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THE EFFECTS OF DRIVE,
TASK DIFFICULTY AND ORIENTING PROCEDURES
ON INCIDENTAL LEARNING

by Alfred Bryan Laver

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Psychology and Education of the
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CURRICULUM VITAE

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TABLE OF CONTENTS

Chapter	page
INTRODUCTION	ix
I.- REVIEW OF THE LITERATURE	1
1. Early Studies of Incidental Memory	3
2. Generalization of Sets to Learn	7
3. Attempts to Eliminate Intent to Learn	13
4. The Orienting Task	17
5. The Roles of Drive and Cue Utilization	20
6. The Hull-Spence Behavior Theory	36
7. Some Conclusions and a Hypothesis	40
II.- EXPERIMENTAL DESIGN	43
1. The Samples	44
2. Pilot Study: Materials and Procedure	46
3. Pilot Study: Effect on Main Investigation	53
4. Main Investigation: Materials	57
5. Main Investigation: Procedure	66
6. Main Investigation: Implications for Analysis of Data	70
III.- PRESENTATION OF RESULTS	75
1. Attitudes Evoked by Learning Materials and Instructions	75
2. The Main Hypothesis: The Variance Analysis Model	80
3. The Main Hypothesis: The "Spelled Aloud" Condition	85
4. The Main Hypothesis: The "Not Spelled Aloud" Condition	93
5. The Main Hypothesis: Task Competition	101
6. Incidental Task Errors	110
7. Effect of Experimental Variables on Intentional Learning	112
8. Intentional Learning Acquisition Curves	116
9. Summary of Main Results	122
IV.- DISCUSSION OF RESULTS	124
1. The Intentional Learning Task	124
2. Incidental Learning and Drive	132
3. Incidental Learning and Cue Utilization	141
4. Task Competition and Task Difficulty Effects	145
5. Acquisition, Performance and Error Incidence	150
6. Mediation, Attention, and Incidental Learning	153

TABLE OF CONTENTS

v

	page
SUMMARY AND CONCLUSIONS	156
BIBLIOGRAPHY	162

Appendix

1. THE A-SCALE AS A MEASURE OF DRIVE	174
1. The Measurement of Response-Inferred Drive	175
2. The A-Scale in Conditioning Studies	182
3. The A-Scale in Serial-Learning Studies	188
4. The A-Scale in Paired-Associates Studies	191
5. Conclusions	196
2. RELATIONS BETWEEN THE A-SCALE AND THE MPI	199
3. THE RETENTION TASK	205
4. ABSTRACT OF The Effects of Drive, Task Difficulty and Orienting Procedure on Incidental Learning .	206

LIST OF TABLES

Table	page
I.- Intentional Task Paired-Associates, with GV and PR of Stimulus Members and Association Values of Response Members	61
II.- Incidental Task Trigrams, and Intentional Task Paired-Associates with which Each Trigram was exposed (GV for Hard Trigrams only)	64
III.- Analysis of Variance for Recognition of Incidental Task Items, for Two Levels of Drive, Two Levels of Intentional Task Difficulty, and Two Levels of Incidental Task Difficulty (Incidental Task Items Spelled Aloud During Intentional Learning)	86
IV.- Breakdown Analysis of Variance by Intentional Task Difficulty, for Recognition of Incidental Task Items, for Two Levels of Drive and Two Levels of Incidental Task Difficulty (Incidental Task Items Spelled Aloud During Intentional Learning)	90
V.- Breakdown Analysis of Variance by Incidental Task Difficulty, for Recognition of Incidental Task Items, for Two Levels of Drive and Two Levels of Intentional Task Difficulty (Incidental Task Items Spelled Aloud During Intentional Learning)	91
VI.- Scheffe's Test of Significance of Contrasts Among Four Task Difficulty Treatment Sums, in the Analysis of Variance for Recognition of Incidental Task Items (Incidental Task Items Spelled Aloud During Intentional Learning)	94
VII.- Analysis of Variance for Recognition of Incidental Task Items, for Two Levels of Drive, Two Levels of Intentional Task Difficulty, and Two Levels of Incidental Task Difficulty (Incidental Items Not Spelled Aloud During Intentional Learning).	95
VIII.- Breakdown Analysis of Variance by Intentional Task Difficulty, for Recognition of Incidental Task Items, for Two Levels of Drive and Two Levels of Incidental Task Difficulty (Incidental Task Items Not Spelled Aloud During Intentional Learning)	98

LIST OF TABLES

Table	page
IX.- Breakdown Analysis of Variance by Incidental Task Difficulty, for Recognition of Incidental Task Items, for Two Levels of Drive and Two Levels Intentional Task Difficulty (Incidental Task Items Not Spelled Aloud During Intentional Learning)	99
X.- Scheffe's Test of Significance of Contrasts Among Four Task Difficulty Treatment Sums, in the Analysis of Variance for Recognition of Incidental Task Items (Incidental Task Items Not Spelled Aloud During Intentional Learning) . .	102
XI.- Mean Numbers of Incidental Items Marked Correctly on Retention Task (Data Averaged Across Drive Groups - N:50)	103
XII.- Analysis of Variance for Recognition of Incidental Task Items, for Two Levels of Drive, Two Levels of Orienting Procedure, and Two Levels of Intentional Task Difficulty	107
XIII.- Mean Number of Responses by Drive Groups on Measure of Retention Following Incidental Learning.	111
XIV.- Analysis of Variance for Correct Anticipation of Intentional Task Responses in Trials 27 to 30, for Two Levels of Drive, Two Levels of Intentional Task Difficulty, and Two Levels of Orienting Procedure	115
XV.- Means and Certain Percentiles of A-Scale Distributions of American University Student Normative Sample (N:1971) and Carleton University Sample (N:175)	201
XVI.- Means, Standard Deviations, and Intercorrelations of IE and N Scales of MPI for Three Samples of University Students	203

LIST OF FIGURES

Figure	page
1.- Means for Levels of Incidental Task Difficulty (G) at Each Level of Intentional Task Difficulty (C), for Each Drive Level and Averaged Across Drive Levels (Incidental Task Items Spelled Aloud During Intentional Learning)	88
2.- Means for Levels of Incidental Task Difficulty (G) at Each Level of Intentional Task Difficulty (C), for Each Drive Level and Averaged Across Drive Levels (Incidental Task Items Not Spelled Aloud During Intentional Learning)	97
3.- Means for Levels of Intentional Task Difficulty (G) at Each Level of Orienting Procedure (C), for Each Drive Level and Averaged Across Drive Levels	109
4.- Acquisition Curves, in terms of Percentage of Correct Responses in Each Block of Three Trials, for Intentional Learning of Hard and Easy Paired-Associates	118
5.- Vincent Acquisition Curves, in terms of Average Number of Correct Responses in Each Tenth of Trials, for Intentional Learning of Hard and Easy Paired-Associates	121

INTRODUCTION

In the last half century, learning has undoubtedly been the subject of more laboratory experiments than any other problem in psychology. Much of this research has been designed to test the validity of the reinforcement principle.

The concept of reinforcement can be extended to account for all learning. Reinforcement may be said to occur:

1. because a stimulus-response association is not weakened by a requirement to make a different response to the same stimulus (contiguity definition);
2. because mediating processes tend to become connected when a series of stimulus patterns is regularly experienced, so that experiencing A is followed by expectancy of B (cognitive, central mediation, or expectancy confirmation definition);
3. because a stimulus-response association is followed by reduction of a drive state, or of stimuli associated with a drive (drive theory definition).

The third definition has generated clearly testable hypotheses about the necessity for reinforcement. Without reinforcement, there would be no reduction of drive, or drive stimuli, and so no learning. Conversely, if there is to be learning, some drive must exist. Critics of this approach to reinforcement have sought to demonstrate learning in the absence of reinforcement, or learning without motivation. In an attempt to show learning without intent to learn, many have studied incidental learning.

Incidental learning studies are studies with human subjects, where either the set to the learning task or the task itself are irrelevant to the retention task.

The models for latent learning and incidental learning are similar. In both, an attempt is made to demonstrate learning on the basis of exposure to successive stimulus situations, without motivation or reinforcement in the drive theory sense. Will rats learn a maze without tangible reward in the goal box? Will introductory psychology students learn nonsense syllables without intent to remember them? The subjects in latent learning studies have usually been animals, while humans have served as subjects in experiments purporting to demonstrate incidental learning. The kind of subject is an easy but arbitrary basis for deciding how a study of learning without apparent motivation or reinforcement should be classified.

Incidental learning seems to be a common enough event. People apparently learn things incidentally. A man riding a bus to and from work will learn the location of landmarks without intent, so far as he is aware. On the other hand, there is ample evidence that people fail to learn in the absence of intention to learn. A man who read the Episcopal Church morning prayer about five thousand times

in twenty-five years was unable to recall it without the prayer book in front of him¹.

In the laboratory, incidental learning, as a variant of learning without drive, and so without reinforcement, is usually "demonstrated" by manipulation of the set of subjects. Jenkins², for example, asked students who thought they were assisting him as experimenters to read lists of nonsense syllables to other students, instructing them to learn the syllables that they heard. He then tested both the intentional learners ("subjects") and the incidental learners ("experimenters") for retention of stimulus materials.

Sometimes, subjects serve as their own controls. They may be given a learning task and then be tested for learning not covered by instructions. Bahrick³ asked subjects to memorize a number of geometric forms, and then tested them for memory of colors with which the forms were filled. Sometimes, subjects are not instructed to learn anything, but are later tested for retention of material

1. E. C. Sanford's experience, in Floyd Carlton Dockeray and G. G. Lane, Psychology (2nd Ed.), New York, Prentice-Hall, 1950, p. 158-159.

2. John G. Jenkins, "Instruction as a Factor in 'Incidental Learning'", in the American Journal of Psychology, Vol. 45, No. 3, issue of July 1933, p. 471-477.

3. Harry P. Bahrick, "Incidental Learning under Two Incentive Conditions", in the Journal of Experimental Psychology, Vol. 47, No. 3, issue of March 1954, p. 170-172.

observed while they were engaged on some other task. Biel and Force⁴ told subjects that their experiment had to do with legibility of different type faces, but tested them for retention of what had been printed.

Common to all methods for investigating incidental learning is the requirement to expose incidental learners to stimulus material for which retention will be tested, without specific instructions to learn it. That is, there is a requirement for an orienting task.

It will be noted that incidental learning is operationally defined by omission. Intentional learners are given an instructional set to learn, and incidental learners are not. When subjects are their own controls, they are not given an instructional set to learn the material for which retention will be tested. The instructional set is assumed to induce intentional learners to pay attention to specific aspects of the stimulus material, to perceive them, and to respond to them as directed. It is further assumed that, once so set, intentional learners are motivated to learn, and reinforced by evidence of successful learning. Conversely, it is assumed that incidental learners, left to

4. William C. Biel and Ronald C. Force, "Retention of Nonsense Syllables in Intentional and Incidental Learning", in the Journal of Experimental Psychology, Vol. 32, No. 1, issue of January 1943, p. 52-63.

their own devices, are neither set nor motivated to learn the stimulus material which is in front of them. Evidence for retention of material to which the orienting task exposed incidental learners is said to be evidence for learning without intent or motive, and so learning without reinforcement.

Drive reduction theorists have not felt their position threatened by the evidence, from incidental learning studies, for learning without reinforcement. The critical study has yet to be designed. It has proven impossible to demonstrate that incidental learners are not, in fact, set to learn. All investigators agree, however, that incidental learning is not as efficient as intentional learning, and studies of incidental learning continue to appear, not so much because investigators hope, somehow, to eliminate set to learn as because they are interested in finding out if factors, known to affect intentional learning in certain ways, affect incidental learning in the same ways.

The present study is in this newer and more modest frame of reference. It is a study of the effect of manipulating certain subject, task, and procedural variables on intentional and incidental learning. The subject variable is drive, defined solely as an energizer (as it is in the Hull-Spence theory of behavior) and measured with a pencil-and-paper test. Some of the evidence for the validity of this test as a measure of drive is set out in Appendix 1.

The task variables are the difficulty levels of the intentional and the incidental tasks. The procedural variable is the nature of the orienting task.

This report on the investigation begins with a history of incidental learning, with particular reference to studies that have defined appropriate conditions for demonstrating the phenomenon, and that provoked this study. The research design, including a pilot study to try out test materials, is outlined in Chapter II, and research results are set out in Chapter III. In Chapter IV, results are discussed in relation to certain problems in learning theory. The thesis concludes with a summary, and recommendations for future investigations.

CHAPTER I

REVIEW OF THE LITERATURE

The problem of incidental learning was implicit in the pioneer studies of memory by Ebbinghaus¹, for he noted the deleterious effect of inconstant attention to his self-imposed task of memorizing nonsense syllables.

For many years, incidental learning was buried in two related areas of investigation, the "span" of consciousness and the psychology of testimony. James², for example, writing on early studies of attention span, noted that "an object once attended to will remain in the memory, whilst one inattentively allowed to pass will leave no traces behind". Writing on incidental memory, Myers³, in 1913, cited over one hundred relevant references, most of which bore on the validity of verbal reports of witnesses.

1. Hermann Ebbinghaus, Ueber das Gedächtnis, translated by Henry A. Ruger and Clara H. Bussenius, under the title Memory: A Contribution to Experimental Psychology, Educational Reprints No. 3, New York, Teachers College, Columbia University, 1913, p. 25, 27.

2. William James, The Principles of Psychology, Vol. 1, New York, Henry Holt, 1950, p. 427.

3. Garry C. Myers, "A Study of Incidental Memory", in Archives of Psychology, Vol. 4, No. 26, issue of February 1913, 108 p.

Whipple⁴, in an analysis of the psychology of testimony, mentioned kind of material, exposure time, interval between exposure and report, choice of questions, and form of report, as some of the factors conditioning the adequacy of reports of experience. All these task and procedural variables were later studied in experiments on incidental learning.

This review of the literature will survey the history of incidental learning for the last half century. Incidental learning has been a continuing problem for psychologists because it brings into question the universality of the reinforcement principle. It is said to occur without intent to learn. If there is no specific drive, need, or motive to reduce or satisfy, then, presumably, learning can occur without reinforcement.

That incidental learning studies might throw light on this theoretical issue was not, at first, recognized. The early studies dealt largely with the inefficiency of incidental learning. Later investigators questioned the reality of truly incidental learning, because of evidence for covert sets to learn, or of the generalization of induced

4. Guy Montrose Whipple, "The Observer as Reporter, A Survey of the Psychology of Testimony", in the Psychological Bulletin, Vol. 6, No. 5, issue of May 15, 1909, p. 153-170.

sets to learn to incidental tasks. Various attempts to eliminate such sets were not particularly successful. In recent years, the reinforcement problem has been put aside, perhaps temporarily, while efforts are directed towards identifying and controlling procedural, task, and subject variables that affect incidental learning.

1. Early Studies of Incidental Memory

The adjective, "incidental", seems to have been first used in connection with learning and memory by Wallace⁵. She asked students, who had attended an illustrated lecture on Hiawatha four weeks earlier, questions which were "purely incidental" to the lecture, such as the date and hour of the talk, the kind of day, the color of the lecturer's suit, and the clothing of the person who operated the magic lantern. She reported that age and education were not associated with any remarkable gain in "incidental memory", and suggested that it was an ability on which there were marked individual differences.

Myers⁶ studied incidental memory with a variety of tasks, many of which were confounded by a requirement for

5. Isabel Wallace, "Incidental Memory", Thesis 14 in Edwin A. Kirkpatrick, "Studies in Development and Learning", in Archives of Psychology, Vol. 2, No. 12, issue of March 1909, p. 79-88.

6. Garry C. Myers, op.cit.

subjects to reproduce graphically their memories of proportions and areas. In one investigation, he asked subjects to count and remember the number of O's in a block of letters printed in red on yellow cards with black dotted borders, and then questioned them about the other letters, their colors, and so on. Only one in 450 was able to recall all the other letters, and only six remembered four of them.

In another investigation, Myers asked subjects to recall (after intervals varying from a few minutes to several days) words that they had written under the impression that they were taking a spelling test. He reported, "Not 1 in 20 could reproduce six simple words in correct order immediately after writing them, in case they did not know beforehand that these words were to be reproduced [. . .] we either shut out entirely from our senses those things that are not in accord with our interests and prejudices, or we perceive them imperfectly."⁷ He concluded that incidental memory was poor because of a tendency to selective perception, in terms of experience and utility.

Kirkpatrick⁸ was one of the first to compare the performance of different groups of subjects on incidental and

7. ibid, p. 102.

8. E. A. Kirkpatrick, "An Experiment in Memorizing versus Incidental Learning", in the Journal of Educational Psychology, Vol. 5, No. 7, issue of September 1914, p. 405-412.

intentional learning. He asked one group to memorize and then apply a difficult multiplication table, and the other to solve problems, referring to the table when necessary. Both groups were then tested for memory for the table. The intentional learning group was the more successful. He also compared groups on a computation task. One group was set for speed, while the other was instructed to learn the products of the numbers that they multiplied. The group that practised without intent to memorize was slightly inferior on a retention task.

Achilles⁹ gave subjects two minutes to sort 15 non-sense syllables into four groups according to ease of articulation. One of her two groups was also told to prepare for a test of memory for the syllables. The incidental learning group recalled 81 per cent as many syllables as the intentional learning group, and recognized 97 per cent as many. It is interesting to note that Achilles was one of the last who considered her study as directly relevant to the psychology of testimony.

Shellow¹⁰ criticized much of the early research on incidental memory on three grounds. Experimenters sometimes

9. Edith Mulhall Achilles, "Experimental Studies in Recall and Recognition", in Archives of Psychology, Vol. 6, No. 44, issue of September 1920, 79 p.

10. Sadie Myers Shellow, "Individual Differences in Incidental Memory", in Archives of Psychology, Vol. 10, No. 64, issue of May 1923, 77 p.

took no care to ensure perception of all the material about which they questioned later, so that subjects were tested for observation, rather than incidental memory. Subjects were sometimes told that they would later be questioned, so that they were tested for intentional rather than incidental memory. Experimental designs and tasks were sometimes too complicated, so that it was difficult to identify the variables that influenced results.

She set four criteria for a suitable test of incidental memory:

1. The test should be simple.
2. The experimenter should ensure perception of material to be learned.
3. A set to learn something should be established.
4. Scoring should be objective.

In one of her studies, she asked subjects to remember the titles and order of presentation of twelve magazine covers, and then questioned them about cover designs. In another, subjects were set to remember the pictures, and then were questioned about the order of presentation. There was clear evidence of incidental learning in the absence of explicit intent to learn. She concluded that it was easier to recall incidental material if it was clearly connected to material to which "primary" attention was being paid. She stated that "facts within the range of attention when attention was directed to some other facts

[became] fixated because their own intensity was sufficient to cause fixation, or because they had in some way become linked up with the individual's habitual interests and past experience."¹¹ (The relevance to the psychology of testimony is obvious.) Once the factors determining incidental memory had been analyzed, and the laws governing it formulated by experimental research, it would be found to be not capricious but as logical and inevitable as direct memory. One of her findings which has been contradicted by later studies was that those who suspected the purpose of the experiments did no better on the memory tasks.

2. Generalization of Sets to Learn

A study by Jenkins¹² was something of a breakthrough in the history of incidental learning, and a major step towards identifying one of its determining factors. He tested intentional and incidental learners for retention of nonsense syllables to which both had been exposed twenty-four hours earlier. Incidental learners, who recalled 10.8 ± 3.6 syllables, were markedly inferior to intentional learners, who recalled 15.9 ± 2.4 syllables.

11. Ibid, p. 75.

12. John G. Jenkins, "Instruction as a Factor in 'Incidental Learning'", in the American Journal of Psychology, Vol. 45, No. 3, issue of July 1933, p. 471-477.

Curious about the greater variability of incidental learners, Jenkins questioned his subjects about their understanding of the purpose of the experiment. He found that ten of twenty-four "incidental" learners had, for one reason or another, formed covert sets to learn. Even in the absence of such deliberate sets to learn, every incidental learner recalled some involuntary, fleeting set that would have influenced learning at some point in the experiment. One remembered a syllable because of its position at the end of a list, another remembered a syllable that the intentional learner with whom he was paired had missed on every trial, and so on. Eight incidental learners who said that they did not try to learn recalled 8.0 ± 2.0 syllables.

The importance of covert set as a confounding factor in attempts to demonstrate incidental learning has generally been recognized since the Jenkins study. McGeogh and Irion¹³ argued that a set-to-learn is probably evoked whenever a set-to-read or a set-to-observe are aroused by instructions, and, of course, such instructional sets are necessary, in the form of orienting tasks, to expose incidental learners to stimulus material. According to McGeogh and Irion, people, rewarded all their lives for learning, are usually more or less set to learn everything that they read or observe.

13. John A. McGeogh and Arthur L. Irion, The Psychology of Human Learning, (2nd Ed.), New York, Longmans, Green, 1952, p. 211-215.

Much the same point was made by Gibson¹⁴, in his conclusion that sets are not only determiners of associative habits but are themselves habits. We learn by virtue of a set to learn, but we also learn to have a set to learn. Such learned sets may themselves become dynamic and self activating, or, in other words, function as drives.

As with so many phenomena in psychology, there is evidence for involuntary sets to learn, but not much understanding of how they are evoked. On the specific point of whether an intentional set may generalize and lead to incidental learning, one may cite Lepley¹⁵, who investigated the memory of students for names on a class roll call that they had heard forty-five times (without instructions to learn), as a function of serial position relative to a student's own name. There was evidence for a gradient on each side of a student's name; that is, each remembered best two or three names before and after his own. A set to watch for and pay attention to their own names seems to have generalized to contiguous names.

14. J. J. Gibson, "A Critical Review of the Concept of Set in Contemporary Experimental Psychology", in the Psychological Bulletin, Vol. 38, No. 9, issue of November 1941, p. 781-817.

15. William M. Lepley, "A Gradient in Incidental Learning", in the Journal of Experimental Psychology, Vol. 18, No. 2, issue of April 1935, p. 195-201.

There is also direct evidence for the generality of set in a study by Postman and Senders¹⁶. They varied set, with learning materials and the retention task constant. The learning material was a dramatic and detailed short story, and five groups of subjects were told variously that the experimenters were interested in reading speed, comprehension, memory for the specific sequence of events, memory for details of wording, and memory for physical appearance, such as typing errors and misspelled words. All subjects were tested for retention of material related to all five conditions. The findings suggested that the instructional set induced a set to learn that generalized, so that subjects learned many facts not relevant to the task specified.

Brown¹⁷ reasoned, in reinforcement theory terms, that a situation similar to that in which motivated learning had occurred in the past would, through stimulus generalization, evoke a set to learn. The appearance of stimuli similar to those frequently experienced in association with reinforced stimuli in the past should be reinforcing. He hypothesized that meaningful material would be more likely

16. Leo Postman and Virginia I. Senders, "Incidental Learning and Generality of Set", in the Journal of Experimental Psychology, Vol. 36, No. 2, issue of April 1956, p. 153-165.

17. George Haskell Brown, "Factors Influencing Incidental Learning", in the Journal of Experimental Psychology, Vol. 47, No. 3, issue of March 1954, p. 163-169.

than nonsense syllables to evoke a set to learn, and that another factor would be proprioceptive stimulation, from overt pronunciation of learning material. His incidental learners pronounced three-letter words and three-letter nonsense syllables for either four or eight trials, for the alleged purpose of having their speech recorded for study. Anticipation scores were then obtained under an intentional learning set, and compared with those of a control (intentional learning) group. Incidental learners performed no better on meaningful words than on nonsense syllables, nor did pronunciation, with consequent proprioceptive stimulation, affect retention. Intentional learners were significantly superior to incidental learners after both four and eight trials. Insofar as events associated in the past with intentional learning did not facilitate incidental learning, the hypothesis that secondary reinforcement accounted for set generalization was not supported.

