5	5 x 5 = 11

APPENDIX C

INSTRUCTIONS GIVEN FOR PAIRED-ASSOCIATES TASK I

I am going to have you learn a paired-associates task while hearing your own voice through these earphones. (Place earphones around S's neck). To illustrate, see the word man (E points to word on memory drum). It is associated with this second word, boy. Each time the word man appeared in this window, you would say man, boy, showing me you had associated the two.

You will now learn eight sets of words just like these two illustrative ones. On the first trial both words will be visible to you. Read them off out loud. Then, you will have eight trials where you will be able to see the first word only as the second word will be covered by a shutter. You are to say both the first word and the hidden second word before the shutter drops revealing the hidden word. If you do not beat the shutter read off the first word and the second. You must respond with two words on each trial. Beat the shutter with the correct hidden word if possible. Are there any questions?

APPENDIX D

INSTRUCTIONS GIVEN FOR PAIRED-ASSOCIATES TASK II

You will now perform a second task. It is essentially the same task as before except that we will now use numbers instead of words. (E points to illustrative stimulus numbers on drum.) You will say 3, 5, 6. Do not say times or equals. You will find this task much more difficult than the first task. You will therefore have 12 trials to beat the shutter instead of 8. On the first trial, read off the numbers; on 12 trials beat the shutter. Are there any questions?

VITA

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