Winnick ¹⁸, who also viewed the concept of a generalized set to learn as a special case of stimulus generalization, reasoned that subjects given an incidental learning task would benefit from prior intentional learning of material with similar content, because a set to learn such material would

18. Wilma A. Winnick, "Transfer of Set in Incidental Learning", in the American Journal of Psychology, Vol. 71, No. 2, issue of June 1958, p. 399-403.

transfer to the incidental learning situation. However, she found no difference in incidental learning of material similar to and different from that previously learned intentionally. There was some suggestion that certain characteristics of the incidental learning task might have interfered with the transfer of set.

These studies of set in incidental learning cast doubt on the suitability of the incidental learning model for testing the validity of the reinforcement principle. It is, apparently, difficult if not impossible to devise an experiment in which subjects are exposed to the learning task without evoking a set to learn it. A study by Postman and Tuma¹⁹ came close to meeting the requirement. Their subjects learned a verbal maze in which the correct path was designated by specific examples of a class concept (fruit, or articles of clothing). A group, simultaneously exposed to items designating the path that they were not required to learn, showed incidental learning of the presence of the irrelevant stimuli, but not of their serial arrangement. Once again, set generalized, to some extent, but one might ask in this study if lack of overt practice rather than lack of motivation could have accounted for the inefficient learning of serial order under incidental learning conditions.

19. Leo Postman and A. H. Tuma, "Latent Learning in Human Subjects", in the American Journal of Psychology, Vol. 67, No. 1, issue of March 1954, p. 119-123.

3. Attempts to Eliminate Intent to Learn

Another line of attack on the reinforcement principle has been to study whether the action of reinforcement is independent of intent to learn, and so of motivation and drive or drive stimulus reduction. If the action of rewards is automatic, and independent of intent to learn, a problem is posed for the drive reduction postulate.

Typically, subjects are asked to respond with numbers to a series of words, and certain responses are reinforced, by being called either 'right' or 'wrong', according to a pre-arranged pattern. Intent to learn is said to be eliminated by telling subjects that they are taking part in a study of extrasensory perception, and that a response which is 'right' on one trial may be 'wrong' on another.

Hallach and Henle²⁰ found that rewards did not strengthen stimulus-response connections under these incidental learning conditions, thus casting doubt on the universality of Thorndike's Law of Effect. Assuring subjects that the same responses would be correct or incorrect on later trials apparently introduced a set to learn, for

20. Hans Hallach and Mary Henle, "An Experimental Analysis of the Law of Effect", in the Journal of Experimental Psychology, Vol. 28, No. 4, issue of April 1941, p. 340-349.

repetition and recall of rewarded responses increased markedly²¹. Postman and Adams²² objected that changing the reward pattern on successive trials provoked a set against repeating. When they tested on the second trial the effect of rewards on the first trial, they found evidence for the automatic effect of rewards in the absence of motivation.

Porter²³ repeated the Postman and Adams study with modifications, to ensure that subjects did not learn the purpose of the experiment, and to control certain factors that increased the discriminability of rewarded responses. The automatic effect of reward persisted, although it was not as great as in the Postman and Adams experiment.

Bitterman²⁴ also repeated the Postman and Adams study, and found a non-significant tendency to repeat rewarded responses. Rewarded subjects who were told, after

21. Hans Wallach and Mary Henle, "A Further Study of the Function of Reward", in the Journal of Experimental Psychology, Vol. 30, No. 2, issue of February 1942, p. 147-160.

22. Leo Postman and Pauline Austin Adams, "Performance Variables in the Experimental Analysis of the Law of Effect", in the American Journal of Psychology, Vol. 67, No. 4, issue of December 1954, p. 612-631.

23. Lyman W. Porter, "The Effect of 'Right' in a Modified Thorndikian Situation", in the American Journal of Psychology, Vol. 70, No. 2, issue of June 1957, p. 219-226.

24. M. E. Bitterman, "Information and Effect in Incidental Learning", in the American Journal of Psychology, Vol. 69, No. 3, issue of September 1956, p. 410-416.

errors, what the correct responses were, showed a marked tendency to shift to responses designated as correct, which led Bitterman to conclude that information and not effect was the significant factor influencing recall. Postman and Adams²⁵ drew attention to the fact that effect had also influenced recall, although only to a limited extent. The issue was unlikely to be resolved with symbolic verbal reinforcement.

If one accepted the assumption that the extrasensory perception orienting task, and the statement that the same responses might not be rewarded on later trials, together eliminated intent to learn, one would probably conclude from this series of studies that learning can occur in the absence of reinforcement in the drive reduction sense. However, apart from the fact that no evidence is presented that the orienting task does not produce a covert set to learn, there is the possibility, suggested by Porter²⁶, that rewards might produce implicit rehearsal of responses, even without intent to learn. To test this possibility, Porter used shock-cessation as an unambiguous reward unlikely to cause rehearsal.

25. Leo Postman and Pauline Austin Adams, "On Recent Studies of the Law of Effect in Incidental Learning", in the American Journal of Psychology, Vol. 70, No. 4, issue of December 1957, p. 642-646.

26. Lyman W. Porter, "Effect of Shock-Cessation as an Incidental Reward in Verbal Learning", in the American Journal of Psychology, Vol. 70, No. 3, issue of September 1957, p. 421-426.

Subjects were not told that particular responses terminated shock. There was no evidence that reward (shock-cessation) increased the recall of responses. This study failed to support not only the Thorndike Law of Effect but also the drive reduction postulate. A possible explanation of the findings is that shock elicited responses that interfered with learning, so that shock-cessation was not an effective reward.

In summary, the incidental learning studies have not thrown much light on the role of reinforcement in learning. No one has yet eliminated the possibility of a covert set to learn. "Incidental learning" is a term that reflects the experimenter's judgement, and not the subject's set.

It is now usual to define incidental learning operationally, as learning in the absence both of an experimentally administered instruction to learn, and of an introspectively reported intention to learn. Such a definition avoids the issue of whether incidental learners are or are not set, and motivated, to learn.

There appears to be ample evidence that intentional learning is more efficient than incidental learning, but the requirement for an operational definition for incidental learning raises the question of whether intent to learn is the sole, or even a critical reason for the superiority of intentional learning.

4. The Orienting Task

It has already been noted that an orienting task is necessary, to ensure that incidental learners are exposed to the stimulus material. Intentional learners may or may not be given the same orienting task. If not, one may question the worth of the experiment, because intentional and incidental learning measures would not have been obtained under identical conditions, with a single independent variable, the instructional set. If they are, on the other hand, it is legitimate to ask if the orienting task might facilitate or impede intentional learning.

Saltzman²⁷ asked both intentional and incidental learners to sort cards on which were printed the items to be learned. Retention scores of intentional learners were not significantly higher than those of incidental learners, a finding that led Saltzman to suggest, at first, that the relative success of intentional learners in many earlier studies was due, in part, to not requiring them to perform the orienting task prescribed for incidental learners.

An alternative explanation was that intentional learners, set for speed as well as for accuracy of sorting,

27. Irving J. Saltzman, "The Orienting Task in Incidental and Intentional Learning", in the American Journal of Psychology, Vol. 66, No. 4, issue of October 1953, p. 593-597.

did not take enough time to memorize stimulus items. Neimark and Saltzman²⁸ found that intentional learners who had the same orienting task as incidental learners were nearly as successful as intentional learners who did not perform the orienting task (and more successful than incidental learners), provided that stimulus items--two-digit numbers on a memory drum--were presented slowly. When intentional and incidental learners had the same orienting task, fast rates of presentation of stimulus items interfered more with intentional learning. Conversely, with length of time of exposure constant, intentional learners benefitted more from an increase in the number of exposures per item.²⁹

Saltzman³⁰ produced further evidence that some orienting tasks minimize the effect of instructions to memorize, either because the orienting task is such that

28. Edith Neimark and Irving J. Saltzman, "Intentional and Incidental Learning with Different Rates of Stimulus-Presentation", in the American Journal of Psychology, Vol. 66, No. 4, issue of October 1953, p. 618-621.

29. Irving J. Saltzman and Rita L. Atkinson, "Comparisons of Incidental and Intentional Learning after Different Numbers of Stimulus Presentations", in the American Journal of Psychology, Vol. 67, No. 3, issue of September 1954, p. 521-524.

30. Irving J. Saltzman, "Comparisons of Incidental and Intentional Learning with Different Orienting Tasks", in the American Journal of Psychology, Vol. 69, No. 2, issue of June 1956, p. 274-277.

incidental learners make much the same responses to the learning task as do intentional learners, or because responses to the orienting task interfere with intentional learning. Postman and Adams³¹ found no difference between intentional and incidental learners when the orienting task was matching stimulus nonsense syllables with geometric figures, but reported intentional learners to have the higher retention scores when the orienting task was giving meaningful associations to nonsense syllables. In general, if the orienting task favors discrimination of stimulus items, it is unlikely to interfere with intentional learning.

Saltzman³² has also suggested that the critical difference between intentional and incidental learning may be simply that those subjects who are intent on learning rehearse stimulus material between and during learning trials. He was unsuccessful in devising a study that would eliminate intra-trial rehearsal, but found evidence, in the course of the study, that intentional learners were more confident of the judgements they made, based on learning, and could not be as easily misled by false cues.

31. Leo Postman and Pauline Austin Adams, "Studies in Incidental Learning: IV. The Interaction of Orienting Tasks and Stimulus Materials", in the Journal of Experimental Psychology, Vol. 51, No. 4, issue of April 1956, p. 329-333.

32. Irving J. Saltzman, "Incidental and Intentional Memory for Lifted Weights", in the American Journal of Psychology, Vol. 70, No. 2, issue of June 1957, p. 253-257.

The nature of the orienting task has recently been used to account for the finding that incidental task performance did not vary with intentional task difficulty. Mechanic³³ argued that there would be less incidental learning with a hard than with an easy intentional learning task, regardless of incidental task difficulty, because more of the available time would be utilized in responding to the hard intentional items. He did not find such a difference, and reasoned that the expected task competition effect was offset by the orienting task, which required subjects to pronounce, and so respond differentially to, incidental items.

5. The Roles of Drive and Cue Utilization

In recent years, the emphasis in studies of incidental learning seems to have shifted from testing the reinforcement principle, and questioning the independent reality of incidental learning, to doing what Shellow³⁴ suggested nearly forty years ago--analyzing its determining factors, and seeking, experimentally, the laws that govern it. It is generally assumed, if not universally accepted, that incidental learning is worthy of study as an independent

33. Arnold Mechanic, "The Distribution of Recalled Items in Simultaneous Intentional and Incidental Learning", in the Journal of Experimental Psychology, Vol. 63, No. 6, issue of June 1962, p. 593-600.

34. Sadie Myers Shellow, op.cit.

phenomenon, and that it cannot be explained away as intentional learning under a weak and intermittent set, differing from it mainly in amount. Investigators have tended to centre their efforts on studying the effect on incidental learning of subject, environmental and task variables that are known to influence the course of intentional learning. Two of the subject variables are drive, as measured by a scale of manifest anxiety, and cue utilization. The former has been conceptualized as an indicator and the latter as a consequence of activation level, or arousal state.

In a recent review of research on anxiety, Martin³⁵ suggested that anxiety was one of many arousal states that can be differentiated from a general state of activation, as arousal becomes more intense. However he concluded that no clear-cut pattern of physiological-behavioral responses associated with anxiety arousal, distinguishable from other arousal patterns, has been demonstrated.

His conclusion is in accord with the concept of emotional responsiveness as a drive component. For many years, Duffy³⁶ argued for a second-order concept of arousal

35. Barclay Martin, "The Assessment of Anxiety by Physiological Behavioral Measures", in the Psychological Bulletin, Vol. 58, No. 3, issue of May 1961, p. 234-255.

36. Elizabeth Duffy, "The Psychological Significance of the Concept of 'Arousal' or 'Activation'", in the Psychological Review, Vol. 64, No. 5, issue of September 1957, p. 265-275.

or activation that would obviate the distinction between emotion and motivation. She posited an inverted U-curve relationship between activation level and quality of performance, with both extremes of arousal associated with poor performance. She cited evidence for persistent and characteristic individual differences in degree of activation by the same situation. Responsive, easily aroused subjects are revealed by their reactions to a wide range of stimulation, by differences in cortical potential, and by their reflex behavior. She considered anxiety to be a form of over-arousal or hyper-responsiveness.

The activation concept helps to explain the paradox that increasing emotion appears to be associated sometimes with improvement and sometimes with impairment of performance. It has strong psychophysiological support.

Lindsley's³⁷ theory of emotion related the activation concept to studies of the ascending reticular activating system. Fuster³⁸, to cite one of many examples of confirmatory evidence, found that moderate stimulation of this system facilitated the accuracy and speed of visual discrimination in rhesus monkeys, but that strong stimulation

37. Donald B. Lindsley, "Emotion", in S.S. Stevens (Ed.), Handbook of Experimental Psychology, New York, Wiley, 1951, p. 473-516.

38. Joaquin M. Fuster, "Effects of Stimulation of Brain Stem on Tachistoscopic Perception", in Science, Vol. 127, No. 3290, issue of 17 January 1958, p. 150.

increased reaction time and decreased the number of correct responses. Hebb³⁹ called the single-mechanism theory of motivation and emotion "the best unifying concept that is available to us at present."

Malmo⁴⁰ summarized three main approaches to activation, noting that theorists of the Hull school, although they rarely used physiological measures, and concentrated on aversive aspects of drive, came close to the activation principle--motivation without a directive function. Elsewhere⁴¹, he suggested the use of the Taylor Manifest Anxiety Scale⁴², (A-Scale), developed as a measure of Hull's generalized drive, to select subjects for studies of physiological aspects of motivation. Intentional learning and conditioning studies in which the A-Scale has been used as a measure of emotionally-based drive are considered in Appendix 1. The evidence indicates that performance on tasks involving strong, competing responses is impaired under conditions of

39. Donald Olding Hebb, A Textbook of Psychology, Philadelphia, Saunders, 1958, p. 159.

40. Robert B. Malmo, "Activation--A Neuropsychological Dimension", in the Psychological Review, Vol. 66, No. 6, issue of November 1959, p. 367-386.

41. Robert B. Malmo, "Anxiety and Behavior Arousal", in the Psychological Review, Vol. 64, No. 5, issue of September 1957, p. 276-287.

42. Janet A. Taylor, "A Personality Scale of Manifest Anxiety", in the Journal of Abnormal and Social Psychology, Vol. 48, No. 2, issue of April 1953, p. 285-290.

high drive, as measured by the A-Scale, but that high drive facilitates performance on tasks where only a single response tendency is evoked. (Hebb⁴³ has suggested that diffuse bombardment of the reticular activating system under high drive conditions might perhaps facilitate incorrect responses with complex tasks, and so impede performance.)

Support for the inverted U-curve relationship between arousal and performance level came from a study by Stennett⁴⁴. He compared the performance of subjects on a tracking task under several stress conditions, ranging from one in which subjects were told that their scores would not be recorded to one where the score determined whether they earned a money bonus and avoided a painful electric shock. He found that tracking performance improved as rewards for correct performance increased, but showed impairment under the extreme condition, where a subject could earn a \$5.00 bonus for high performance but would receive a 150-volt shock if he did not reach the high level. In general, an increase in arousal (defined by increasing stress) improved performance up to a point, and then impaired it.

43. D.O. Hebb, "Drives and the C.N.S. (Conceptual Nervous System)", in the Psychological Review, Vol. 62, No. 4, issue of July 1955, p. 243-254.

44. Richard G. Stennett, "The Relationship of Performance Level to Level of Arousal", in the Journal of Experimental Psychology, Vol. 54, No. 1, issue of July 1957, p. 54-62.

One may use either a stimulus-induced or a response-inferred method to manipulate activation level (drive level, emotional responsiveness) experimentally. Stimulus-induced methods include using noxious stimuli (such as shock, or threat of shock) criticizing, or experimentally causing the failure of ego-involved subjects, and obtaining measures during real life stress situations (just before doctoral oral examinations, or parachute jumps). Response-inferred methods involve the use of measures, such as projective tests, or self-report scales like the A-Scale, which are assumed, or shown, to be coordinated with the underlying construct.

One effect of high activation is said to be reduction of the range of cues to which a subject will respond⁴⁵. The concept of cue utilization was a by-product of the New Look in perception. Bruner⁴⁶ hypothesized that a person in a perceptual recognition situation gathers cues in order to discriminate, and responds with a class name when he has enough cues to satisfy himself as to the stimulus object's identity. People are said to differ in the number of cues

45. J.A. Easterbrook, "The Effect of Emotion on Cue Utilization and the Reorganization of Behavior", in the Psychological Review, Vol. 66, No. 3, issue of May 1959, p. 183-201.

46. Jerome S. Bruner, "On Perceptual Readiness", in the Psychological Review, Vol. 64, No. 2, issue of March 1957, p. 123-152.

they accumulate before a recognition response, and one of the variables correlated with cue utilization on which they differ is said to be activation level, or drive level.

Tolman⁴⁷ reported that, under strong motivation, rats tend to fixate a specific path through a maze, and do not learn the general orientation of the maze pattern. It can be inferred from the Spence and Lippitt⁴⁸ test of sign-gestalt theory that strong thirst motivation decreases learning by rats of the position of irrelevant food incentives. In humans, perception of threat to the self is said to produce "tunnel vision", or reduction of the perceptual field to the area of perceived threat, while, if need is too great, awareness may become so acute that differentiation of other parts of the field ceases⁴⁹. It has been noted, clinically, that high anxiety interferes with performance on measures of digit span. Bruner, Matter and Papanek⁵⁰ concluded that over-motivation was one of two conditions that

47. Edward C. Tolman, "Cognitive Maps in Rats and Men", in the Psychological Review, Vol. 55, No. 4, issue of July 1948, p. 189-208.

48. Kenneth A. Spence and Ronald Lippitt, "An Experimental Test of the Sign-Gestalt Theory of Trial and Error Learning", in the Journal of Experimental Psychology, Vol. 36, No. 6, issue of December 1946, p. 491-502.

49. Arthur W. Combs and Donald Snygg, Individual Behavior: A Perceptual Approach to Behavior, New York, Harper, 1959, p. 167, 195.

50. Jerome S. Bruner, Jean Matter, and Miriam Lewin Papanek, "Breadth of Learning as a Function of Drive Level and Mechanization", in the Psychological Review, Vol 62, No. 1, issue of January 1955, p. 1-10.

decreased breadth of learning, or the use of peripheral sensory cues. In short, strong activation restricts cue utilization in perception and learning.

Bahrnick, Fitts and Rankin⁵¹ tested the hypothesis that an increase in incentive results in increased perceptual selectiveness, favoring those parts of the perceptual field interpreted by subjects as most relevant. Their subjects were given a central pursuit-rotor task, for which there was a sliding scale money bonus for good performance, and three intermittent peripheral tasks, differing in relevance to the central task and in the ease with which they could be perceived. High incentives facilitated central task performance, but interfered with peripheral task performance.

The relationship between incentive and perceptual selectiveness was extended by Bahrnick⁵² to incidental learning. His subjects were given a serial anticipation task, with geometric forms as the stimulus material. They were then tested for incidental learning of colors with which

51. Harry P. Bahrnick, Paul M. Fitts and Robert E. Rankin, "Effect of Incentives Upon Reactions to Peripheral Stimuli", in the Journal of Experimental Psychology, Vol. 44, No. 6, issue of December 1952, p. 400-406.

52. Harry P. Bahrnick, "Incidental Learning under Two Incentive Conditions", in the Journal of Experimental Psychology, Vol. 47, No. 3, issue of March 1954, p. 170-172.

the forms were filled. A high incentive group was told that they would be paid for good performance. A low incentive group was told to treat the task as if it were an uninteresting lecture. The low incentive group required more trials to criterion on intentional learning, of course. When rate of learning was controlled, the high incentive group displayed significantly less incidental learning. In another study, Bahrick⁵³ asked subjects to learn a serial list of nonsense syllables, and then tested them at five stages of intentional learning for memory of geometric forms in which the syllables were embedded. As the goal of intentional task mastery was approached, incidental learning decreased. Results of these two studies were interpreted as evidence for greater variability of set (that is, greater cue utilization) when coexisting goal demands were equal, with cognitions relating set to goal attainment becoming more firmly established as the incentive or goal demand increased.

In an incidental learning study, the experimenter's instructions determine which cues will be prepotent and which irrelevant, and, so to speak, in the margin or periphery of attention. The role of an incentive is to further reduce the range of attention, by increasing its intensity

53. Harry P. Bahrick, "Incidental Learning at Five Stages of Intentional Learning", in the Journal of Experimental Psychology, Vol. 54, No. 4, issue of October 1957, p. 259-261.

and narrowing its focus, warding off distraction and so decreasing utilization of irrelevant cues.

Easterbrook⁵⁴ cited the Bahrick studies as part of the evidence for the generalization that an increase in drive is associated with a reduction in the range of cue use, when the direction of behavior is constant. He argued that a drive increment may facilitate or impair relevant cue use, depending on task complexity, but that it will always impair learning of peripheral cues.

He was called to task by Kausler and Trapp⁵⁵ for not distinguishing between incentive and drive manipulation. Drive theorists such as Spence distinguish between the energizing (drive) and the directive (incentive) aspects of motivated behavior. (In Spence's behavior theory, incentive magnitude combines additively with drive strength, so that, in practice, an increase in incentive should act much as does an increase in drive.) Easterbrook's reasoning is, perhaps, consistent with a cue-stimulus or non-drive theory, where the distinction between energizing and directive roles is irrelevant, because all behavior is motivated by stimulus conditions.

54. J. A. Easterbrook, op.cit.

55. Donald H. Kausler and E. Philip Trapp, "Motivation and Cue Utilization in Intentional and Incidental Learning", in the Psychological Review, Vol. 67, No. 6, issue of November 1960, p. 373-379.

In any event, there is direct evidence for the deleterious effect of stimulus-induced and response-inferred drive on incidental learning.

Aborn⁵⁶ found that ego threat (experimentally induced failure) had no effect on retention of material acquired by intentional learning, but that incidental learning retention scores were depressed.

Silverman⁵⁷ manipulated task difficulty and shock threat in a study in which subjects were given incidental auditory stimulation, in the form of a list of two-syllable words repeated at five-minute intervals. Task difficulty and shock threat decreased incidental learning.

Kohn⁵⁸ had subjects study a detailed story under threat of shock. The quantity of story detail recalled was lower than for a control group, with the greatest loss under stress being for irrelevant detail.

Several investigators have used the A-Scale to select subjects differing in drive or emotional responsiveness,

56. Murray Aborn, "The Influence of Experimentally Induced Failure on the Retention of Material Acquired through Set and Incidental Learning", in the Journal of Experimental Psychology, Vol. 45, No. 4, issue of April 1953, p. 225-231.

57. Robert E. Silverman, "Anxiety and the Mode of Response", in the Journal of Abnormal and Social Psychology, Vol. 49, No. 4, issue of October 1954, p. 538-542.

58. Hugh Kohn, "Effects of Variations of Intensity of Experimentally Induced Stress Situations upon Certain Aspects of Perception and Performance", in the Journal of Genetic Psychology, Vol. 85, Second half, issue of December 1954, p. 289-304.

for studies relevant to the effect of level of arousal, or drive, on cue utilization and incidental learning.

Siegmán⁵⁹ instructed high and low A-Scale groups to copy standard stimuli (Bender-Gestalt figures) and then tested them for incidental memory of the stimuli. He concluded that anxiety had a disruptive effect on incidental learning. Spielberger, Goodstein and Dahlstrom⁶⁰ carried out a similar study with larger groups, an interpolated task, and data on the difficulty values of the Bender-Gestalt figures. High drive subjects were better at reproducing from memory the easy items, while low drive subjects were superior on difficult items. These findings are in accord with the Hull-Spence theory of the interaction of habit strength and drive strength, in the intentional learning of simple and complex material. They do not, however, support the contention that high drive is associated with low incidental learning, regardless of task difficulty.

59. Aron W. Siegmán, "The Effect of Manifest Anxiety on a Concept Formation Task, a Nondirected Learning Task and on Timed and Untimed Intelligence Tests", in the Journal of Consulting Psychology, Vol. 20, No. 3, issue of June 1956, p. 176-178.

60. Charles D. Spielberger, Leonard D. Goodstein and W. Grant Dahlstrom, "Complex Incidental Learning as a Function of Anxiety and Task Difficulty", in the Journal of Experimental Psychology, Vol. 56, No. 1, issue of July 1958, p. 58-61.

Durvall⁶¹ predicted, from the Hull-Spence theory, a negative relationship between level of A-Scale measured drive and both intentional and incidental learning of complex material. When she adjusted results to control the effect of intelligence, she found that level of drive was unrelated to either kind of learning. (She was able to suggest explanations for her results which were compatible with the Hull-Spence theory.)

Maltzman, Fox and Morrisett⁶² reported that high A-Scale subjects were less likely than low A-Scale subjects to shift from a dominant set to a direct solution, when attempting to solve Luchins water jar problems. In Hull-Spence terms, an increase in drive increased the excitatory potential of responses with the strongest habit strength. Alternatively, it could be said that high drive subjects were unable to utilize new task-relevant cues once a dominant set was established.

61. Mary Irene Durvall, "The Effect of Manifest Anxiety upon Incidental and New Task Learning", in Dissertation Abstracts, Vol. 17, No. 3, issue of 1957, p. 680.

62. Irving Maltzman, Jack Fox and Lloyd Morrisett, Jr., "Some Effects of Manifest Anxiety on Mental Set", in the Journal of Experimental Psychology, Vol. 46, No. 1, issue of July 1953, p. 50-54.

Silverman and Blitz⁶³ compared the performance of high and low A-Scale subjects on incidental memory for two-digit numbers presented at the same time as the intentional task, serial anticipation of nonsense syllables. High drive was associated with lower incidental learning. (There were also three stress conditions, threat of shock that could not be avoided, threat of shock that could be avoided by correct responses, and no shock threat. Threat of shock that could be avoided improved the performance of low A-Scale subjects, but threat of unavoidable shock impaired their performance. Stress had no effect on the performance of high drive subjects.)

Studying the utilization of previously irrelevant cues as a basis for new discriminations in a concept learning task, Braley⁶⁴ found that the difference between drive groups, defined by A-Scale scores, was not related to either the acquisition or the utilization of irrelevant cues.

63. Robert L. Silverman and Bernard Blitz, "Learning and Two Kinds of Anxiety", in the Journal of Abnormal and Social Psychology, Vol. 52, No. 3, issue of May 1956, p. 301-303.

64. Loy S. Braley, "Some Conditions Influencing the Acquisition and Utilization of Cues", in the Journal of Experimental Psychology, Vol. 64, No. 1, issue of July 1962, p. 62-66.

Kausler, Trapp and Brewer⁶⁵ varied drive, measured by the A-Scale, instead of incentive in a study otherwise similar to the Bahrick (1954)⁶⁶ investigation, in which subjects were tested for incidental memory for colors embedded in geometric forms. High drive subjects were superior on the intentional task, serial anticipation of forms, but the groups did not differ on the incidental learning retention measure. When non-stress and strong ego-involving instructions were used, instead of the A-scale, results were the same.

Their findings obviously did not support the simple hypothesis that an increment to emotionally-based drive inevitably reduces incidental learning. Kausler and Trapp⁶⁷ suggested that the positioning of irrelevant cues was important. When irrelevant cues are within the reduced perceptual range of high drive subjects (as when color is actually inside forms), somewhat more incidental learning takes place than when these cues are relatively peripheral. In Hull-Spence theory terms, the net effect of low drive

65. Donald H. Kausler, E. Philip Trapp and Charles L. Brewer, "Intentional and Incidental Learning under High and Low Emotional Drive Levels", in the Journal of Experimental Psychology, Vol 58, No. 6, issue of December 1959, p. 452-455.

66. Harry P. Bahrick, 1954, op.cit.

67. Donald H. Kausler and E. Philip Trapp, op.cit.

and strong habit strength is then offset by the net effect of high drive and weak habit strength. They suggested three reasons for the lack of agreement amongst findings as to the effect of cue utilization and drive on incidental learning:

1. Different methods have been used to vary motivation, such as changes in incentive strength, changes in stress-induced drive, and differences in A-Scale scores.
2. Tasks have differed in complexity and difficulty.
3. The physical positioning of irrelevant cues has differed, and, in at least one study, irrelevant cues have been presented to a different sense modality.⁶⁸

It may be added that not only have the studies not been comparable, because of differences in task and procedural variables, but also that there has been little attempt at replication. The studies have also suffered, in most instances, from lack of clear hypotheses as to the effect on incidental learning of variables that are known to influence intentional learning. Three of these variables are drive, incentive motivation, and task difficulty.

⁶⁸. Robert E. Silverman, op.cit.

6. The Hull-Spence Behavior Theory.

In Hull's behavior theory⁶⁹, the probability of a response, R , was a function of excitatory potential, sRr , which, when other conditions were constant, was itself a function of the product of habit strength, sHr , and drive strength, D . The intervening variables, sHr and D , were operationally defined, the former by the number of reinforcements and the latter by deprivation time, the concentration of certain hormones in the blood, the strength of a noxious stimulus, and other antecedent conditions.

All needs present in an organism, both relevant and irrelevant, combined to yield the effective general drive strength, and so to facilitate performance. Irrelevant needs were distinguished from relevant needs in terms of relationship of a need to the objective nature of a reward. For example, if water were the reward, food would be an irrelevant need.

69. Clark L. Hull, Principles of behavior: An Introduction to Behavior Theory, New York, Appleton-Century-Crofts, 1943, xii - 424 p.

In a later version of the theory, Hull⁷⁰ stated that variations in the magnitude of the reinforcing stimulus contributed to the level of another intervening variable, K (incentive motivation), which combined with sHr and D to determine sEr. He was influenced in this regard by Spence⁷¹. In Spence's notation, the relationship between habit strength, drive strength and incentive motivation is expressed as $E = Hx (D+K)$ ⁷².

One of the threads of the nomological network that bounds the concept of drive is that the relative habit strengths of competing response tendencies must be taken into account before one can predict whether an increase in drive will facilitate or impede the correct response. This is no problem in conditioning studies, because, with only a single response tendency--to blink or not to blink, for example--one can readily predict that high-drive subjects will condition more readily than low-drive subjects.

In verbal learning, one must consider the amount of competition within stimulus lists. If there is no, or only

70. Idem, "Behavior Postulates and Corollaries--1949", in the Psychological Review, Vol. 57, No. 3, issue of May 1950, p. 173-180.

71. Kenneth W. Spence, Behavior Theory and Conditioning, New Haven, Yale University Press, 1956, p. 133 seq.

72. Idem, ibid., p. 162 seq.

slight, intra-list competition, one can predict that high drive strength will facilitate correct responses, as habit strength builds up on successive trials. When intra-list competition is high, there is a difference in habit strength early in learning in favor of incorrect responses, and the effect of increasing drive is to increase the size of the difference. Accordingly, it is predicted that early in learning high drive will impede performance. As training progresses, the habit strength of correct reinforced responses will build up, until eventually the performance of high drive subjects should exceed that of low drive subjects.

Under what conditions does a correct response occur in learning? Hull⁷³ postulated that reaction potential varied from moment to moment, and that the oscillations of competing response tendencies were asynchronous. Thus, it was possible for a correct response to occur, even though the average value of its reaction potential was below that of competing incorrect responses.

Spence distinguishes between appetitional drive states, defined in terms of deprivation, and aversive or emotional drive states, defined originally in terms of

73. Clark Leonard Hull, A Behavior System: An Introduction to Behavior Theory Concerning the Individual Organism, New Haven, Yale University Press, p. 198.

noxious stimuli. In aversive situations, drive is assumed to be, in part, a function of the magnitude of a hypothetical emotional response mechanism, which, when activated by aversive stimulation, organizes activity of the autonomic nervous system, and may energize certain cortical mechanisms.⁷⁴ The reflex response magnitude of a particular person will vary with the intensity of the stimulus. It is assumed that the magnitude of a reflex response is related to emotional responsiveness, through the latter's contribution to drive strength, often as an irrelevant need.

In studies of intentional verbal learning, one may assume that incentive motivation is, on the average, a constant for all subjects, regardless of their drive levels. On the other hand, the fact that there is little or no revealed learning in the course of incidental learning can be attributed to negligible incentive motivation. Instructional set ensures that incentive motivation is, on the average, large during intentional learning and small during incidental learning. Instructions accompanying the presentation of the incidental learning retention task serve to increase incentive motivation, with the result that there is a sudden gain

74. Kenneth W. Spence, "A Theory of Emotionally Based Drive (D) and Its Relation to Performance in Simple Learning Situations", in the American Psychologist, Vol. 13, No. 3, issue of March 1958, p. 131-141.

in reaction potential, and emission of responses that reveal incidental learning.

From this research model, one may predict that incidental learning of verbal material will be subject to the same effects of intra-list competition as intentional learning of verbal material, but that these effects will be revealed only on the retention task.

7. Some Conclusions and a Hypothesis

This review of the literature on incidental learning has traced the phenomenon from its origins, primarily in studies of the worth of testimony, through the period when set was recognized as the critical event distinguishing incidental from intentional learning, to recent studies of the effect of cue utilization and motivation on incidental learning. It has been shown that incidental learning is of theoretical importance because it holds promise of casting light on the role of reinforcement in learning, but that the crucial study, in which intent or motivation to learn is eliminated, has yet to be designed. Accordingly, many investigators have turned to examining the effect on incidental learning of task, environmental and subject variables that are known to influence intentional learning. Finally, it has been argued that lack of

a clearly stated theory to generate hypotheses for incidental learning studies, and lack of replication, have led to conflicting findings, in studies where incentive and drive have been manipulated.

The present investigation had as its purpose the study of the effect on incidental learning of certain task and subject variables. The subject variable was drive, operationally defined in terms of scores on the A-Scale. Two of the task variables were the difficulty levels of the intentional task and of the incidental task. A third task variable was, originally, the positioning of incidental cues.

It was reasoned from the Hull-Spence behavior theory that the performance of high-drive subjects on an incidental learning task that included hard and easy items but was low in intra-list competition would be superior to that of low-drive subjects. From cue utilization theory, it was hypothesized that all subjects would learn more readily incidental items placed adjacent to the intentional learning task. The possibility of an interaction between intentional and incidental task difficulty was envisaged. It was reasoned that all subjects would retain more readily incidental items exposed with easy intentional items, learning of which would require less exposure time than learning hard intentional items.

The first statement of the null hypothesis was: High- and low-drive subjects do not differ in their success in learning easy and difficult incidental task items positioned within and to one side of easy and difficult intentional task items.

As will be seen, a pilot study showed that the positioning of peripheral incidental cues led to an apparently insoluble design problem. The pilot study also suggested a requirement to examine the nature of the orienting task. In its final form, the statement of the null hypothesis was: The difficulty level (easy or hard) of intentional and incidental learning tasks, and the nature of the orienting task (spelling aloud or not spelling aloud incidental stimuli) do not affect incidental learning of verbal trigrams by high-drive and low-drive subjects.

CHAPTER II

EXPERIMENTAL DESIGN

In this chapter are described the materials and the procedures used to conduct an experiment to test the hypothesis stated at the end of Chapter I.

Chapter II begins with a description of the selection of subjects for the experiment, with particular reference to the use of a psychometric device to distinguish between subjects high and low on the organismic variable, drive. Then follows an account of a pilot study carried out to check on the adequacy of intentional and incidental learning task materials, and of the experimental procedure. Modifications to the hypothesis and to task materials and procedure consequent on pilot study findings are discussed next. The chapter concludes with a restatement of the main hypothesis, and some implications of this hypothesis and the research design for analysis of data.

1. The Samples

Subjects for this experiment were drawn from two classes in introductory psychology at Carleton University, Ottawa. All the students were naive to verbal learning experiments. To avoid influencing the study, the course instructors (one of whom was the experimenter) did not refer in their lectures either to incidental learning or to the measurement of drive in human subjects until after all the data had been analyzed.

Under the guise of gathering information on the relationship between two measures of the same personality variable, 175 students were given the Maudsley Personality Inventory¹ and the Biographical Inventory². In Appendix 2 are discussed findings in the analysis of test results, findings that were a bi-product of the main investigation. It will suffice here to state that twenty per cent of those tested scored 11 or less on the A-Scale, that twenty per cent scored 26 or more, and that subjects for the study of

1. Arthur R. Jensen, "The Maudsley Personality Inventory", in Acta Psychologica, Vol. 14, No. 4, issue of 1958, p. 314-325.

2. Janet A. Taylor, "A Personality Scale of Manifest Anxiety", in the Journal of Abnormal and Social Psychology, Vol. 48, No. 2, issue of April, 1953, p. 285-290. The Biographical Inventory--so-called by Taylor--consists of the fifty A-Scale items embedded in 175 other items from the Minnesota Multiphasic Personality Inventory, including most of the L-, F-, and K-Scale items.

incidental learning were drawn from these extreme groups.

Test results of twenty-one individuals with Maudsley Personality Inventory Lie-Scale scores of 11 or more, or Biographical Inventory L-scale scores of 7 or more, or F-Scale scores above 16, were considered to be invalidated. No individuals with invalidated test results were selected for the incidental learning study.

The group with low A-scale scores included approximately equal numbers of males and females, but the high-scoring group was predominantly female. Because of the possibility of a relationship between sex and incidental learning, high- and low-scoring groups were matched for sex composition by randomly drawing from male and female subgroups, within the high-scoring and the low-scoring groups, ten males and fifteen females with low A-Scale scores, and ten males and fifteen females with high A-Scale scores.

With drive defined in terms of scores on the A-Scale, these two groups will henceforth be referred to as the "high-drive" and the "low-drive" groups. The construct, "drive", carries no impediments other than those assigned to it in the Hull-Spence theory of behavior. The A-Scale was accepted, for the purposes of this study, as a measure of drive. The claim that the A-Scale is satisfactory as a measure of drive is considered in Appendix 1.

No attempt was made to match high-drive and low-drive groups for learning ability. Firstly, it was assumed that university students are a relatively homogeneous group intellectually. Secondly, it was reasoned that it would be better to replace subjects who did not meet selected learning criteria, than to match groups as to intelligence test results. During the incidental learning study, three low-drive and two high-drive males were replaced because of apparent inability to learn paired-associates readily. They had less than six correct responses on the final intentional learning trial. One low-drive female and one high-drive female were replaced because they had completed two successive errorless trials before the twenty-fifth intentional learning trial.

The age range of the high-drive group was 19 to 38, (median: 24) while that of the low-drive group was 19 to 42 (median: 24).

Ten subjects for a pilot study to test the adequacy of the verbal learning materials were drawn randomly from those with A-Scale scores between 12 and 25.

2. Pilot Study: Materials and Procedure

The purpose of the pilot study was to try out test materials on a small sample of the population from which

high-drive and low-drive subjects were drawn for the main investigation.

The original hypothesis called for positioning easy and difficult incidental stimuli with and apart from easy and difficult intentional learning stimuli. The intentional learning task used in the pilot study was a list of sixteen paired-associates, and the incidental task items were nonsense syllables.

The stimulus members of the paired-associates were three-letter consonant syllables from Witmer's list, eight with association, or "meaningfulness", values of 8 per cent or less, and eight with association values of 92 per cent or more.³ The letters of items of the "hard" list were not duplicated in the same position within the list, nor did they appear in the paired response. There were several duplications in the "easy" list, but these syllables were particularly meaningful because, with the addition of one vowel, each became a common four-letter monosyllable, easily associated with the paired response word. The hard stimuli,

3. Louise R. Witmer, "The Association Value of Three-Place Consonant Syllables", in the Journal of Genetic Psychology, Vol. 47, No. 2, issue of December, 1935, p. 337-359. Witmer's association values represent the percentage of her twenty-five subjects (male university students) who reported an association to a syllable within four seconds of seeing it.

of which "zjq" is typical, included a high proportion of letters that occur rarely in English. A typical easy stimulus was "pnk". Each of the sixteen syllables began with a different consonant.

The response members of the paired-associates were all five-letter disyllables. The eight "hard" responses were paralog⁴s from Noble's list, with association values of 1.55 or less. The mean association value of these eight paralog⁴s was 1.26. The eight "easy" responses were common words. Four, taken from Noble's list, had an average association value of 7.95.

This method of selection of intentional task items presumably ensured a high initial habit strength for easy stimulus and response items, and a low initial habit strength for hard stimulus and response items. ("Habit strength" is used here in the sense of "availability" of a response, or its position in a hypothetical hierarchy of verbal habits.) An attempt was made to manipulate task difficulty further, in terms of the associative strength between the stimulus and response members of each pair. Easy pairs were made up of items that could easily be associated. For example,

4. Clyde E. Noble, "An Analysis of Meaning" in the *Psychological Review*, Vol. 59, No. 6, issue of November, 1952, p. 421-430. Noble's association values represent the average number of written associations given in sixty seconds to each verbal unit (paralog⁴s and words) by 119 airmen in basic training.

"grl", which suggests "girl", was paired with "model", and "pnk" which suggests "pink", was paired with "melon". There was no reason to expect a significant amount of pre-experiment associative strength between members of hard pairs; the possibility that identity of letters might affect associative strength was reduced by ensuring that the same letter did not appear in both stimulus and response members of any hard pair. A typical hard pair was "zjq--balap".

The incidental task consisted of sixteen nonsense syllables--a vowel between two consonants--from Glaze's list⁵. Eight hard items had association values of 7 per cent or less, and eight easy items had association values of 92 per cent or more. Each syllable had a different initial and a different final consonant, and four of the five vowels appeared three times in the list, with "a" being used four times. It should be noted that there is no necessary correspondence between the Glaze and the Witmer association values. Witmer's exposure time was longer by one to two seconds per syllable. It would also seem to be self-evident that it is far more difficult to learn an essentially unpronounceable consonant syllable like "lqw"

5. J. A. Glaze, "The Association Value of Non-sense Syllables", in the Journal of Genetic Psychology, Vol. 35, No. 2, issue of December 1928, p. 255-269. Glaze's association values represent the percentage of fifteen university students who reported an association within two or three seconds of seeing a syllable.

(Hitmer value: 50 per cent) than a nonsense syllable like "sot" (Glaze value: 0 per cent).

The sixteen paired-associates were typed in black in lower case elite type on memory drum paper, in three random orders to reduce serial position effects. Stimulus and response members were spaced twenty-three millimetres apart. Four hard and four easy incidental task syllables (also in black, in elite type) were spaced midway between paired-associate members, two easy and two hard syllables within easy paired-associates ("near cue" incidental stimuli). The remaining eight nonsense syllables were distributed among the other eight paired-associates in the same way but, instead of being positioned within pairs, they were spaced about fifty millimetres to the right of response members of the intentional task ("far cue" incidental stimuli). Thus, intentional and incidental task difficulty, and the positioning of incidental stimuli, were counter-balanced. To reduce the possibility of an association developing between a nonsense syllable and either a stimulus or a response member of a paired-associate, each nonsense syllable appeared with a different paired-associate, in each of the three orders of presentation of the intentional task. Of course, no incidental stimulus, once used within a paired-associate, was also used after a response member.

A memory drum was modified by the addition of a bracket against which the subject rested the bridge of his nose. The bracket maintained a constant distance of twelve inches between the eyes of subjects and the intentional task, and also ensured that, with eyes focussed on the intentional task, the image of the incidental stimulus in the "far cue" position would fall on the retina nine to ten degrees off the fovea. The memory drum was set at a 2 : 2 second rate, so that an intentional task stimulus appeared alone for two seconds, and then together with an intentional task response and an incidental stimulus, in either the "near cue" or the "far cue" position, for two more seconds. The inter-trial interval was four seconds.

Standard paired-associate instructions were used, with the addition of the following instruction about the incidental task stimuli.

To make the task a little harder, a nonsense syllable will be shown with each paired-associate. A nonsense syllable is a vowel between two consonants, like 'cak' or 'dob'. Sometimes the nonsense syllable will be between the stimulus and the response, and sometimes it will be to the right of the response word. You are not expected to learn these nonsense syllables. They are there simply to make the task of learning the paired-associates a little harder, by distracting you from the main task. The main task for you is to learn to say the five-letter words that are the responses to the three-letter consonant syllables.

Each subject was given twenty learning trials. The experimenter recorded, for each trial, the number of correct responses, the number of omissions, and the number of intrusions, or incorrect responses. Immediately after the last trial, subjects were read the following additional instructions about the incidental task.

That was very good. Now there is one more thing for you to do. I said that you did not have to learn the nonsense syllables that were placed in the paired-associate list to distract you from the main task. However, some people, particularly those of high intelligence, like you, are able to pay attention to several things at once. They can learn the nonsense syllables as they are learning the paired-associates. Here is a list of ninety-six nonsense syllables. The sixteen that were shown over and over again while you were learning the paired-associates are in this list. I want you to try to find as many as you can. Cross out each one that you think was shown while you were learning the paired-associates. Remember, this is a kind of intelligence test, so try to find as many as you can.

The recognition task, used to measure retention of incidental stimuli, included, in addition to the sixteen incidental stimuli, eighty more syllables from Glaze's list, sixteen being drawn from each of five association value levels--93 to 100 per cent, 73 to 87 per cent, 33 to 47 per cent, 13 to 27 per cent, and 0 to 7 per cent. Within each group of sixteen syllables, initial consonants were the same as those of the incidental task items, and each of the five vowels was used three times, with "y"

used once. No consonant was used more than once in the third position with any one initial consonant.

After the test for retention of nonsense syllables, subjects were questioned as to their understanding of the purpose of the experiment, with particular reference to how they reacted to incidental stimuli. They were asked not to talk about the experiment until the main investigation was completed.

3. Pilot Study: Effect on Main Investigation.

One conclusion drawn from the pilot study was that both the incidental and the hard intentional tasks were far too difficult.

The median number of trials to two errorless anticipations of all eight easy paired-associate responses was only six, and yet no subject exceeded three correct anticipations of hard responses on the twentieth trial.

Accordingly, it was decided to

1. increase the difficulty of easy paired-associates,
2. decrease the difficulty of hard paired-associates,
3. increase the number of trials to thirty.

On the incidental stimulus retention task, not one subject correctly identified a single nonsense syllable that had been shown in the "far cue" position. Only the

two easy syllables within easy paired-associates ("mex" and "lev") were regularly identified. When questioned, subjects stated that they rarely glanced at incidental stimuli in the "far cue" position. Moreover, they usually said that they tried to ignore incidental stimuli within paired-associates, judging them (because of the instructions that they had been given) to be unrelated to, and likely to interfere with, the intentional task.

Lack of success in identifying "far cue" stimuli is understandable when it is recalled that visual acuity ten degrees off the fovea is only about one-fifth as good as at the fovea. Subjects presumably simply did not perceive stimuli that they did not look at directly. As to the "near cue" stimuli, lack of evidence of much incidental learning seemed to be attributable to a deliberate attempt to ignore distracting stimuli, prompted by the instructions given to subjects.

These findings pointed to a design error that should have been obvious. The orienting task, learning paired-associates, had not required subjects to pay attention to incidental stimuli, and, in fact, had tended to induce them to try to ignore the incidental stimuli. It was necessary to modify the design, so that subjects would pay attention to incidental stimuli, without intent to learn.

It seemed likely that such an orienting task would interfere with the possibility of testing the effect of cue position on incidental learning. It was evident that a subject could perceive a complex stimulus like a nonsense syllable in the "far cue" position only if he looked more or less directly at it. In that case, the stimulus in one sense would no longer be a peripheral cue, because its image would fall on, or very near, the fovea. The possibility of using a relatively simple peripheral incidental task (such as color identification), which would not require the subject to look directly at the stimulus, was considered and rejected, because of the problem of manipulating incidental task difficulty.

To direct attention to incidental stimuli, without provoking a deliberate intent to learn, it was decided to require subjects in the main investigation to spell half the incidental stimulus syllables aloud, under conditions which would make it unlikely that they would try to learn them. Because there might well be an interaction between such an orienting task and intentional learning, it was judged necessary to provide a control condition, under which subjects would be exposed to the remainder of the incidental stimuli without instructions to do anything with

them. This procedure would provide an opportunity to check on Mechanic's⁶ conclusion that incidental learning does not vary as a function of intentional task difficulty when the orienting task requires subjects to make differential responses to incidental stimuli.

Consequent on these decisions, the main hypothesis was reframed to read: The difficulty level (easy or hard) of intentional and incidental learning tasks and the nature of the orienting task (spelling aloud or not spelling aloud incidental stimuli) do not affect incidental learning of verbal trigrams by high- and low-drive subjects.

In summary, the pilot study indicated a need to modify the intentional and the incidental task material, and to change the design so as to investigate not the positioning of cues but the effect of the orienting task. So evident were these conclusions that it was judged unnecessary to document the findings further, before the main investigation.

6. Arnold Mechanic, "The Distribution of Recalled Items in Simultaneous Intentional and Incidental Learning", in the Journal of Experimental Psychology, Vol. 63, No. 6, issue of June 1962, p. 593-600.

4. Main Investigation: Materials

Paired-associate learning has two stages.

1. The subject first learns the responses as responses, so that they become available for pairing with stimuli.
2. The subject then learns to associate each response with the specific stimulus with which it is paired.

The investigator can manipulate the difficulty of the first stage of learning paired-associates primarily by selecting responses differing in pre-experiment familiarity, or habit strength. He can manipulate the difficulty of the second stage primarily by constructing pairs that differ in the strength of pre-experiment associative connections. In the main investigation, an attempt was made to control the difficulty level of stimuli and the associative strength between members of pairs, so that ease of learning depended largely on the pre-experiment habit strength of responses.

The lists of Glaze⁷, Witmer⁸, Noble⁹, and others, depended for their utility on the assumptions that ease of learning is a function of meaningfulness, and that association value is the basic factor underlying meaningfulness.

7. J. A. Glaze, op.cit.

8. Louise R. Witmer, op.cit.

9. Clyde E. Noble, op.cit.

Underwood and Schulz¹⁰ produced evidence that association value is not a directly relevant factor in paired-associate response learning, although it probably affects associative strength within pairs. The evidence that they cited indicates that familiarity, frequency of occurrence in English letter sequences, and "pronunciability" are more important in determining the rate of learning of paired-associates.

To replace the unsatisfactory concept of association value, they suggested, for three-letter units, "generated value" (GV) and "pronunciability rating" (PR).

GV reflects the level of integration of three-letter verbal units, indexed by the strength of the habits leading from the first letter to the second, and from the first two letters to the third.¹¹ The value of the first letter is based on the frequency of first letters in the Thorndike-Lorge word count, with S, the most frequent letter, assigned a value of 100, and other letters valued according to their frequency in proportion to that of S. Values for the second and third letters of trigrams are based on the number of times each letter was given, in either second or third position, by 273 elementary psychology students, instructed

10. Benton J. Underwood and Rudolph W. Schulz, Meaningfulness and Verbal Learning, Chicago, Lippincott, 1960, viii - 430 p.

11. Idem, chapter 9 and Appendix F.

to respond with a single letter to 702 stimuli--the twenty-six letters of the alphabet, alone and in all 676 two-letter combinations.

Underwood and Schulz gave PR values for 239 three-letter units¹², based on ratings by 181 elementary psychology students, on a nine-point scale of relative ease or difficulty of pronunciation.

Evidence was given to support the contention that GV and PR were highly correlated, and that each was closely related to rate of learning, when three-letter units are the responses to one-digit stimuli.¹³ The evidence suggested that the easier a trigram was to pronounce and the higher its generated value, the greater was the degree of initial integration of letters, so that less time had to be devoted to the first stage of learning paired-associates, increasing the habit strength of responses so that they became readily available for associative connections with stimuli.

GV and PR were used in the selection of task materials for the main investigation. The trigrams which were the incidental stimuli in the main investigation were exposed not with the stimulus and response members of paired-associates (as in the pilot study) but beside the

12. Idem, Appendix E.

13. Idem, chapter 10.

intentional task stimuli, when they appeared alone, without their paired responses. The difficulty of the intentional task was manipulated primarily in terms of pre-experiment familiarity or habit strength of responses. An attempt was made to control one variable that might have interacted with incidental task difficulty, by matching stimulus members of easy and hard pairs for GV and PR. This matching presumably did not affect the ease or difficulty of paired-associate learning unduly; there is considerable evidence that rate of paired-associate learning is more influenced by the difficulty level of responses than by that of stimuli.¹⁴

Table I shows the sixteen paired-associates of the intentional task. The stimuli were three-letter nonsense syllables. Discrimination of stimuli was facilitated by ensuring that there were no duplications within the sixteen initial or the sixteen terminal consonants. The Mann-Whitney U test was used to test the significance of deviations of summed GV and PR ranks from their expected values. For PR, the normal deviate was .105 and for GV it was .053; both values are well short of statistical significance. It was concluded that the stimulus terms for hard and easy paired-associate lists were matched for average ease of learning.

14. Idem, p. 35-42, 246-255.

Table I.

Intentional Task Paired-Associates, with GV and PR of Stimulus Members and Association Values of Response Members

Hard Pairs					Easy Pairs				
Stimuli			Responses Association		Stimuli			Responses Association	
Item	GV	PR	Item	Value	Item	GV	PR	Item	Value
bot	120	2.64	kupod	1.55	ced	75	3.07	wagon	8.12
dal	47	2.62	xylem	1.24	fus	52	2.51	model	--
jum	23	3.11	latuk	1.26	gaw	34	3.35	table	--
lar	29	2.23	zumap	1.28	hov	61	3.01	money	8.98
mak	47	3.29	gojey	0.99	kix	25	2.44	water	--
puf	66	2.92	gokem	1.27	nop	149	2.63	jewel	7.58
sog	165	2.65	balap	1.22	rec	44	2.43	zebra	7.12
ven	75	2.66	tarop	1.24	toz	112	3.36	pupil	--
Mean	71.5	2.76		1.26		69.0	2.85		7.95

With one exception, the response members were those used in the pilot study. Association values are given in Table I for responses drawn from Noble's list¹⁵. It would seem to be obvious that easy and hard responses differed markedly in pre-experiment familiarity, and so in habit strength.

The eight hard incidental stimuli were unpronounceable consonant syllables, in two sub-groups of four each, drawn from the 75 per cent level of Witmer's list, and matched for GV. The "spelled aloud" group had a mean GV of 40.25, while that of the "not spelled aloud" group was 41.5. ("Spelled aloud" and "not spelled aloud" refer to the procedural or orienting task variable referred to in Section 3 of this chapter.) No consonant appeared more than once in first position, in second position, or in third position.

The eight easy incidental stimuli were three-letter nouns, the initial letters of which did not appear in first position in the eight hard incidental stimuli. No endeavor was made to match sub-groups of easy incidental stimuli for GV, because familiarity has a greater effect on rate of learning verbal material than do either GV or Ph.

15. Clyde E. Noble, op.cit.

The sixteen paired-associates were typed in black in lower case elite type on memory drum paper, in four random orders, to reduce serial position effects. Stimulus and response members were spaced twenty-one millimetres apart. Four hard and four easy incidental task trigrams (also in black, in elite type) were positioned thirteen millimetres to the left of incidental task stimuli, two hard and two easy trigrams with the stimuli of easy paired-associates and two hard and two easy trigrams with the stimuli of hard paired-associates. The remaining eight incidental stimuli were distributed among the other eight paired-associates in the same way, but they were typed in red, and not in black. Each pair of incidental stimuli was exposed, in all four lists, with the same two paired-associates; thus, in the four lists, each incidental stimulus was shown twice with one paired-associate and twice with another. Table II lists the sixteen incidental task trigrams, the GV's of hard items, and the two paired-associates with the stimulus members of which each item was exposed.

The eight incidental stimuli printed in red were to be spelled aloud during intentional task trials. The use of red served, of course, to make the trigrams that were to be spelled aloud more readily discriminable. However, it also meant that differences in the numbers retained of black

Table II.

Incidental Task Trigrams, and Intentional Task Paired-Associates with which Each Trigram was Exposed (GV for Hard Trigrams only)

Orienting Condition	Hard Trigrams			Easy Trigrams	
	Trigram	GV	Paired-Associates	Trigram	Paired-Associates
Incidental Items Spelled Aloud	dtr	44	fus-model, ced-wagon	jam	kix-water, rec-zebra
	rgd	37	fus-model, ced-wagon	cup	kix-water, rec-zebra
	fns	44	bot-kupod, lar-zumap	pot	puf-gokem, ven-tarop
	thx	36	bot-kupod, lar-zumap	war	puf-gokem, ven-tarop
Incidental Items Not Spelled Aloud	hsb	42	gaw-table, hov-money	gas	nop-jewel, toz-pupil
	ntp	41	gaw-table, hov-money	sin	nop-jewel, toz-pupil
	mrz	41	dal-xylem, jum-latuk	van	mak-gojeje, sog-balap
	bkg	42	dal-xylem, jum-latuk	leg	mak-gojeje, sog-balap

and red incidental stimuli could be a function not only of the orienting task--spelling aloud only red syllables--but also of isolation effects due to the use of a different color.

It will be seen that the design counterbalanced all possible combinations of intentional and incidental task difficulty, and of the "aloud--not aloud" procedural variable.

The nose rest modification of the memory drum, made initially to control the distance between the eyes of subjects and the memory drum aperture, was retained in the main investigation because its use seemed to help subjects to concentrate on the tedious intentional learning task.

The memory drum was again set at a 2 : 2 second rate. An intentional task stimulus and an incidental task stimulus appeared together for two seconds, and were followed by the intentional task stimulus and its paired response, for two more seconds. The inter-trial interval was four seconds.

The incidental stimulus retention task consisted, in the main investigation, of only sixty-four trigrams, including the sixteen incidental stimuli. Half of the remaining forty-eight items were common three-letter words beginning with the same eight consonants as the easy incidental items. The other half were consonant syllables, drawn from the 50 per cent, 75 per cent, and 92 per cent levels of Witmer's list. Appendix 3 is a copy of the retention task.

5. Main Investigation: Procedure.

Subjects were tested one at a time, in a small interviewing room in the Carleton University Psychology Department. The room was furnished with two tables and three chairs. The memory drum was on one of the tables. On entering the room, the subject was asked to sit at the other table, and was then read the following instruction:

The purpose of this experiment is to find out how well you can learn a list of paired-associates. In learning paired-associates, what you have to do is to learn to say the second or response word of a pair of words as soon as you see the first or stimulus word. In this study, the stimulus or first word will always be a three-letter nonsense syllable, like 'cak' or 'dob'. The response or second word will be a five-letter word, like 'camel' or 'talep'. Not all the responses will be real words, but all will have five letters and two syllables.

There are sixteen pairs of stimulus and response paired-associates in the list you will see. The list will be shown over and over again, thirty times in all. At the start of the list is the word "Start", and at the end is the word "Finish".

You will see the stimulus nonsense syllable first, for two seconds. Then you will see the response word beside it, for two more seconds. What you have to learn to do is to say the nonsense syllable aloud, as soon as you see it, and then try to say the response word aloud, before it appears in the memory drum window. Of course, the very first time you see the list, you won't be able to anticipate any of the response words. All you will be able to do, the first time you see the list, is say the nonsense syllables. The second time you see the list, you may be able to anticipate one or two of the response words before you see them. As you see the list over and over again, you will be able to say more and more of the response words before they appear in the memory drum window. Do not read the response words aloud. Only say them aloud if they come to mind when you see the nonsense syllable alone.

Now, to make the task a little harder, there will be three more letters in front of each stimulus nonsense syllable. If these letters are printed in red, spell them aloud, before you say the stimulus nonsense syllable. If they are printed in black, do not spell them aloud. The main task for you, however, is to learn to say the five-letter words that are the responses to the nonsense syllables.

Remember. Spell the three letters on the left aloud, if they are printed in red, like this: WXY. Then say the nonsense syllable, like this: cak. Then try to say the paired-associate response word before you see it. What you are to try to learn to do is to say "WXY cak talep", or whatever it happens to be, within two seconds, before the response word appears in the memory drum window.

It will be noted that the instruction respecting the incidental stimuli did not suggest that subjects need not learn them, as in the pilot study, nor did it suggest that their role was to distract subjects from the main task.

The subject was next seated in front of the memory drum, and the use of the nose rest was explained. Each subject was then given a single practice trial during which he was coached in spelling the incidental stimuli printed in red aloud, and in saying the nonsense syllables aloud, before the response words appeared in the memory drum window.

After the practice trial, the experimenter stopped the memory drum momentarily, said, "Away we go now, for thirty learning trials", and then switched the machine on again.

It was, of course, impossible to record exactly what the subject said on each stimulus presentation on each trial. Recording of intentional learning results was restricted to noting whether the response word was given correctly before it appeared in the memory drum window, whether the response that was given was an incorrect intrusion, or whether no response at all was given.

Immediately after the thirtieth intentional learning trial, the subject was asked to seat himself at the second table. He was then read the following instruction.

That was very good. Now, there is one more thing for you to do. You will recall that I did not ask you to learn the letters printed in black or in red to the left of the paired-associates. Now, some people are able to pay attention to two things at once. They could, for example, learn some of the three-letter combinations to the left of the nonsense syllables, while they were learning the paired-associates. Here is a list of 64 three-letter combinations. The sixteen that were shown over and over again while you were learning the paired-associates are included in this list.

What I want you to do is to try to find as many of them as you can. Put a large cross through each one that you think was shown, either in black or in red, on the left, while you were learning the paired-associates. You will have five minutes for this task.

Unlike the procedure in the pilot study, no suggestion was given that the retention task was "a kind of intelligence test", to avoid influencing emotionally-based drive.

No instructions were given as to guessing, but subjects were encouraged to work on the task for the full five minutes.

It is important, in a study on incidental learning, to attempt to eliminate subjects who were, despite the instructions, set to learn the incidental learning material. In other words, it is necessary to replace subjects for whom the incidental stimuli were not, in fact, incidental. Therefore, after the measure of retention of incidental stimuli had been completed, each subject was asked the following questions, informally.

1. When you were learning the paired-associates, what did you think was the real purpose of this experiment?
2. When you were learning the paired-associates, what did you think was the reason why the three-letter combinations in black and red were shown with the nonsense syllables?
3. Did you consciously try to learn any of those three-letter combinations?
4. Did you consciously try not to learn any of them?
5. When you were learning the paired-associates, did you think I was going to test your memory for the red or the black three-letter combinations on the left?

One other question was asked, to provide a basis for eliminating subjects whose intentional learning scores might have been influenced by a tendency to more or less ignore difficult items until the easy items had been mastered.

6. When you were learning the paired-associates, you probably noticed that you tended to learn the easy ones first. Do you think that you deliberately concentrated on learning the easy ones first, or do you believe that you tried to learn each item, easy or hard, as it appeared in the memory drum window?

When judged necessary to clarify answers, additional questions were asked.

After the questioning, each subject was read the following instruction:

Before your course ends, I shall let you know just what this experiment is all about, and how it turned out. At that time, I shall also tell you what I found out when I analyzed the questionnaires that you completed for me some time ago. In the meantime, please do not talk over what happened to you here today with anyone else, even someone whom you know has already been tested. This is very important, because the success of this experiment, like every other experiment, depends on subjects not knowing just what is going to happen to them. If you talk about the experiment outside this room, someone who has not yet been tested may overhear you, and would have an unfair advantage. So please keep the secret until the experiment is over.

6. Main Investigation: Implications for Analysis of Data

What follows in this final section of the chapter on the experimental design is an examination of implications of certain aspects of the design for data analysis, a restatement of the main hypothesis, and the specification of certain subsidiary hypotheses.

It will be recalled that each subject was exposed to sixteen incidental task trigrams on each of thirty intentional learning trials. The number of incidental task items correctly identified on the retention task can be conceived, for purposes of data analysis, as depending on four independent variables: one organismic variable, two task variables, and one procedural variable. The organismic variable was drive, as measured by the A-Scale. The two task (or treatment) variables were the difficulty of intentional task paired-associates--hard or easy--and the difficulty of incidental task items--also hard or easy. The procedural (or behavioral) variable was the nature of the orienting task. Under one procedural condition, subjects made differential responses to incidental task items, spelling them aloud during intentional learning. Under the other procedural condition, subjects were exposed to incidental items, but were not instructed to do anything with them.

Within each of the two drive groups, subjects served as their own controls for the task conditions and for the procedural condition. That is, two groups of subjects, who differed on the drive variable, were treated identically in terms of manipulation of task and procedural variables, and all subjects in both groups performed under all task and procedural conditions.

Each subject spelled eight incidental task items aloud on each intentional learning trial but did nothing observable with the other eight incidental task items. Within each procedural condition, there were four combinations of task conditions. Hard incidental task items were paired with hard paired-associates. Hard incidental task items were paired with easy paired-associates. Easy incidental task items were paired with hard paired-associates. Easy incidental task items were paired with easy paired-associates. Since there were four combinations of task conditions under each of two procedural conditions, there were two incidental task items for each of four by two, or eight, task and procedural combinations of conditions. It was possible for a subject to mark correctly on the retention task no, one or two incidental task items, learned under each combination of conditions. The number that the subject marked correctly under a single combination of conditions constituted his score for that combination.

This design was developed after the pilot study, to test the revised main hypothesis: The difficulty level (easy or hard) of intentional and incidental learning tasks, and the nature of the orienting task (spelling aloud or not spelling aloud incidental stimuli) do not affect incidental learning of verbal trigrams by high- and low-drive subjects.

The possibility of interaction between two or more of the independent variables indicated that the method used to test the significance of differences between the mean number of incidental task items retained by high- and low-drive groups under each condition should be the analysis of variance.

Since drive in the Hull-Spence theory of behavior is a multiplier of habit strength, one effect of a drive increment is to increase response evocation. It was reasoned that high-drive subjects would make more responses than low-drive subjects on the measure of retention of incidental items. It was decided to test this prediction in a subsidiary investigation with the null hypothesis: High-drive and low-drive groups do not differ as to mean number of responses on a recognition task following incidental learning.

Although the purpose of the intentional learning task was simply to provide an excuse for exposing subjects to the incidental task, it was decided to study results on the intentional task in the interests of exploiting all the data. One obvious matter to investigate was the effect on intentional learning of the procedural variable. It seemed likely that spelling incidental task items aloud would interfere with paired-associate learning, perhaps by reducing slightly the time available on each trial for memorizing.

This problem was expressed as a null hypothesis: intentional task difficulty and the requirement to make differential responses to incidental stimuli in an incidental learning experiment do not affect the intentional learning of paired-associates by high- and low-drive groups.

In the Hull-Spence theory of behavior, it is reasoned that there will be little or no difference between high- and low-drive groups at the start of learning paired-associate lists low in intra-list competition, but that, as learning progresses, the curves of correct responses will diverge, with that for high-drive subjects being higher. The acquisition curves for intentional paired-associate learning were plotted, as a test of this prediction from the theory.

Results of the analysis of data gathered in the experiment described in this chapter are presented in Chapter III.

CHAPTER III

PRESENTATION OF RESULTS

In this chapter is reported the analysis of data gathered in the experiment described in Sections 4 and 5 of Chapter II.

Chapter III opens with a brief discussion of responses to the questions asked informally after the retention task. The rationale for the analysis of data respecting the main hypothesis is considered next, following which results of this analysis are reported. The rest of the chapter deals with subsidiary findings, as to incidence of responses on the retention task, the effect of three of the experimental variables on intentional learning, and the intentional learning curves of acquisition.

1. Attitudes Evoked by Learning Materials and Instructions

It was concluded in Section 3 of Chapter I that incidental learning is a term that reflects the experimenter's judgement and not the subject's set. No one has yet eliminated the possibility of a covert set to learn. All that the experimenter can do is to set up experimental conditions that appear to favor intentional learning, and then, after he has tested for retention of stimuli presented incidentally,

question subjects in an attempt to verify the success of his ruse, replacing those who report more than fleeting sets to learn the incidental material.

Five of the six questions put to all subjects in this experiment, immediately after the retention task, were intended to identify those who deliberately tried to memorize some or all of the incidental task items. The questions varied in directness from a general query as to understanding of the purpose of the experiment to a specific question as to anticipation of the retention task.

Asked what they thought was the "real" purpose of the experiment when they were learning the paired-associates, nearly all subjects replied that they thought that the experimenter was trying to find out how quickly they could learn to associate responses with stimuli. Two subjects "didn't know", and one thought that her intelligence quotient was being measured.

The incidental task items were apparently accepted by all subjects in terms of their description in the orienting instructions. They were there simply to make the task of learning the paired-associates harder. Not one subject offered an alternative explanation when asked, "what did you think was the reason why the three-letter combinations in black and red were shown with the nonsense syllables?"

Asked if they had consciously tried to learn any of the three-letter combinations, most subjects stated that they had not. The question provoked enlightening comments from several subjects, who indicated not only that they did not try to learn the incidental task items, but also that the nature of the orienting task made it difficult to do so. So short was the time available for them to spell the incidental stimuli in red, pronounce and learn the intentional stimuli, and anticipate the paired responses, that they barely glanced at incidental items, spelling aloud those in red as quickly as possible, but doing little more than identifying the color of those in black.

This is not to say that some subjects did not perceive clearly, and learn, some of the incidental items. In each group, there were four subjects who suspected, for the first few learning trials, that learning the incidental items would, in some way, facilitate learning the paired-associate responses. They sought, unsuccessfully, a lawful relationship, of meaning or alliteration, but gave up the search very quickly, when they recognized that incidental items did not always appear with the same pairs. Typical perceptions that initiated the search were the relationship of "cup" to "water" and the common letter in "pot" and "puf".

Subjects who reported such a set to pay attention to incidental items were asked how long they maintained it. In general, the set was not maintained beyond the fourth or fifth learning trial, after which these subjects came to accept the orienting instructions at face value. Unfortunately, a systematic record was not kept of subjects who reported this kind of set, and so it was not possible to relate it to success on the retention task, or to drive level.

Because such sets were apparently abandoned very early in the course of learning paired-associates, it was not considered necessary to replace any subjects for maintaining, despite instructions, a set to learn incidentally-presented material.

It was inevitable that some of the incidental items provoked involuntary sets that facilitated their retention by subjects who did not try to learn any of them on any learning trial. The number of members of both groups who mentioned that they had noticed that "cup" often went with "water" suggests that this combination was probably perceived and retained by most subjects, including many who made no deliberate attempt to learn incidental items. One or two subjects noticed that some of the incidental items, invariably those printed in red, such as "dtr", suggested,

with the addition of two vowels, a five-letter word. One subject recalled "war" and "gas" because they "went together". Another noticed "sin" when it appeared with "jewel". A girl noticed "van", the nickname of her boy friend.

In reply to the question about consciously trying not to learn incidental items, most subjects said that they soon came to ignore incidental items printed in black, and that they tried to ignore the red items, because they thought that the incidental stimuli would interfere with learning the paired-associates. The eight subjects who set out to find a relationship between incidental items and paired-associates joined the rest in deliberately trying to ignore incidental items by the fifth or sixth trial.

The fifth question had to do with anticipating a test of memory for the red or the black incidental items. All subjects claimed that they had not expected such a test.

From the answers to the five questions about the incidental task, it would appear that the orienting instructions were satisfactory in focussing intent to learn on the intentional task. Subjects were successfully exposed to, at least, the items printed in red without arousal of more than a brief set to learn them. The instructions and the tasks met the criteria for an incidental learning experiment.

A sixth question was asked, as a basis for eliminating subjects whose intentional learning scores might have been influenced by a tendency to learn the easy items first. All subjects recognized that some pairs were easier to learn than others, or said that they realized that they learned easy pairs first, but all denied that they deliberately avoided learning hard pairs until the easy ones were mastered, or even that they concentrated on learning easy pairs first. Additional questioning indicated that pairs associated with incidental items printed in black were not deliberately learned first by any subject.

2. The Main Hypothesis: The Variance Analysis Model

The statement of the main hypothesis specified four independent variables that might affect retention of incidental stimuli in this experiment. They were drive level, the difficulty of the intentional learning task, the difficulty of the incidental learning task, and the procedural condition under which subjects were exposed to incidental stimuli. There were, in fact, not four but five ways to classify data on retention of incidental stimuli, for individual differences among subjects must be considered as a fifth variable. With so many factors, the resolution of problems associated with the selection of an appropriate

model for analysis of variance was a preliminary step in data analysis.

One of these problems was whether to regard levels of each factor as random or as fixed. The drive factor had two levels, high and low. If one were to conceptualize these levels as random, one would have to regard each level as drawn at random from a population of levels. However, subjects were selected for the experiment only if their scores fell below the twentieth or above the eightieth percentile of the A-Scale distribution of those tested. Perhaps these two levels were, in a sense, representative of many possible levels, variously defined, but they are best regarded as fixed constants, rather than as random, if only because replication of the experiment would involve not random selection from the population of levels but use of particular high and low levels, similarly defined.

It follows that inferences could not be drawn from this experiment as to the effect of various levels of drive on retention of incidental task items, but only as to the effect of the particular drive levels studied in the experiment.

A similar argument led to the conclusion that three other factors should be regarded as having fixed levels, intentional task difficulty, incidental task difficulty, and

the orienting task variable. In each case, the experimenter was concerned with the effect on incidental learning of particular levels of a factor, selected not randomly from a hypothetical population of levels but deliberately, because they represented extreme points on continua.

The fifth factor, individual differences, was regarded as random (even though A-Scale scores determined whether or no a student was eligible for selection as a subject) because subjects were drawn randomly from within the extreme groups defined by A-Scale scores and sex.

An analysis of variance with data classified five ways is cumbersome, tedious, and hard to interpret. A casual examination of results suggested that it would be sensible to simplify the investigation by first analyzing separately the data obtained under each of the two orienting or procedural conditions. This decision was justified because the total number of incidental items retained by all fifty subjects under the "spelled aloud" condition (272) was more than three times the number retained under the "not spelled aloud" condition (86). It was amply clear that the nature of the procedural variable had a marked effect on retention of incidental items. Advantages of analyzing interactions of this variable with all other independent variables were considered to be offset by disadvantages associated with difficulty of interpreting

significant higher-order interactions. In any event, no matter what the nature of such interactions, a main finding would inevitably be the requirement, in order to demonstrate a substantial amount of incidental learning, for an orienting task that compelled subjects to do something with incidental material during intentional learning.

The plan for analysis of variance assigned subjects to B blocks, C columns, G groups, and R rows. Columns C_1 and C_2 represented respectively the hard and the easy levels of intentional task difficulty, and groups G_1 and G_2 the hard and the easy levels of incidental task difficulty. Twenty-five high-drive subjects were assigned to block B_1 and twenty-five low-drive subjects to block B_2 . The $R:25$ rows corresponded to subjects in each block serving under all CG combinations.

With a design incorporating an organismic variable (in this case, two levels of drive), row means calculated across blocks are meaningless. It was not permissible to test any first-, second-, or third-order interactions involving these across-block row means. In other words, it was not feasible to test the variance estimates for three first-order interactions, $B \times R$, $C \times R$, and $G \times R$, three second-order interactions, $B \times C \times R$, $B \times G \times R$, and $C \times G \times R$, and the quadruple interaction, $B \times C \times G \times R$,

because such tests would have been spurious. The variance estimate for individual differences was based not on individual differences across blocks but on combining the sum of squares for individual differences within blocks.

The model was rather similar to a split-plot design, with replication degeneracy occasioned in this investigation by the organismic variable. With a split-plot design, the error estimate is divided into two parts, one valid for testing the main effect of the degenerately replicated factor and the other valid for testing subsidiary effects, and interactions. Edwards¹, and Villars², and others, give the basis for selecting appropriate error terms for a split-plot design.

In a split-plot design in which subjects are assigned randomly to blocks, the mean square or variance estimate for individual differences is appropriate for testing the significance of the variance estimate for the block factor. The residual is appropriate for testing significance of within-blocks treatments, and of interactions. In this investigation, the variance estimate for individual differences was used to test the variance estimate for drive,

1. Allen I. Edwards, Experimental Design in Psychological Research, New York, Rinehart, 1960, p. 309-311.

2. Donald Statler Villars, Statistical Design and Analysis of Experiments for Development Research, Dubuque, Iowa, Wm. C. Brown, 1951, p. 129-140.

while the residual, which can be considered as a pooled subjects by combinations of CG variance estimate, was used to test the variance estimates of the CG treatments and those for the interaction of B with the CG treatments. Examination of McNemar's mixed model with a pseudo three-way classification (Case XVII)³ led to a similar choice of error terms.

The design in this study may be described as a mixed model with a pseudo four-way classification, involving one random effect and three fixed effects. It differed from the simple split-plot design primarily in that subjects were not randomly assigned to blocks, but were assigned on the basis of the organismic variable, drive. All subjects served under all CG conditions.

3. The Main Hypothesis: The "Spelled Aloud" Condition

Table III summarizes the analysis of variance for recognition of incidental task items under the procedural condition that required subjects to spell incidental task trigrams aloud during intentional learning.

It was immediately evident that the second-order interaction, $B \times C \times G$, was not statistically significant.

3. Quinn McNemar, Psychological Statistics (Second Edition), New York, Wiley, 1955, p. 332-335.

Table III.

Analysis of Variance for Recognition of Incidental Task Items, for Two Levels of Drive, Two Levels of Intentional Task Difficulty, and Two Levels of Incidental Task Difficulty (Incidental Task Items Spelled Aloud during Intentional Learning).

Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	0.18	1	0.18	-
Individual differences (R)	24.40	48	0.49	
Intentional task difficulty (C)	6.48	1	6.48	14.40
Incidental task difficulty (G)	3.92	1	3.92	8.71
Interaction: B x C	0.50	1	0.50	1.11
Interaction: B x G	0.18	1	0.18	-
Interaction: C x G	2.00	1	2.00	4.44
Interaction: B x C x G	0.02	1	0.02	-
Residual	64.40	144	0.45	
Total	102.08	199		

(The sum of squares was so small that combining it with that of the residual would not have improved the residual variance estimate noticeably.)

The main effect, drive, and the interactions of drive with task difficulty, B x C and B x G, did not yield significant variance ratios. The B variance estimate corresponded to a comparison between means of high- and low-drive groups, averaged over two levels of C and two levels of G. Since it did not yield a statistically significant value of F, it could be concluded that drive was not related to retention of incidental task items under the "spelled aloud" procedural condition. Moreover, the means for the two drive groups at each level of C, averaged over two levels of G, and at each level of G, averaged over two levels of C, were not significantly different. The task difficulty effects, in short, were independent of drive.

The interaction of intentional with incidental task difficulty, C x G, may be described as "probably significant", since the value of F fell between the .05 and the .01 levels of significance for $n_1:1$ and $n_2:144$ degrees of freedom. Intentional and incidental task difficulty had a joint effect on retention of incidental task items. The nature of the interaction may be seen in Figure 1, which shows the means for levels of incidental task difficulty, G, at each

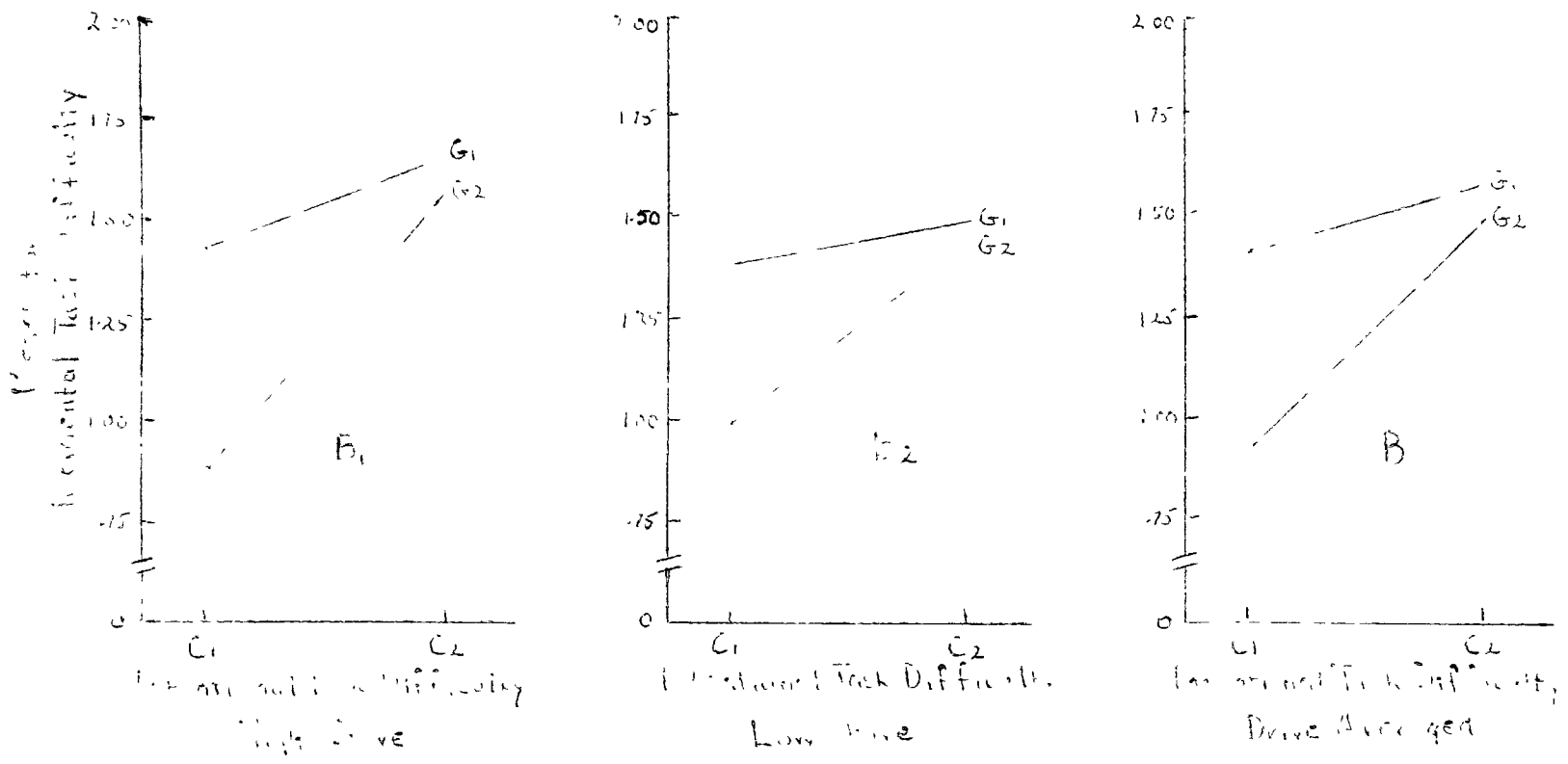


Figure 1.- Means for levels of incidental Task Difficulty (G) at Each Level of intentional Task Difficulty (C), for each Drive Level and Averaged across drive levels (Incidental Task Items Spelled aloud During Intentional Learning).

level of intentional task difficulty, C, for each drive level, and averaged across drive levels. The magnitude of the difference between G_1 and G_2 was, clearly, not the same for C_1 and C_2 . For all fifty subjects, the difference between the means of G_1 and G_2 for C_1 was

$$G_1 - G_2 = 1.42 - .94 = .48$$

and for C_2

$$G_1 - G_2 = 1.58 - 1.50 = .08.$$

In order to take the $C \times G$ interaction into account when interpreting the C and the G effects, breakdown analyses of variance were completed. The analysis by intentional task difficulty is summarized in Table IV. The value of F for drive in Table IV. 2 was well short of statistical significance at the .05 level, for $n_1:1$ and $n_2:48$ degrees of freedom. In Table IV. 1, the F for incidental task difficulty was significant beyond the .001 level, for $n_1:1$ and $n_2:48$ degrees of freedom. A second breakdown analysis, by incidental task difficulty, is summarized in Table V. The value of F for intentional task difficulty in Table V. 1 was not statistically significant, while F for intentional task difficulty in Table V. 2 was significant beyond the .001 level for $n_1:1$ and $n_2:48$ degrees of freedom.

From the two breakdown analyses, it was evident that the difference between means of the two levels of

Table IV

Breakdown Analysis of Variance by Intentional Task Difficulty, for Recognition of Incidental Task Items, for Two Levels of Drive and Two Levels of Incidental Task Difficulty (Incidental Task Items Spelled Aloud During Intentional Learning).

1. Hard Level of Intentional Task Difficulty				
Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	.04	1	.04	-
Individual differences (R)	25.72	48	.53	
Incidental task difficulty (G)	5.76	1	5.76	13.09
Interaction: B x G	.16	1	.16	-
Residual	21.08	48	.44	
Total	52.76	99		
2. Easy Level of Intentional Task Difficulty				
Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	.64	1	.64	2.00
Individual differences (R)	15.20	48	.32	
Incidental task difficulty (G)	.16	1	.16	-
Interaction: B x G	.04	1	.04	-
Residual	26.80	48	.56	
Total	42.84	99		

Table V

Breakdown Analysis of Variance by Incidental Task Difficulty, for recognition of Incidental Task Items, for Two Levels of Drive and Two Levels of Intentional Task Difficulty (Incidental Task Items Spelled ALOUD During Intentional Learning).

1. Hard Level of Incidental Task Difficulty				
Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	.36	1	.36	-
Individual differences (R)	22.64	48	.47	
Intentional task difficulty (C)	.64	1	.64	2.37
Interaction: B x C	.16	1	.16	-
Residual	13.20	48	.27	
Total	37.00	99		
2. Easy Level of Incidental Task Difficulty				
Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	.00	1	.00	-
Individual differences (R)	34.16	48	.71	
Intentional task difficulty (C)	7.84	1	7.84	20.10
Interaction: B x C	.36	1	.36	-
Residual	18.80	48	.39	
Total	61.16	99		

intentional task difficulty was significant only at the easy level of incidental task difficulty, and, conversely, that the difference between means of the two levels of incidental task difficulty was significant only at the hard level of intentional task difficulty. From Figure 1, it appeared that the easy level of intentional task difficulty was associated with relatively more incidental learning than the hard level. The effect of incidental task difficulty was unexpected, for incidental learning was least, at both levels of drive, when easy rather than hard incidental items were paired with hard intentional task paired-associates.

Scheffe's method for judging the significance of contrasts in the analysis of variance^{4,5} was used to compare treatment sums, averaged over two levels of drive, for retention of incidental items under each of the four incidental by intentional task combinations. With $k:4$ (the number of treatments) and $n:50$ (the number of observations contributing to each sum) the least value of a significant at the .05 level was 3.58, the product of .45 (the residual variance estimate from Table III) and F' , where F' was $k-1$ multiplied by 2.65, the value of F for $n_1:k-1$ (or 3) and

4. Henry Scheffe, "A Method for Judging all Contrasts in the Analysis of Variance", in Biometrika, Vol. 40, Parts 1 and 2, issue of June 1953, p. 87-104.

5. Allen I. Edwards, op.cit., p. 154-156, 191.

$n_2:k(n-1)$ (or 196) degrees of freedom. The values of F for the six contrasts are listed in Table VI.

Retention under the G_2C_1 treatment (easy incidental task items, hard intentional task paired-associates) was significantly lower than retention under the other three task combinations. The latter may be ranked in the order $G_1C_2 > G_2C_2 > G_1C_1$, but differences were not statistically significant.

4. The Main Hypothesis: The "Not Spelled Aloud" Condition.

The analysis of variance for retention of incidental task items under the procedural condition that exposed subjects to incidental task items without instructions to do anything with them is summarized in Table VII. Results of this analysis were essentially the same as those for the "spelled aloud" condition.

The variance ratio for the triple interaction, $B \times C \times G$, was negligible. The first-order interactions of drive with task difficulty, $B \times C$ and $B \times G$, were also very small, while that for drive as a main effect was well short of statistical significance at the .05 level. Consistent with findings under the "spelled aloud" condition, drive level was not significantly related to retention of incidental task items.

Table VI

Scheffe's Test of Significance of Contrasts Among Four Task Difficulty Treatment Sums, in the Analysis of Variance for Recognition of Incidental Task Items (Incidental Task Items Spelled Aloud During Intentional Learning).

Contrast	A
$\Sigma G_2 C_2:75$ vs. $\Sigma G_2 C_1:47$	7.84
$\Sigma G_2 C_2:75$ vs. $\Sigma G_1 C_2:79$.16
$\Sigma G_2 C_2:75$ vs. $\Sigma G_1 C_1:71$.16
$\Sigma G_2 C_1:47$ vs. $\Sigma G_1 C_2:79$	10.24
$\Sigma G_2 C_1:47$ vs. $\Sigma G_1 C_1:71$	5.76
$\Sigma G_1 C_2:79$ vs. $\Sigma G_1 C_1:71$.64

Table VII

Analysis of Variance for Recognition of Incidental Task Items for Two Levels of Drive, Two Levels of Intentional Task Difficulty, and Two Levels of Incidental Task Difficulty (Incidental Task Items Not Spelled Aloud During Intentional Learning).

Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	.50	1	.50	1.28
Individual differences (R)	18.52	48	.39	
Intentional task difficulty (C)	.72	1	.72	2.40
Incidental task difficulty (G)	.08	1	.08	-
Interaction: B x C	.08	1	.08	-
Interaction: B x G	.08	1	.08	-
Interaction: C x G	3.38	1	3.38	11.27
Interaction: B x C x G	.02	1	.02	-
Residual	43.64	144	.30	
Total	67.02	199		

The task difficulty interaction, C x G, could be described as "highly significant", for the value of F was almost exactly at the .001 level of significance for $n_1:1$ and $n_2:144$ degrees of freedom. From Figure 2, it would appear that the nature of the interaction differed markedly from that under the "spelled aloud" condition. Averaged across drive levels, the difference between the means of G_1 and G_2 for C_1 was

$$G_1 - G_2 = .48 - .26 = .22$$

and for C_2

$$G_1 - G_2 = .34 - .64 = -.30.$$

Again, it was necessary for breakdown analysis of variance, in order to take the C x G interaction into account when interpreting the C and the G effects. In Table VIII is summarized the analysis by intentional task difficulty. The variance ratios for incidental task difficulty in Table VIII.1 and for drive in Table VIII.2 are well short of significance at the .05 level, but that for incidental task difficulty in Table VIII.2 is probably significant for it falls between the .05 and the .01 levels of significance, for $n_1:1$ and $n_2:48$ degrees of freedom. The breakdown analysis by incidental task difficulty is summarized in Table IX. The values of F for intentional task difficulty in Table IX.1 and for drive in Table IX.2 are not statistically significant,

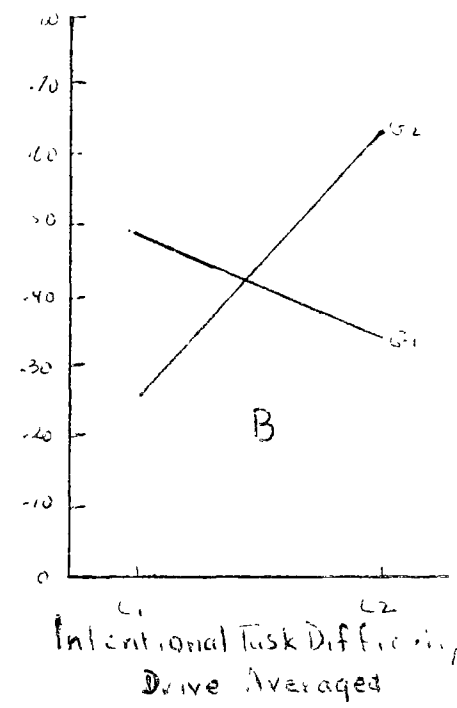
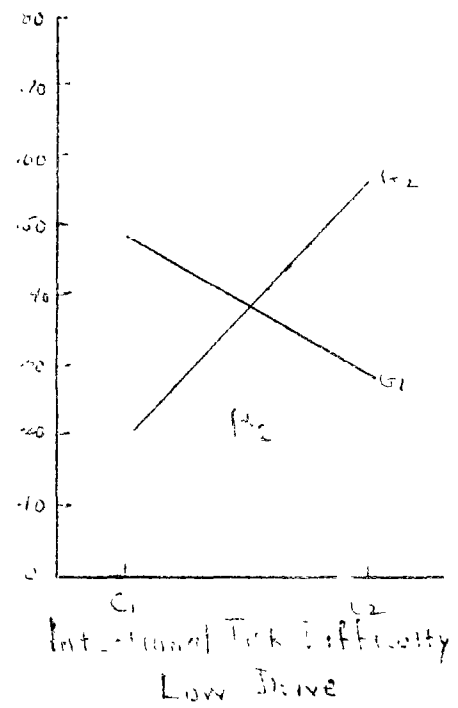
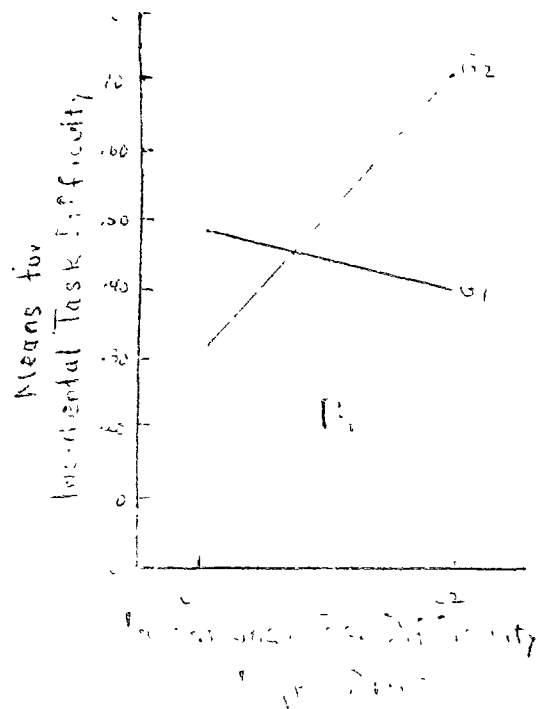


Figure 3.- Means for levels of incidental task difficulty (G) at each level of intentional task difficulty (C), for each drive level and averaged across drive levels (incidental task items not spelled aloud during intentional learning).

Table VIII

Breakdown Analysis of Variance by Intentional Task Difficulty for Recognition of Incidental Task Items, for Two Levels of Drive and Two Levels of Incidental Task Difficulty (Incidental Task Items Not Spelled Aloud During Intentional Learning).

1. Hard Level of Intentional Task Difficulty				
Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	.09	1	.09	-
Individual differences (R)	11.72	48	.24	
Incidental task difficulty (G)	1.21	1	1.21	2.63
Interaction: B x G	.09	1	.09	-
Residual	22.20	48	.46	
Total	35.31	99		
2. Easy Level of Intentional Task Difficulty				
Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	.49	1	.49	1.06
Individual differences (R)	22.00	48	.46	
Incidental task difficulty (G)	2.25	1	2.25	6.62
Interaction: B x G	.01	1	.01	-
Residual	16.24	48	.34	
Total	40.99	99		

Table IX

Breakdown Analysis of Variance by Incidental Task Difficulty for Recognition of Incidental Task Items, for Two Levels of Drive and Two Levels of Intentional Task Difficulty (Incidental Task Items Not Spelled Aloud During Intentional Learning).

1. Hard Level of Incidental Task Difficulty				
Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	.09	1	.09	-
Individual differences (R)	15.60	48	.32	
Intentional task difficulty (C)	.49	1	.49	1.69
Interaction: B x C	.09	1	.09	-
Residual	13.92	48	.29	
Total	30.19	99		
2. Easy Level of Incidental Task Difficulty				
Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	.49	1	.49	1.19
Individual differences (R)	19.76	48	.41	
Intentional task difficulty (C)	3.61	1	3.61	13.37
Interaction: B x C	.01	1	.01	-
Residual	12.88	48	.27	
Total	36.75	99		

but that for intentional task difficulty in Table IX.2 is highly significant, for it falls beyond the .001 level of significance for $n_1:1$ and $n_2:48$ degrees of freedom.

From the breakdown analysis by incidental task difficulty, it was concluded that the difference between means of levels of intentional task difficulty was significant only at the easy level of incidental task difficulty, a finding agreeing with that in the corresponding analysis under the "spelled aloud" condition. On the other hand, the breakdown analysis by intentional task difficulty yielded a result that was not in accord with the "spelled aloud" finding, for the difference between means for incidental task difficulty was significant at the easy (and not the hard) level of intentional task difficulty. From Figure 2, it appeared that the pairing of hard intentional with hard incidental task materials was more favorable to incidental learning than a combination with both easy and hard items. The most incidental learning apparently occurred when easy incidental items were exposed with easy paired-associates.

Scheffe's method was again used to estimate significance of contrasts between treatment sums averaged over drive levels. With $k:4$ and $n:50$, the least significant value of Λ , at the .05 level, was 2.39, the product of .30 (the residual variance estimate from Table VII) and F' , where F' was $k-1$ multiplied by 2.65 (the value of F

for $n_1:3$ and $n_2:196$ degrees of freedom). Results for the six contrast conditions are in Table X.

Although retention under the four task treatment combinations could be ranked in the order $G_2C_2 > G_1C_1 > G_1C_2 > G_2C_1$, only the difference between treatment sums for G_2C_1 and G_2C_2 was statistically significant beyond the .05 level. That between G_1C_2 and G_2C_2 approached the .05 level of significance.

5. The Main Hypothesis: Task Competition

The main conclusion drawn from the analyses of variance described in Sections 3 and 4 was that drive, as measured by the A-Scale, was unrelated to incidental item retention under either orienting procedure, and independent of task difficulty effects. The role of task difficulty was not so clear. Under both procedural conditions, retention was least when easy incidental items were exposed with hard paired-associates, while differences in retention under the other three task difficulty combinations were not statistically significant. The data suggested that task difficulty had more effect on retention when subjects were required to spell incidental items aloud, for contrasts were more marked under that condition.

Data from the two drive groups were combined in calculating for Table XI the mean numbers of items marked

Table X.

Scheffe's Test of Significance of Contrasts Among
 Four Task Difficulty Combination Treatment Sums,
 in the Analysis of Variance for Recognition of
 Incidental Task Items (Incidental Task Items Not
 Spelled Aloud During Intentional Learning).

Contrast	A
$\Sigma G_2 C_2 : 32$ vs. $\Sigma G_2 C_1 : 13$	3.61
$\Sigma G_2 C_2 : 32$ vs. $\Sigma G_1 C_2 : 17$	2.25
$\Sigma G_2 C_2 : 32$ vs. $\Sigma G_1 C_1 : 24$.64
$\Sigma G_2 C_1 : 13$ vs. $\Sigma G_1 C_2 : 17$.16
$\Sigma G_2 C_1 : 13$ vs. $\Sigma G_1 C_1 : 24$	1.21
$\Sigma G_1 C_2 : 17$ vs. $\Sigma G_1 C_1 : 24$.49

Table XI.

Mean Numbers of Incidental Items Marked Correctly on Retention Task
(Data Averaged Across Drive Groups - N:50).

Procedural Condition	Incidental Task	Intentional Task		
		Hard	Easy	Total
Spelled aloud	Hard	1.42	1.58	3.00
	Easy	.94	1.50	2.44
	Total	2.36	3.08	5.44
Not spelled aloud	Hard	.48	.34	.82
	Easy	.26	.64	.90
	Total	.74	.98	1.72
Both	Hard	1.90	1.92	3.82
	Easy	1.20	2.14	3.34
	Total	3.10	4.06	7.16

correctly on the retention task. It will be seen that, on the average, exposing incidental items with easy paired-associates favored retention under both procedural conditions.

It has been suggested that the effect of task competition on incidental learning of verbal material is greater with a difficult than with an easy intentional task, unless the orienting procedure requires subjects to make differential responses to incidental material, such as pronouncing items⁶. When the orienting task requires differential responding to incidental items, the role of task competition may be severely limited. In the present study, the differential response hypothesis apparently was not supported, for retention of incidental items shown with hard paired-associates was less than that for items shown with easy pairs, even when differential responses were made to incidentally-presented material. This tentative conclusion warranted further analysis of the effects of intentional task difficulty and the orienting procedure.

A first requirement was for empirical evidence as to the difficulty levels of hard and easy paired-associates.

6. Arnold Mechanic, "The Distribution of Recalled Items in Simultaneous Intentional and Incidental Learning", in the Journal of Experimental Psychology, Vol. 63, No. 6, issue of June 1962, p. 593-600.

For combined drive groups, the median number of trials to criterion (two errorless trials) for the hard paired-associate list was 27.5, and for the easy list, 13.5. The mean number of correct responses to the eight hard paired-associates in the course of thirty trials was 62.4, and to the eight easy paired-associates, 141.1. The sixteen paired-associates were ranked by median number of trials to criterion and by total number of correct response, and the coefficient of correlation between rankings was .92, which is significant beyond the .01 level.

The lists were not of uniform difficulty. "Hov-money" and "kix-water" required, on the average only 6.0 trials to criterion, four less than "ced-wagon" and eight less than "gaw-table", the most difficult of the easy pairs. "Dal-xylem" was a relatively easy member of the hard list, requiring 17.5 trials to criterion, four less than "muk-gojey", next in difficulty. ("Xylem", of course, is meaningful to students of botany.)

Despite the fact that items within lists were not of equal difficulty, it was clear that, on the average, the hard and easy lists of paired-associates differed markedly in difficulty, whether defined by trials to criterion or by number of correct responses.

primarily to find out if there was a significant interaction between orienting procedure and either drive or intentional task difficulty, an analysis of variance was carried out for recognition of incidental task items, for two levels of drive, two levels of orienting procedure, and two levels of intentional task difficulty.

The null hypothesis for this supporting investigation was: The difficulty level of the intentional task (easy or hard) and the nature of the orienting task (spelling aloud or not spelling aloud incidental stimuli) do not affect incidental learning of verbal trigrams by high- and low-drive groups.

Subjects were assigned on the basis of drive to B:2 blocks, on the basis of orienting procedure to C:2 columns, and on the basis of intentional task difficulty to G:2 groups. Within blocks, subjects were assigned to H:2 rows. Levels of B, C and G were regarded as fixed, and levels of H as random. The model for analysis of variance was again mixed, with a pseudo four-way classification.

Results are summarized in Table III. The only significant interaction was between intentional task difficulty and orienting procedure; it may be described as "probably significant", for the value of $F_{(1,144)}$ is between the .05 and the .01 levels of significance, for $df = 1$ and $n = 144$ degrees of freedom. The nature of the interaction is

Table XII.

Analysis of Variance for Recognition of Incidental Task Items, for Two Levels of Drive, Two Levels of Orienting Procedure, and Two Levels of Intentional Task Difficulty.

Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	1.28	1	1.28	1.17
Individual differences (R)	47.90	48	1.09	
Orienting Procedure (C)	172.98	1	172.98	274.57
Intentional task difficulty (G)	11.52	1	11.52	18.28
Interaction: B x C	.08	1	.08	-
Interaction: B x G	.98	1	.98	1.56
Interaction: C x G	2.88	1	2.88	4.57
Interaction: B x C x G	.18	1	.18	-
Residual	91.38	144	.63	
Total	329.18	199		

pictured in Figure 3, which shows the means for levels of intentional task difficulty, G , at each level of orienting procedure, C , for each drive level and averaged across drive levels. For all fifty subjects, the difference between means of G_1 and G_2 for C_1 was

$$G_1 - G_2 = 1.18 - 1.54 = -.36$$

and for C_2

$$G_1 - G_2 = .37 - .49 = -.12.$$

There was, of course, no requirement for a breakdown analysis to take the interaction into account, for it had already been shown that the intentional task difficulty effect was significant at both procedural levels. Specifically, fewer of those incidental items which had been shown with hard paired-associates were correctly marked on the retention task, whether or no differential responses were made to them during intentional learning trials. The requirement to make differential responses to incidental material did not, as in Lechinic's study⁷, offset the effect on incidental learning of competition from the intentional learning task.

7. Ibid., ibid., p. 596-597.

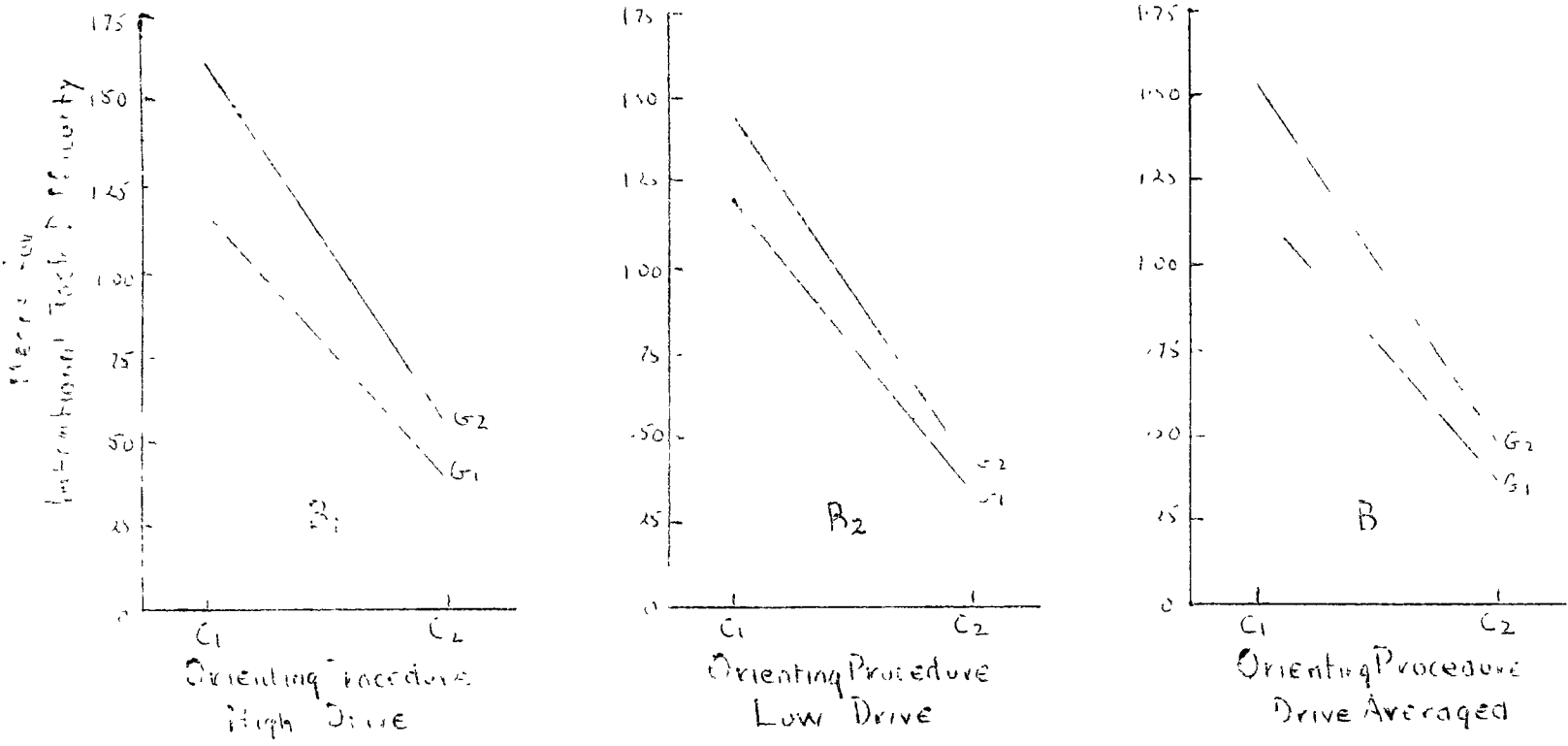


Figure 3.- Means for Levels of Intentional Task Difficulty (G) at Each Level of Orienting Procedure (C), for Each Drive Level and Averaged across Drive Levels.

6. Incidental Task Errors.

Incidental learning is less efficient than intentional learning. One would not expect subjects who did not anticipate a retention task to master material presented incidentally during intentional learning. In fact, the mean number of items marked correctly by the fifty subjects in this experiment was only 7.16, evidence that the retention task was presented well before mastery of the sixteen incidental items.

Subjects were free to make as many or as few responses as they wished on the retention task. In the Hull-Spence theory of behavior, drive, as the multiplier of habit strength, energizes or activates all response tendencies present by virtue of existing stimulus cues. The recognition task provided the stimulus cues. One could predict that the high-drive group would make more responses than the low-drive group on the recognition task, because more response tendencies would be suprathreshold. This prediction was expressed as a null hypothesis: high-drive and low-drive groups do not differ as to mean number of responses on a recognition task following incidental learning.

In Table XIII. are shown the mean numbers of correct and incorrect responses made by the two drive groups on the

Table XIII.

Mean Number of Responses by Drive Groups on Measure
of Retention Following Incidental Learning.

Response	Means	
	High-Drive(N:25)	Low-Drive(N:25)
Correct	7.48	6.84
Incorrect	5.64	2.84
Total	13.12	9.68

recognition task. The difference between groups in mean number of responses was $13.12 - 9.68$, or 3.44 , and the standard error of the difference between means was $.942$. The t-ratio was 3.65 , significant beyond the $.01$ level of confidence. It was concluded that drive groups differed as to total responses on the recognition task.

With partial learning of incidental material, one would expect errors on the recognition task. Since the analyses of variance, described in Sections 3 and 4, had indicated that drive groups did not differ significantly as to number of correct responses (although the difference was in the predicted direction), it was evident that the difference between groups in total number of responses was almost entirely a function of the number of errors.

7. Effect of Experimental Variables on Intentional Learning.

The incidental learning study provided, as a by-product, data on the effect of several variables on the intentional learning of paired-associates. These variables included drive, as measured by the A-Scale, the difficulty of the intentional task, and the orienting procedure used to expose incidental items without intent to learn. Two cognate and subsidiary investigations threw light on the effect of these variables on intentional learning. The

first was a test of the null hypothesis: intentional task difficulty and the requirement to make differential responses to incidental stimuli in an incidental learning experiment do not affect the intentional learning of paired-associates by high- and low-drive groups.

There was good reason to expect that spelling aloud an incidental item before pronouncing the intentional task stimulus member would interfere with learning the correct responses. This procedural condition required subjects to pay attention momentarily to incidental material before looking at intentional task stimuli, thus reducing the time available for intentional learning.

The influence of the main effect, task difficulty, was already evident (section 5) but interaction with the orienting procedure had yet to be determined.

Because both the hard and the easy lists were considered to be non-competitive, it was assumed that there would have been little or no likelihood of a tendency developing for a stimulus to evoke a response other than the one with which it was paired. It was predicted from the Hull-Spence theory of behavior that the high-drive group would make significantly more correct responses than the low-drive group, on both the hard and the easy lists.

The dependent variable selected for a test of the effects of drive, the orienting procedure, and intentional

task difficulty was the number of correct intentional task responses on learning trials 27, 28, 29, and 30. It was reasoned from the $E = H \times D$ relationship that differences, if any, would be greater late in learning than in a random selection of trials representative of various degrees of learning.

Table XIV. summarizes an analysis of variance for correct anticipation of intentional task responses on the last four learning trials. Subjects were assigned on the basis of drive to B:2 blocks, on the basis of intentional task difficulty to C:2 columns, and on the basis of the orienting procedure to G:2 groups. Within each block, subjects were assigned to R:25 rows. Levels of B, C and G were regarded as fixed, for the reasons given in Section 2 of this chapter, while levels of R were random. The analysis of variance model was again mixed, with a pseudo four-way classification.

None of the variance estimates for interaction was significant at the .05 level for $n_1:1$ and $n_2:144$ degrees of freedom. As expected, the variance estimate for intentional task difficulty was highly significant, beyond the .001 level. Subjects averaged 27.94 correct anticipations of easy responses on the last four learning trials, and 18.34 correct anticipations of hard responses.

Table XIV.

Analysis of Variance for Correct Anticipation of Intentional Task Responses in Trials 27 to 30, for Two Levels of Drive, Two Levels of Intentional Task Difficulty, and Two Levels of Orienting Procedure.

Source	Sum of Squares	df	Variance Estimate	F
Drive (B)	2.88	1	2.88	-
Individual differences (R)	1481.64	48	30.87	
Intentional task difficulty (C)	1152.00	1	1152.00	157.59
Orienting procedure (G)	228.98	1	228.98	31.32
Interaction: B x C	1.62	1	1.62	-
Interaction: B x G	0.00	1	0.00	-
Interaction: C x G	23.12	1	23.12	3.16
Interaction: B x C x G	0.02	1	0.02	-
Residual	1052.76	144	7.31	
Total	3943.02	199		

The variance estimate for the orienting procedure was also significant beyond the .001 level. Subjects averaged 25.28 correct anticipations on the last four learning trials when incidental items were not spelled aloud, but only 21.00 correct anticipations on those items exposed with incidental stimuli that were spelled aloud. Clearly, the requirement to make differential responses to incidental task items interfered with the intentional learning of paired-associates.

8. Intentional Learning Acquisition Curves.

Progress in learning is most clearly shown by acquisition curves. Success on each learning trial is revealed when proficiency is plotted against practice.

It was apparent from the analysis of variance described in Section 7 of this chapter that high- and low-drive subjects did not differ in numbers of correct paired-associate responses on the last four learning trials. However, the possibility remained that learning curves would reveal differences between drive groups in acquisition of correct responses prior to the last four trials.

From the $E = H \times D$ relationship, it is predicted not only that the learning curve for a high-drive group will be above that for a low-drive group, when learning lists do not provoke response competition, but also that the difference

between groups will tend to increase at successive stages of practice. It was possible that the learning curves might have conformed to expectations aroused by the theory on early trials, but that some uncontrolled variable, perhaps interference from the incidental learning orienting task, or response competition associated with the length of the learning list and interaction between hard and easy pairs, might have distorted the curves at later stages of learning.

The analysis of variance described in Section 7 showed that the requirement to spell incidental task items aloud had affected intentional task performance on at least the last four learning trials. Presumably, the effect was present throughout the course of learning. It was decided, therefore, to plot only performance on those paired-associates shown with incidental items not spelled aloud.

Figure 4 shows the curves for correct anticipation of intentional task responses, for the two difficulty levels and the two drive levels, in terms of the percentage of correct responses in each block of three trials. Data are for the four easy and the four hard pairs shown with incidental stimuli that were not spelled aloud.

There was a tendency for the curve of the high-drive group for hard paired-associate learning to be higher on blocks 3 to 7. There was little or no difference between

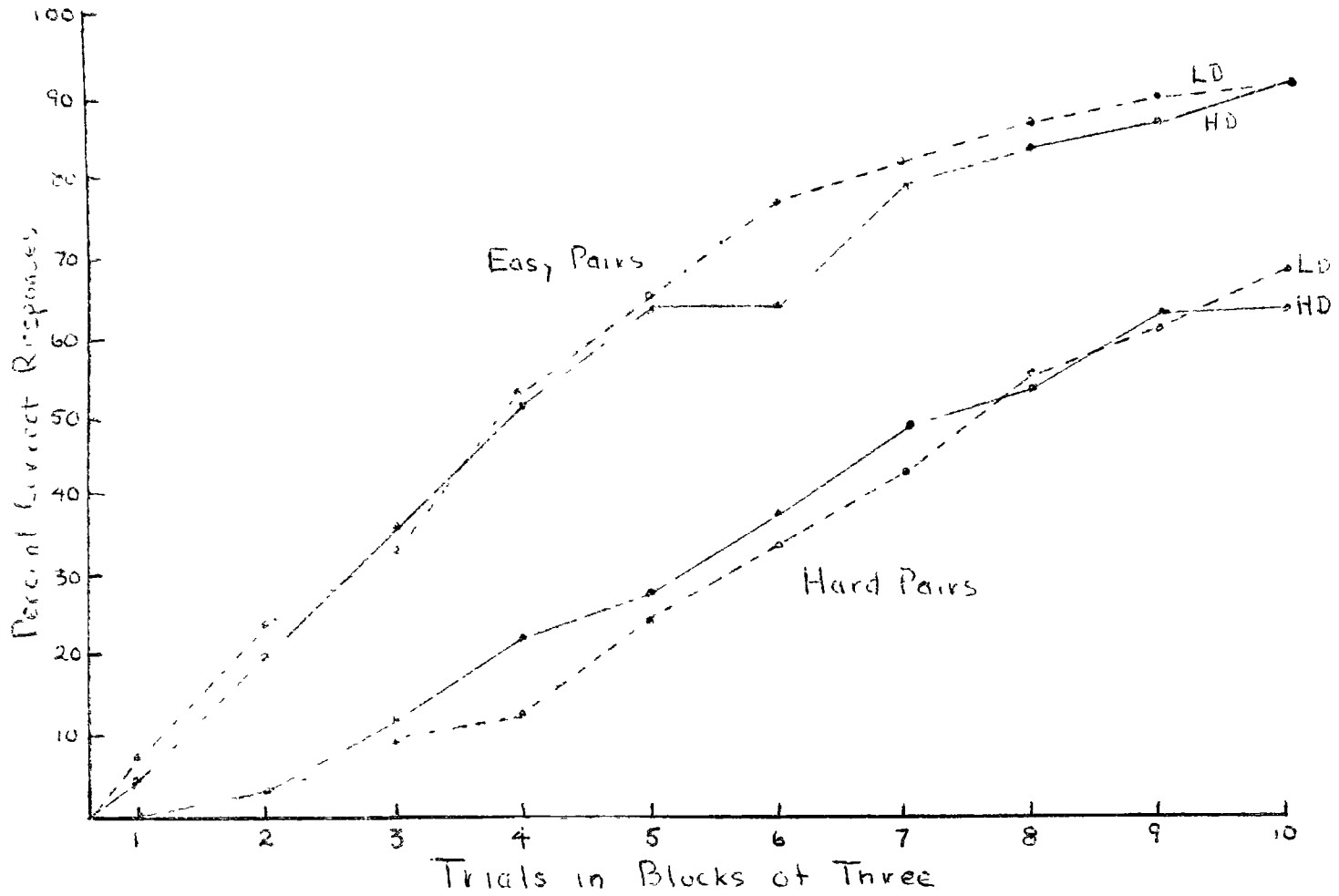


Figure 4.- Acquisition Curves, in terms of Percentage of Correct Responses to Each Block of Three Trials, for Intentional Learning of hard and Easy Paired Associates.

the curves for learning easy pairs. It was concluded that the prediction as to paired-associate acquisition curves was not supported by this evidence.

It can be argued that these curves of acquisition may conceal real differences between high- and low-drive groups because averaging data of individuals who learned at different rates could well have obscured lawful relationships.

Several methods are available for taking individual differences into account. Spence⁶ recommended plotting composite curves of subjects grouped together because they performed similarly at several points in learning. This method was not practical in the present study, because it would conceal group differences by matching drive groups in terms of performance.

Another method for taking individual differences into account involves dividing each individual's curve into an equal number of parts, and averaging the measures for each part. The shape of these so-called Vincent curves is a function of the arbitrarily chosen criterion of learning. For example, including the criterion trials and the trial immediately before them usually results in an end-spurt

6. Kenneth W. Spence, Behavior Theory and Conditioning, New Haven, Yale University Press, 1956, p. 61.

which distorts the curve⁹, a matter of some importance if the "true" shape of the curve is being sought, but not a cause for concern in the present study.

The Vincent curves shown in Figure 5 are based on the data of those subjects who completed two successive errorless trials between the tenth and the thirtieth trial. Data of subjects who learned to criterion before the tenth trial were excluded. The total number of trials for each subject, including the criterion trials, was divided into tenths, and the number of correct responses in each tenth was calculated. Data are expressed in terms of the average number of correct responses in each tenth of practice trials, including criterion trials.

The Vincent curves for learning easy paired-associates were each based on results of twenty-two subjects. In both high- and low-drive groups, two subjects were excluded because they reached the criterion of two successive errorless trials before the tenth trial, and one because he had not reached the criterion by the thirtieth trial.

The curves for learning hard paired-associates were each derived from data of thirteen subjects. In both drive groups, one subject reached the criterion too early, and eleven too late.

9. Ernest R. Hilgard and Albert A. Campbell, "Vincent Curves of Conditioning", in the Journal of Experimental Psychology, Vol. 21, No. 3, issue of September 1927, p. 320-319.

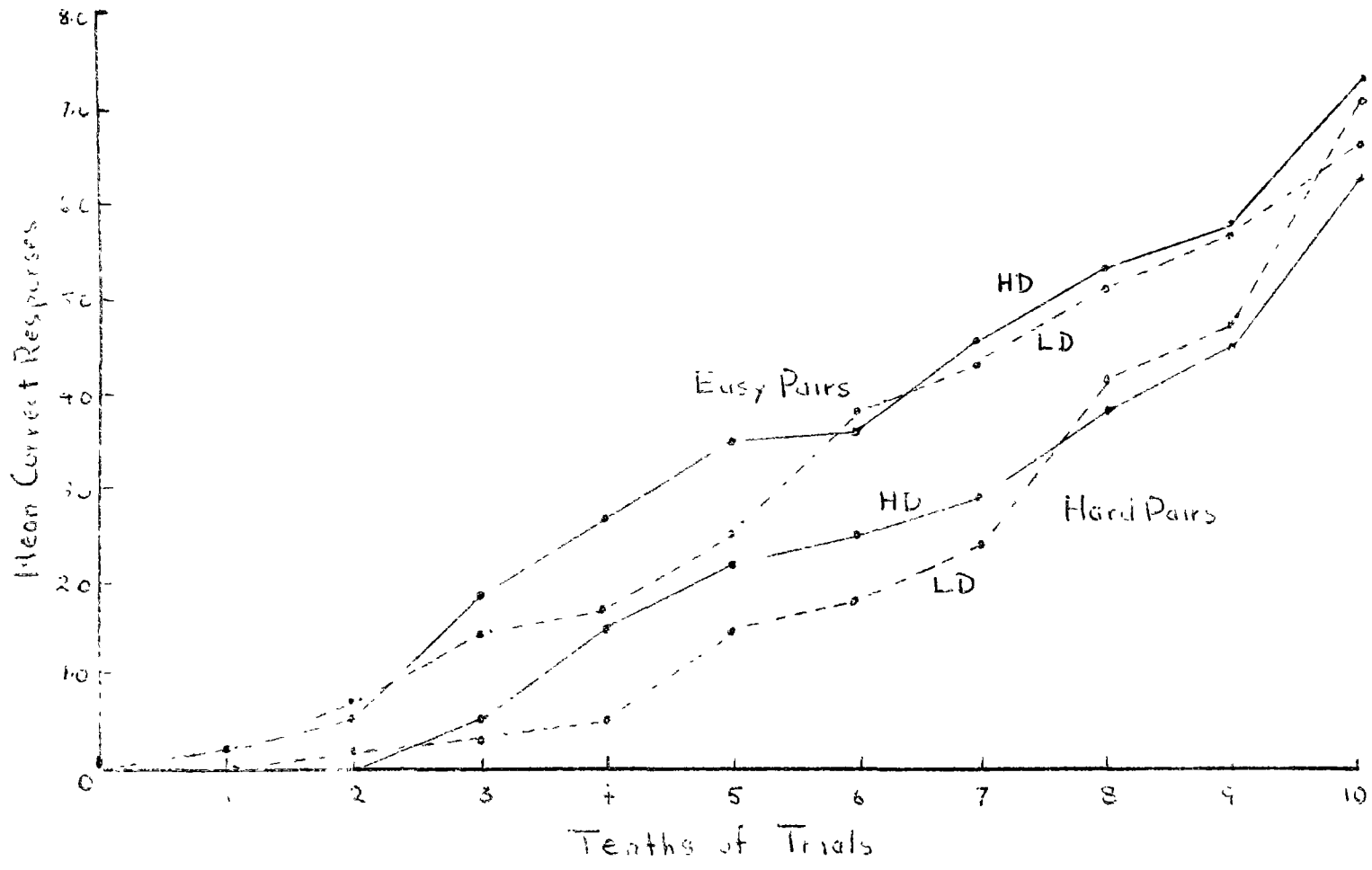


Figure 5.- Vincent Acquisition Curves, in terms of Average Number of Correct Responses in Each Tenth of Trials, for Intentional Learning of Hard and Easy Paired-Associates.

The Vincent curves were not in accord with the prediction. For neither hard nor easy paired-associates did the curves diverge as learning progressed, nor were the curves for high-drive subjects consistently higher.

9. Summary of Main Results.

In this final section of Chapter III are summarized the main findings in the experiment described in Chapter II.

There were no statistically significant differences between high- and low-drive groups, defined by A-Scale scores, in retention of incidental items or in acquisition of paired-associates. Drive did not interact with other experimental variables.

The high-drive group marked significantly more items on the measure of incidental learning than the low-drive group; the difference was almost entirely a function of the number of errors, although there was also a non-significant tendency for high-drive subjects to mark more items correctly.

The requirement to make differential responses to incidental items facilitated incidental learning but impeded intentional learning.

Retention of incidental items was least when easy incidental items were exposed with hard intentional paired-associates. Differences in retention under the other three

task difficulty combinations were not significant.

The effect of task competition on incidental learning was greater with hard than with easy paired-associates, whether or no subjects made differential responses to incidental items.

Mention should also be made of the evidence from the post-learning enquiry for sets that apparently facilitated retention of incidental items whether or no subjects were directed to make differential responses.

An important conclusion from the pilot study was that it was not possible to investigate with verbal materials the effect of positioning of cues on incidental learning.

CHAPTER IV.

DISCUSSION OF RESULTS

In the fourth and last chapter of this thesis, the findings set out in Chapter III are discussed, in the light of work of other investigators, and explanations are suggested for results that were not in accordance with predictions.

The chapter opens with a discussion of findings as to the intentional learning of paired-associates. Explanations in terms of the selection of subjects, the experimental procedure, and the learning task are examined. Incidental learning results are considered first in terms of drive theory, then in terms of the cue utilization hypothesis, and finally in terms of task competition and task difficulty interactions. In each instance, the discussion leads to the conclusion that findings which did not confirm predictions are congruent with a mediation hypothesis. An explanation is also sought for the relatively high incidence of errors by the high-drive group on the retention task.

1. The Intentional Learning Task.

From the Hull-Spence theory of emotionally-based drive, it was predicted that the paired-associate acquisition curves for high- and low-drive groups would diverge as

learning progressed, with the curve for the high-drive group being above that for the low-drive group. The evidence did not conform to the prediction. Before a claim can be made for refutation of the theory, or for a requirement to modify it to encompass the findings, one must consider whether conditions set by the theory were met. The selection of subjects, the experimental procedure, and the learning task will each be considered.

The fault, if any, does not lie in specifications for drive groups. Subjects were selected in much the same way that they have been selected in paired-associate learning studies that have supported the theory. For example, Spence, Farber and McFann¹ stated,

The Ss were 20 men and 20 women enrolled in an introductory psychology course, an equal number of each sex having scored in the upper 20% or lower 20% of scores on the A scale. All were naive with respect to the experimental task.

Two unusual features of the experimental design should be mentioned. The successive stimulus items were exposed every four seconds, with a two second anticipation interval, and a four second interval between successive

1. K. W. Spence, I. E. Farber and H. N. McFann, "The Relation of Anxiety (Drive) Level to Performance in Competitive and Non-Competitive Paired-Associate Learning", in the Journal of Experimental Psychology, Vol. 52, No. 5, issue of November 1956, p. 296-305.

presentations of the list. The anticipation interval in several studies by Spence and his associates has been 1.67 seconds. It is difficult to see, however, how reducing the anticipation interval by .33 seconds and increasing the learning interval by a like amount could possibly lead to convergence of acquisition curves.

The requirement to make differential responses to incidental items interfered with paired-associate learning, and so the acquisition curves were based only on responses to those items shown with incidental stimuli that were not spelled aloud. It is possible that subjects were differentially affected by the requirement to spell aloud some incidental items and not others, with a consequent effect on the effort or time expended on intentional learning. If this were the case, the procedural variable logically could be viewed as a mild stress condition.

However, if one assumes that stress adds an increment to drive level, and that high-drive subjects are at least as reactive to stress as low-drive subjects, it is difficult to see how the procedural variable could have reduced the difference between learning curves of high- and low-drive groups.

With sample and method presumably free of relevant fault, only the task is left for examination. It was mentioned in Section 4 of Chapter II that there are two basic

ways to manipulate paired-associate difficulty. One may vary the familiarity of stimulus and response terms, and also the associative strength within pairs.

Hard and easy pairs in this study were differentiated primarily by the associative values, or familiarity, of response members. Hard and easy lists were matched for average stimulus difficulty. No deliberate attempt was made to vary associative strength within pairs.

In studies of paired-associate learning that have provided support for the contention that the probability of a response is a joint function of habit strength and drive, habit strength has been manipulated not so much in terms of pre-experiment familiarity of stimulus and response members as in terms of associative strength within pairs. Typically, stimuli and responses have been familiar nouns or adjectives. Non-competitive lists have been so constructed that correct responses can be said to be higher than incorrect responses in the hypothetical hierarchy of response tendencies. In competitive lists, correct responses are less likely to occur than incorrect responses.

Response tendency competition is a vital boundary condition of the Hull-Spence theory of learning². Standish

2. A. W. Spence, "A Theory of Emotionally-based Drive (D) and Its Relation to Performance in Simple Learning Situations", in the American Psychologist, Vol. 13, No. 3, issue of March 1958, p. 131-141.

and Champion³ prepared a non-competitive list from common associates in the Kent-Kosanoff list, and a competitive list, always learned after the non-competitive list, by pairing the same stimuli with new responses rarely if ever given in free-association. Spence and his associates have preferred intra-list to inter-list competition. For example, Spence, Farber and McFann⁴ paired synonymous adjectives in constructing a non-competitive list, while the stimulus terms of their competitive list were synonymous, and paired with adjectives with which they had little or no associative connection.

It was not necessary in this study to manipulate response tendency competition in order to study the effect of hard and easy intentional tasks on incidental learning. In fact, some care was taken to vary only the pre-experiment familiarity of response terms, in order to control factors that might interact with other variables and affect incidental learning. An attempt was made to reduce competition among response tendencies, by pairing paralogous and non-synonymous nouns (the response terms) with nonsense syllables (the stimulus terms).

3. K. H. Standish and K. A. Champion, "Task Difficulty and Drive in Verbal Learning", in the Journal of Experimental Psychology, Vol. 59, No. 6, issue of June 1960, p. 361-365.

4. K. G. Spence, I. E. Farber and H. H. McFann, op.cit.

Pre-experiment associative strength was assumed to be much the same for hard and easy pairs. There was no reason to expect that stimulus nonsense syllables would tend to elicit, in free association, the nouns or paralogues with which they were paired, or any other nouns or paralogues used as responses. On the other hand, there was no reason to expect competition among response members, due either to synonymy or to strong associations with stimuli other than those with which they were paired.

These assumptions were not, in fact, entirely justified. As reported in Section 5 of Chapter III, the ease with which many subjects learned the response "money" to the stimulus "hov", and the response "water" to the stimulus "kix", suggests that "hov" and "kix" led to mediating responses that facilitated both learning these nonsense syllables and associating them with the correct responses.

On the whole, however, it seems reasonable to suggest that the difficulty of both hard and easy intentional pairs was primarily a function of the first stage of learning (learning the responses as responses) and not of the second (associating each response with its paired stimulus). There is no reason to expect that learning to pair "table" with "gaw" would have been easier than learning to pair "latuk" with "jum", if "latuk" and "table" had been learned to the same degree of familiarity, and so were equally available as possible responses.

On these grounds, it was reasoned that both hard and easy lists could be legitimately described as "non-competitive", and that high- and low-drive subjects should perform on both lists in accordance with predictions from the Hull-Spence theory of behavior in acquisition of non-competitive paired-associates. The fact that stimuli were not paired with meaningfully associated responses was not considered a serious deficiency, for it was assumed that it would suffice that a tendency for each stimulus to elicit its paired response, rather than other responses, would develop early in the course of learning.

In the light of findings, it would appear that lack of response tendency competition is not a sufficient condition for calling a paired-associate list non-competitive. It is apparently also essential to pair stimuli and responses that have pre-experiment associative connections. A simple test of this hypothesis would involve training high- and low-drive groups on two lists, one of non-competitive, non-associated pairs, like "arid-grouchy" and "quiet-opaque", and the other of non-competitive associated pairs, like "arid-parched" and "quiet-tranquil".

Another characteristic of the intentional learning list that may have had some effect on acquisition curves was its heterogeneity. Manipulating the task difficulty variable within the list may have led to interaction effects that

would not have been present if separate hard and easy lists had been used.

It is concluded that at least one of the conditions set by the theory of emotionally-based drive and its relation to performance in paired-associate learning was not met, and that, accordingly, findings as to paired-associate learning in this study did not provide grounds for criticizing the theory.

Brief mention should be made of two other findings about intentional learning. As to the first, the average number of trials to criterion should be considered as indicative of the relative and not the absolute difficulty of hard and easy lists. Investigators of paired-associate learning typically use lists of eight to twelve pairs. Difficulty increases disproportionately with the number of pairs, and the sixteen pairs used in this study constitute an exceptionally long and so an exceptionally difficult list. Had hard and easy lists been presented separately, the average number of trials to the criterion of two errorless trials in each case would almost certainly have been less. If inhibition develops in consequence of incorrect (non-reinforced) responses, the possibility exists that, over a long series of trials, high- and low-drive groups might be differentially affected, with consequent distortion, and perhaps convergence, of learning curves.

The relatively poor performance on those paired-associates shown with incidental items that were spelled aloud is further evidence to support Saltzman's finding⁵ that responses to the orienting task in incidental learning studies can interfere with intentional learning. With a limited amount of time to make differential responses on incidental and intentional tasks, intentional learning is inevitably impeded.

2. Incidental Learning and Drive.

Neither Hull nor Spence have dealt explicitly with incidental learning. Hull⁶, however, did account for latent learning within his system, concluding that it was subject to the same conditions of drive stimulus reduction and reinforcement as intentional learning, differing from the latter primarily in degree of incentive motivation (h) present at the time of learning. On the assumption that incidental learning was a special case of latent learning, a point of view that Hull⁷ seems to have endorsed, it was concluded in Section 6 of Chapter I that incidental learning of verbal

5. Irving J. Saltzman, "Comparisons of Incidental and Intentional Learning with Different Orienting Tasks", in the American Journal of Psychology, Vol. 69, No. 2, issue of June 1956, p. 274-277.

6. Clark Leonard Hull, A Behavior System: An Introduction to Behavior Theory Concerning the Individual Organism, New Haven, Yale University Press, 1952, p. 140-148.

7. Idem, p. 150.

material should be subject to the same effects of response tendency competition as intentional learning.

The critical finding as to drive and incidental learning in this study was that high-drive and low-drive groups did not differ significantly in the number of hard and easy trigrams marked correctly on the retention task following incidental learning. Either Spence's theory of emotionally-based drive was disproven in a legitimate and fair test, or some of the conditions set by the theory were not met, or incidental learning and intentional learning are not subject to the same conditions.

Spence has developed his theory slowly, without straying far from experimental evidence. When findings have not conformed to theory, he has examined the joint implications of the theory and new conditions, and modified the theory if he has deemed it necessary. Because he has not yet considered the implications of incidental learning studies, in which drive was manipulated, the present experiment must be considered as an exploratory investigation, dealing with matters outside the boundaries within which Spence has developed his position. It is not a crucial test of the theory; it does, however, suggest matters that may have to be considered if the theory of emotionally-based drive is extended to encompass the incidental learning studies.

As to whether conditions set by the theory were met, the critical matters are the selection of drive groups, and the nature and method of presentation of the task. It has already been concluded, in Section 1 of this chapter, that the selection of drive groups conformed to procedures used by Spence and his associates in experiments that have supported the theory of the role of emotionally-based drive in the intentional learning of verbal material.

Spence⁸ has stated that a paired-associates task is desirable for testing implications of the theory for intentional learning of verbal material, because only with paired-associates is it possible to control and manipulate the strengths of competing response tendencies. The conditions under which incidental learning takes place necessitate less demanding stimulus material. The requirement for a relatively simple task carries with it the inevitable consequence that task competition effects cannot be manipulated under conditions that are optimal for tests of the theory.

As in the case of the intentional task, the difficulty level of items in the incidental task was varied in terms of familiarity, or availability in a hypothetical habit family

8. Kenneth F. Spence, "A Theory of Emotionally-based Drive (D) and Its Relation to Performance in Simple Learning Situations", in the American Psychologist, Vol. 13, No. 3, issue of March 1958, p. 131-141.

hierarchy. An endeavor was made to reduce the amount of formal identity within the hard list, by using consonants no more than once in any letter position, a difficult condition to meet, when all items were drawn from a single level of Witmer's list, and when sub-groups of four items were matched for average GV. There is a tendency for high frequency and low frequency trigrams to differ as to component letters. Only fourteen of the twenty-one consonants appear in the eight trigrams of the hard list, six used once, six used twice, and two used three times (though not in the same position). A claim could perhaps be made that, contrary to the intention, the hard list items provoked response tendency competition because of letter duplication. This claim would be difficult to support, a priori, and no evidence for or against it emerged in the course of the experiment. It may be noted that it is patently impossible to prepare a list of eight consonant syllables without letter duplication, and that the association value of Witmer's consonant syllables tends to vary with component letters.

The easy list can be described as non-competitive, in the sense that the eight words were not synonymous. Letter duplication is not critical when words differ as to meaning.

On the basis of these considerations alone, one could tentatively extend the theory of emotionally-based drive to

predict that high-drive subjects would learn relatively more of both the easy and the hard items.

Apart from the obvious fact that an incidental task is not in the focus of attention, incidental and intentional learning differ in that the former but not the latter involves interference of one task with another. The evidence for interaction of intentional with incidental task difficulty indicates that the difficulty level of an incidental task cannot be estimated solely from an examination of its component items. At least with verbal material, the possibility exists that the difficulty of each incidental item is to some extent determined by the intentional task item with which it is exposed. The exact nature of the interaction may not be predictable. Because of letter identity, or the development of unforeseeable associative connections, the relationship between intentional and incidental task difficulty will inevitably be complex. There is also the possibility, admittedly remote, that the difficulty of an incidental item is, in part, determined by the items that precede and follow it, so that it changes from trial to trial, when order of items is varied to reduce serial position effects.

In contrast to the results of this study, Mechanic⁹ found that meaningfulness, or difficulty, of concurrently learned intentional items was not a significant source of variance in incidental learning. Mechanic's subjects had ten seconds on each of two, four, or eight trials to study each pair of intentional and incidental task trigrams. Such a slow rate of presentation would have facilitated differentiating between items presented simultaneously. It would also permit implicit rehearsal, and the operation of covert sets to learn, even without recognized, or admitted, intent to learn. The twenty-second inter-trial interval would also allow rehearsal. It may be relevant that Mechanic, who used both consonant and nonsense syllables, was fairly successful in reducing formal inter-list similarity.

Lack of independence of the intentional and incidental tasks is one factor that could help to explain why drive groups in the present study did not differ as to incidental learning. The roles of drive and response tendency competition are sufficiently complex to suggest the difficulties involved in designing verbal task materials, for an incidental learning study, that do not provoke unexpected task

9. Arnold Mechanic, "The Distribution of Recalled Items in Simultaneous Intentional and Incidental Learning", in the Journal of Experimental Psychology, Vol. 63, No. 6, issue of June 1962, p. 593-605.

interactions which interfere unpredictably with incidental learning.

Perhaps one should not be confident that the Hull-Spence theory of behavior can encompass incidental learning without modification. The theory has often been criticized for not incorporating perception and so attention. Degree of incidental learning is obviously dependent on the direction and intensity of attention. Berlyne¹⁰ attempted to extend the theory to permit prediction of selective perception, suggesting that attention be regarded as the momentary effective reaction potential of the perceptual response. His argument does not explain why the attention of some subjects should be drawn to incidental stimuli which others ignore. A suggestion by Hull¹¹ is relevant. He observed that the tendency to perceive and later recall and utilize things unrelated to the intentional task was strong in men and weak in rats, which "presumably means that some subvocal speech mechanism not possessed by rats is primarily responsible for the difference". The operation of such a mechanism would favor perceptual responses to some items and not others.

10. D. E. Berlyne, "Attention, Perception and Behavior Theory", in the Psychological Review, Vol. 58, No. 2, issue of March 1951, p. 137-146.

11. Clark L. Hull, op.cit., p. 150.

Another explanation can be advanced, which suggests a serious problem in designing a study to demonstrate the role of drive in incidental learning.

If one assumes that the critical variables in incidental learning are habit strength, drive, and incentive motivation, then it follows that, with drive either high or low, and incentive motivation low, reaction potential varies with habit strength. It is reasonable to assume in any learning experiment that there will be pre-experiment individual differences in habit strengths of verbal material. In an intentional learning experiment, this factor is controlled, by training all subjects to the same criterion. Since one cannot measure the course of incidental learning, it is not possible to control individual differences in either pre-experiment habit strength or rate of learning in an incidental learning study. Ensuring that all subjects are exposed to all items for an equal number of times adds an increment to habit strength, but presumably preserves the effect of pre-experiment individual differences. It follows that the number of items that a subject recalls or recognizes on a retention task after incidental learning will be partly determined by the positions of those items in the habit family hierarchy before the start of the experiment. Thus, it could be argued that individual differences in habit strength will inevitably obscure drive effects in an incidental learning study.

One could, perhaps, first conduct an incidental learning study with drive as an independent variable, then train subjects to a specified criterion on the items that had been used as incidental stimuli, and, finally, adjust incidental learning scores in terms of individual differences in trials to criterion, on the assumption that individual differences in pre-experiment habit strength and rate of learning would be reflected in trials to criterion.

In connection with the failure to find a relationship in this study between drive, as measured by the A-Scale, and either incidental or intentional learning, some may wish to "explain" results by denying the adequacy of the A-Scale as a measure of the drive construct. The writer is inclined to adhere to his original conclusion, after reviewing the literature on the A-Scale, that the test is appropriate for the purpose for which it was developed. Results of the present experiment are attributed to failure to meet the boundary conditions set by the theory of emotionally-based drive, and to problems associated with individual differences within drive groups that were not related to drive. This experiment did not provide an opportunity to assess the validity of the instrument. Under the circumstances, there are no grounds for attributing results to the inadequacy of the test.

3. Incidental Learning and Cue Utilization.

According to Easterbrook¹², an increment to drive will always reduce utilization of peripheral cues. Kausler and Trapp¹³ modified this generalization, suggesting, in part, that the effect of the drive increment will depend on the positioning of irrelevant cues. Incidental task material positioned within the reduced perceptual range of high-drive subjects will still be learned, so that a drive increment will not appear to affect incidental learning.

Some of the results of the pilot study support the Kausler and Trapp position. There was no evidence at all for acquisition of stimuli in the "far cue" position, after twenty trials. The fact that subjects learned at least some of the items in the "near cue" position suggested that these items (between the stimulus and response terms of the paired-associates) were within the perceptual range of subjects in the middle of the A-Scale or drive continuum.

The finding in the main study that high- and low-drive groups did not differ in incidental learning under the

12. J. A. Easterbrook, "The Effect of Emotion on Cue Utilization and the Reorganization of Behavior", in the Psychological Review, Vol. 66, No. 3, issue of May 1959, p. 183-201.

13. Donald H. Kausler and E. Philip Trapp, "Motivation and Cue Utilization in Intentional and Incidental Learning", in the Psychological Review, Vol. 67, No. 6, issue of November 1960, p. 373-379.

"spelled aloud" condition is also compatible with the cue position hypothesis, rather than with Hasterbrook's conclusion, for it is logical to assume that the requirement to make differential responses to incidental items brought these cues within the perceptual range of high-drive subjects.

This explanation, however, will not easily account for the finding that high- and low-drive groups did not differ in acquisition of incidental items under the "not spelled aloud" condition. These items, positioned thirteen millimetres to the left of intentional task stimuli, could not be clearly perceived by subjects who did not look at them directly; their images fell two or three degrees off the fovea when subjects focussed on intentional task stimuli. One would predict, from the Kausler and Trapp hypothesis, that high-drive subjects would acquire fewer of these incidental items, when task instructions required that subjects do no more with them than identify their color.

Kausler, Trapp and Brewer¹⁴ found no difference between high- and low-drive subjects in incidental learning of colors inside geometric forms that constituted the

14. Donald H. Kausler, L. Philip Trapp and Charles L. Brewer, "Intentional and Incidental Learning under High and Low Emotional Drive Levels", in the Journal of Experimental Psychology, Vol. 58, No. 6, issue of December 1959, p. 452-455.

intentional task. Silverman and Blitz¹⁵ reported that high-drive subjects were relatively less successful than low-drive subjects in learning numbers spaced six centimetres from intentional task syllables. In neither experiment were differential responses required to incidental stimuli. It could, perhaps, be argued that the "scanning" behavior of high-drive subjects in the present study was sufficiently flexible to permit perception of incidental stimuli only thirteen millimetres from the intentional task, and that the critical distance at which a drive difference effect appears lies between thirteen millimetres and six centimetres. This possibility, which seems to stretch the cue position hypothesis unduly, could easily be examined by positioning incidental stimuli at varying distances from intentional stimuli, with the prediction that the differences between drive groups in incidental learning would increase with distance between relevant and irrelevant cues.

It may be pertinent that incidental items not spelled aloud were printed in black, in contrast to the "spelled aloud" red items. The black color may have served to isolate these incidental items, and so facilitate learning. Apart from the likelihood that it was the red items that were

15. Robert E. Silverman and Bernard Blitz, "Learning and Two Kinds of Anxiety", in the Journal of Abnormal and Social Psychology, Vol. 52, No. 3, issue of May 1956, p. 301-303.

isolated by color, a Postman and Phillips¹⁶ study suggests that this factor alone would be unlikely to affect incidental learning markedly.

The findings as to incidental learning of items that were not spelled aloud become explicable when one examines the implications of Hull's suggestion, mentioned in Section 2 above, that some subvocal speech mechanism may be responsible for the apparent fact that humans ordinarily observe things unrelated to the tasks they perform.

Whether a subject learns on repeated presentation an incidental stimulus to which he is not required by task instructions to make an overt differential response may depend on whether or no he makes an implicit or covert differential response to it. Specifically, the response to such an incidental stimulus may be mediated by a subvocal speech process. An incidental stimulus may arouse mediation responses¹⁷ that

16. Leo Postman and Laura W. Phillips, "Studies in Incidental Learning: I. The Effects of Crowding and Isolation", in the Journal of Experimental Psychology, Vol. 48, No. 1, issue of July 1954, p. 48-56.

17. By mediation is meant a hypothetical process that intervenes between a stimulus and a response, including a perceptual or recognition response. The acceptance of the mediation hypothesis does not necessarily commit one to either central or peripheral intermediaries. Many learning theories provide for some sort of mediation. Hull's fractional antecedent goal responses, Guthrie's movement-produced stimuli, and Hebb's cell assemblies are examples. It is assumed that stimuli are meaningful insofar as they lead to mediation that relates them to previous learning. The usage is consistent with: Charles E. Osgood, "The Nature and Measurement of Meaning", in the Psychological Bulletin, Vol. 49, No. 3, issue of May 1952, p. 197-237.

that occur, without intent to learn, because of prior association between the stimulus and other patterns of stimulation. To say that an individual recognizes or perceives a verbal stimulus is little different from saying that the stimulus has evoked mediation responses.

It is suggested that the richer the mediation network that gives meaning to the verbal stimulus, the more likely it is that a stimulus which is peripheral or incidental to the central task will arouse a mediating response, and so recognition. The recognition response will establish a readiness to respond to the stimulus on subsequent presentations, with some such implicit reaction as "there it is again". Some fraction of a total verbal stimulus may suffice to produce mediating responses that give meaning to the perceived fraction.

The mediation hypothesis would carry with it the implication that the likelihood of learning an incidental stimulus to which an overt differential response was not required would be less a function of drive or cue position than of individual differences in the mediators aroused by the stimulus.

4. Task Competition and Task Difficulty Effects.

When subjects are exposed to intentional and incidental learning tasks simultaneously, the two tasks compete, in terms

of the total exposure time spent in responding to each kind of item. It is self-evident that more time will be consumed on an intentional task involving the learning of more or less meaningless paralogues than on one based on familiar nouns. One would expect that less time would be available for learning incidental material presented with a hard intentional task, and that an increase in intentional task difficulty would be associated with a decrease in incidental learning.

When Mechanic¹⁸ tested this task competition hypothesis, however, he found that incidental learning did not vary significantly with meaningfulness of intentional items. He sought an explanation in the fact that his orienting task required subjects to make definite pronouncing responses to both intentional and incidental stimuli. Arguing that learning depends on performance of differential responses to learning stimuli, he suggested that competition from the intentional task could not prevent subjects from making differential responses to incidental items, responses which inevitably led to a substantial amount of incidental learning, whether or no the intentional task was difficult.

The present study provided a controlled opportunity to check on the validity of Mechanic's explanation, for

18. Arnold Mechanic, op.cit.

subjects were exposed to some incidental items which they were required to spell aloud, and to others which it was possible to ignore while still conforming to experimental instructions. As might be expected, the requirement to spell incidental items aloud facilitated incidental learning. A more interesting finding was that there was significantly less incidental learning of items shown with hard intentioned material, whether or no the orienting task elicited differential responses to the incidental task.

The findings in this study support the task competition hypothesis, and suggests that a factor other than the orienting task accounted for the results that were obtained. This factor was, perhaps, the slow rate of presentation of stimulus items, which would permit the operation of covert sets to learn and implicit rehearsal, even without recognized or admitted intent to learn. The use of a free recall test of retention, rather than a recognition test, may also have been relevant.

In connection with the orienting procedure, some may be inclined to dismiss findings under the "not spelled aloud" condition as irrelevant to task competition in incidental learning, on the grounds that, because the task did not require differential responses to incidental stimuli, subjects were tested for observation or not observation. Since memory is involved in both cases, however, it is

learning, this is hair splitting. The real significance of the orienting procedure was that spelling the items aloud ensured practice under conditions that were not favorable to learning.

If the task competition hypothesis is a sufficient explanation of the interaction between hard and easy intentional and incidental learning tasks, one would expect less learning of hard than of easy incidental materials. The most incidental learning should occur when easy incidental items are exposed with easy intentional items, and the least when hard incidental items are exposed with hard intentional items. The pairing of easy incidental with hard intentional items, and of hard incidental with easy intentional items should presumably lead to an intermediate amount of learning.

The results in the present study did not conform to these expectations. Whether or no the orienting task entailed differential responses, incidental learning was least when easy incidental items were exposed with hard paired-associates, while differences in retention under the other three task difficulty combinations were not significant at the .05 level. The difference between means for levels of intentional task difficulty was significant at only one level of incidental task difficulty, and, conversely, the difference between means for levels of incidental task difficulty was significant at only one level of intentional task

difficulty. The effect of incidental task difficulty was significant at the hard level of intentional task difficulty under the "spelled aloud" condition, and at the easy level under the "not spelled aloud" condition. Obviously, these interaction effects were not predictable from the task competition hypothesis.

Two other findings are considered to be relevant to these results. The first was the evidence that subjects learned, on the average, 3.82 hard and 3.34 easy incidental items. The second was the evidence, from the post-experiment enquiry, that many subjects were able to recall the reasons why they first noticed both hard and easy incidental items that they later recognized on the retention task.

Both these findings are consistent with the mediation hypothesis outlined in Section 3. It is tentatively suggested that verbal incidental learning is less affected by the difficulty level of incidental material than by the presence or absence of mediating responses. Verbal incidental items that arouse mediation and a perceptual recognition response will be favored for retention, regardless of difficulty level.

The difficulty of the intentional task affects the amount of exposure time available for incidental learning. How the subject disposes of this "free" time may be dependent on the meaningfulness for him of incidental stimuli. There

is evidence--admittedly controversial--that needs and value systems affect perceptual readiness, lowering thresholds for some stimuli and raising them for others. The subject will be more likely to learn those incidental stimuli which, for one reason or another, lead to mediating responses and recognition.

In this respect, it may be noted that Mechanic's subjects were told that intentional and incidental task trigrams were items from two different primitive languages. Such an instruction might well provoke a search for meaningfulness in both intentional and incidental items.

5. Acquisition, Performance, and Error Incidence.

A restriction which the investigator of incidental learning must accept is that he cannot follow the course of acquisition, as may be done in a study of intentional learning. His observations are largely restricted to performance on the retention task, and he has little basis for inferences as to what led up to the responses that he accepts as evidence for incidental learning.

It is theoretically possible that the incidental learning of drive groups in the present study was wholly in accord with predictions derived from the theory of emotionally-based drive, or the cue utilization hypothesis, and that the retention task evoked responses that obscured

relationships. A parsimonious statement as to the influence of drive on incidental learning would be simply that high-drive subjects performed no differently from low-drive subjects on a retention task, following exposure to incidental stimuli. It would exceed the evidence to state that high-drive subjects performed no differently from low-drive subjects during incidental learning.

Evidence given in Appendix 1 supports the conclusion that differences in learning, between groups defined by A-Scale scores, are found only when the stimulus situation can be conceptualized as, in some sense, noxious or threatening. This conclusion has two correlates, that the A-Scale measures emotional responsiveness, and that emotional responsiveness contributes to drive level.

The retention task itself was probably perceived as threatening by some subjects. Urged to concentrate on the intentional task, subjects now found themselves faced with the requirement to demonstrate that they had learned material which they had been led to believe was irrelevant, with a veiled suggestion that poor performance might suggest limited intelligence. The retention task might well be the noxious stimulation that disrupted performance of, particularly, high-drive subjects when emotionally-based drive interacted with competing habit tendencies. This suggestion is put forward to account for the finding that high-drive subjects

made significantly more errors on the retention task than low-drive subjects. It is a principle of generalized drive theory that any active drive contributes to a general state of activation that facilitates on-going activity. It was reasoned that it would be compatible with the theory to predict that high-drive subjects would mark more items than low-drive subjects, on a recognition task with a liberal time limit, particularly as guessing was a matter for personal decision. This, in fact, was the finding.

The sixty-four item recognition test was characterized by high intra-list confusion, due, primarily, to letter duplication in similar items. If high-drive subjects have relatively low thresholds for noxious stimulation, and if the retention task is conceived to be a kind of noxious stimulation, it should follow that, because of response tendency competition, with higher response evocation, high-drive subjects would make more errors on the retention task than low-drive subjects. This, too, was the finding.

A retention task item would tend to evoke an erroneous response if it resembled an incidental item not learned to the point where it led, on presentation, to an immediate and firm recognition response. That is, those retention task items that evoked incorrect responses were probably identified by subjects as similar or as identical to incidental task items that had not been adequately discriminated during incidental learning.

c. Mediation, Attention, and Incidental Learning.

The importance of mediation processes in incidental learning, and their relation to attention, is considered to be the main inference to be drawn from findings in this study. Both mediation and attention have been more or less ignored by investigators of incidental learning, who have tended to study the effect of task and procedural variables, rather than (with the exception of driver subject variables).

Modern behavior theory has provided logical foundations for the commonsense view that there are mediation processes. A stimulus-response theory that ignores mediation cannot account for learning, for it provides no basis for the observation that a response is not simply a function of the stimulus, but is, in some measure, also determined by past experience, present motivation, the direction and intensity of attention, and, in short, by individual differences in what the subject brings to, and applies to, the learning task.

Unfortunately, the necessity for taking mediation, and so individual differences, into account reduces the possibility of making precise prediction as to the course and outcome of learning. The usual solution is to substitute individual differences in the average and variability of group performance. This suffices when the direction and intensity of attention are controlled, but obviously it is not enough in investigations of learning that deal with the

to the central task. It is suggested that, as attention to a task decreases, the effect of mediating processes on acquisition and retention of cues increases.

The writer has been led to the tentative conclusion that difficulties entailed in testing drive theory in an incidental learning study may be insuperable. There seems to be no satisfactory way to control differences as to mediation processes within drive groups, and these differences seem particularly likely to obscure the role of drive when attention is not focussed on the learning material. Even when one is not concerned with differences between groups, it is not only possible but also logical to call on the role of mediators to account for unpredicted results.

Many incidental learning studies have been carried out in the hope of shedding light on the place of reinforcement in learning. There seems to be no way of controlling motivation, or set, to learn, and so the evidence, always debatable, does not disturb reinforcement theorists. It is unlikely that incidental learning studies will be found appropriate for studying the precise role of mediation in learning, transfer, and related topics. Perhaps, however, there is still a task for investigators of incidental learning. This task is to study attention and its implications for learning.

It may well turn out that reinforcement is of less significance for learning than attention. Attention is an aspect of perception which has been singularly little investigated in recent years. The revival of interest in perception studies has incited a little work on attention, but learning theorists, who tend to view the learning process as a thing in itself, meaningful apart from the whole organism, have usually assumed constant and unwavering attention to the central task, and all but ignored the topic.

Investigation of cue utilization in incidental learning offers hope of developing, as a by-product, a measure of attention from which might be derived an intervening variable for incorporation in a learning theory. It may eventually be possible to state with some precision the effect of an increase or decrease in span of attention on learning.

Attention is related behaviorally to such concepts as set and expectancy, and conceptually to neural facilitation and activation in the central nervous system. Incidental learning studies may, perhaps, contribute to increased understanding of these processes. One could, for example, determine whether a subject will respond more readily to incidental cues to which he has been conditioned, or whether incidental learning is greater under conditions of reduced sensory input (and so reduced activation), or whether an increase in the intensity, contrast, or movement of intentional cues impedes incidental learning.

SUMMARY AND CONCLUSIONS

Undertaken originally as an investigation of the roles of emotionally-based drive, task difficulty, and the positioning of cues in incidental learning, this experiment was modified, after a pilot study, to permit investigation of the effect of the orienting procedure rather than of cue position. The study provided, as a by-product, data on the effect of the experimental variables on intentional learning.

Two groups of twenty-five subjects each, differentiated in terms of scores on a measure of drive, the A-Scale, each learned sixteen paired-associates for thirty trials, while incidentally exposed to sixteen verbal trigrams. The four independent variables were drive (high versus low), intentional task difficulty (hard versus easy), incidental task difficulty (hard versus easy), and orienting procedure (incidental items spelled aloud versus not spelled aloud). An analysis of variance design was used in analyzing data.

In connection with the role of emotionally-based drive in incidental learning, the study cannot be considered as having provided a definitive test of the Hull-Spence theory respecting drive and learning generally, because the theory does not make explicit the variables and boundary conditions that influence learning of stimuli irrelevant to the central task. All that can be said is that drive

groups, as defined by A-scale scores, did not differ in retention of incidental verbal trigrams, and that drive did not interact with other experimental variables. Two possible reasons were suggested for the negative results:

1. The interaction of intentional with incidental task difficulty, and the need to use material other than paired-associates as incidental items, made it difficult to ensure that incidental items were non-competitive in the sense required by the Spence theory of emotionally-based drive.

2. Pre-experiment individual differences in habit strength of incidental items, and in a "subvocal speech mechanism", posited by Hull, may have obscured drive effects.

Drive groups did differ as to mean number of responses on the retention task following incidental learning, the difference being almost entirely a function of the number of errors. (The difference in correct responses, while not significant, was in the same direction.) The finding as to mean number of responses was judged to be essentially in accordance with drive theory. It was suggested that high-drive subjects were relatively susceptible to the retention task as a source of noxious stimulation, and that this effect, in association with formal identity within the retention task, tended to increase error incidence, particularly among high-drive subjects.

As to orienting procedure, spelling incidental items aloud favored incidental learning, presumably because it facilitated stimulus discrimination. There was, however, measurable learning of those items not spelled aloud.

As to task difficulty, retention of incidental items was least when they were exposed with hard paired-associates. This finding emerged whether or not subjects spelled incidental items aloud, a result which did not support the view that task competition effects are reduced or eliminated when subjects make differential responses to incidental material.

Retention of incidental items was least when easy incidental items were exposed with hard paired-associates. There were no significant differences in retention under the other three task difficulty combinations, whether or no incidental items were spelled aloud. Results were discussed in terms of a mediation hypothesis, related to Hull's subvocal speech mechanism.

Results of the pilot study, and of the main investigation under the "spelled aloud" condition, were not at variance with the view that positioning of incidental cues is a factor in incidental learning, and related to drive or activation level. However, when differential responses were not required to incidental stimuli, drive groups did not differ as to cue utilization, a finding difficult to explain in terms of the cue position hypothesis. An explanation was sought in individual differences in mediators aroused by incidental stimuli. Under conditions of reduced attention, individual differences in mediation processes may be relatively important in determining which stimuli will be acquired and retained.

There was evidence, particularly from the post-experiment enquiry, for the operation of mediating responses that facilitated not only acquisition of incidental items, even when subjects were not required to spell them aloud, but also of the intentional task paired-associates.

The main finding as to intentional learning was that drive groups did not differ in acquisition of either hard or easy paired-associates. Failure to meet one of the boundary conditions specified in the theory of emotionally-based drive, and its interaction with habit strength in non-competitive learning, was judged to be the relevant factor. Other findings were that task difficulty and the requirement to make differential responses to incidental items both impeded intentional learning.

Three studies for the future, arising from findings in this investigation, were suggested in Chapter IV. These recommendations for further research are consolidated here.

To verify the impression that lack of response tendency competition is not a sufficient condition for describing a paired-associate intentional learning task as "non-competitive", in the sense that the term is used in the Spence theory of emotionally-based drive, high- and low-drive groups, defined by A-Scale scores, could be trained on two lists, one of non-competitive, non-associated adjective or noun pairs, and the other of non-competitive, associated

pairs. It would be predicted that, for the non-competitive, associated list only, high-drive group performance would exceed that of the low-drive group, with acquisition curves diverging as learning progressed.

To study the possibility of controlling the effect of individual pre-experiment differences in habit strengths of incidental task stimuli, high- and low-drive subjects could first be measured for incidental learning of verbal stimuli, and then trained to a specified criterion on these same items, after which the effect could be examined of correcting incidental learning retention scores in terms of individual differences in trials to criterion.

To test the cue position hypothesis, high- and low-drive groups, defined by A-Scale scores, could be exposed to incidental stimuli positioned at varying distances from intentional task items, with the prediction that low-drive group performance would increasingly exceed that of the high-drive group, with increase in distance between intentional and incidental items.

Finally, future investigators of incidental learning, who hope to extend the Spence theory of emotionally-based drive to include the phenomenon, will have to pay more attention to complexity of task material than was attempted in this study. The goal should be to use intentional task items that will not readily become associated with,

or otherwise interfere with, incidental learning material, so that the effect of such variables as cue position and intensity will not be obscured. As to incidental stimuli, at least in studies relevant to drive theory, there is a need to develop incidental stimulus lists that conform to theory conditions respecting response tendency competition.

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This study was one of several cited by Easterbrook as evidence for the deleterious effect of increased activation on incidental learning. In this case, Easterbrook was wrong, for Bahrck manipulated not drive but incentive. The design of this study was the basis for the Lausler, Trapp and Brewer investigation, which directly influenced the present study.

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Berlyne, D.E., "Attention, Perception and behavior Theory", in the Psychological Review, Vol. 58, No. 2, issue of March 1951, p. 137-146.

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Brown, George Haskell, "Factors influencing Incidental Learning", in the Journal of Experimental Psychology, Vol. 47, No. 3, issue of March 1954, p. 163-167.

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Bruner, Jerome S., "On Perceptual Readiness", in the Psychological Review, Vol. 64, No. 2, issue of March 1957, p. 123-152.

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-----, Jean Matter and Miriam Lewin Papanek, "Breadth of Learning as a Function of Drive Level and Mechanization", in the Psychological Review, Vol. 62, No. 1, issue of January 1955, p. 1-10.

A report of a study with rats as subjects that suggested that increasing goal demand (or over-motivation) reduces learning of irrelevant aspects of a task. Important as an early indication of the hypothesized relationship between activation level and breadth of learning, span of attention, or cue utilization.

Cameron, Norman, The Psychology of Behavior Disorders, Boston, Houghton Mifflin, 1947, xxii - 622 p.

A neo-behavioristic interpretation of what Cameron did not call "mental illness", which included, in Chapter 9, an account of anxiety disorders that provided the description used by Taylor in developing the A-Scale.

Child, I. L., "Personality", in Saul K. Murnsworth (ed.) and Quinn McNemar (associate ed.), Annual Review of Psychology, Vol. 5, 1954, Palo Alto, California, Annual Reviews Inc., p. 149-171.

An endeavor to explain findings in A-Scale studies as due not to differences in emotionally-based drive but to differences in susceptibility to task-irrelevant responses. Taylor (1958) provided experimental evidence to refute this interpretation.

Duffy, Elizabeth, "The Psychological Significance of the Concept of 'Arousal' or 'Activation'", in the Psychological Review, Vol. 64, No. 5, issue of September 1957, p. 265-275.

Duffy is one of the chief proponents of the view that emotion and motivation are related through the concept of activation level. This point of view is essentially in accordance with Spence's theory of emotionally-based drive. She argues, basically, that increasing activation first facilitates and then impedes quality of performance.

Durval, Mary Irene, "The Effect of Manifest Anxiety upon Incidental and New Task Learning", in Dissertation Abstracts, Vol. 17, No. 3, issue of 1957, p. 680.

With intelligence controlled, no difference was found between high- and low-drive groups (defined by A-Scale) in incidental learning of verbal material. This study did not support a prediction that the Hull-Spence theory of learning would apply to incidental learning. The author did not consider her study an effective test of the theory.

Easterbrook, J. A., "The Effect of Emotion on Cue Utilization and the Reorganization of Behavior", in the Psychological Review, Vol. 66, No. 3, issue of May 1959, p. 183-201.

A review of the literature, which led him to the generalization that increased activation reduces cue utilization. Disagreement with interpretations by Easterbrook of studies in which incentive was manipulated led Kausler and Trapp (1960) to evaluate and extend Easterbrook's position. Strongly recommended.

Gibson, J. J., "A Critical Review of the Concept of Set in Contemporary Experimental Psychology", in the Psychological Bulletin, Vol. 38, No. 9, issue of November 1941, p. 781-817.

Related the concept of set to motivation, arguing that sets are dynamic and self-activating. Provides support for the conclusion that a set-to-learn is probably evoked whenever an instructional set induces attention to an orienting task in incidental learning studies. If so, the reinforcement principle cannot be adequately tested by incidental learning experiments.

Glaze, J. A., "The Association Value of Non-sense Syllables", in the Journal of Genetic Psychology, Vol. 35, No. 2, issue of December 1928, p. 255-269.

Association values in terms of percentage of subjects reporting an association within two or three seconds of seeing syllable. Material for the pilot study was drawn from this list.

Hull, Clark Leonard, A Behavior System: An Introduction to Behavior Theory Concerning the Individual Organism, New Haven, Yale University Press, x - 372 p.

The final statement of Hull's position, incorporating the basic ideas reported in earlier books and articles. Includes the provocative suggestion that a subvocal response mechanism may be responsible for the difference between rats and men in utilization of irrelevant cues, and an interpretation of latent (and so incidental) learning as learning under low incentive motivation.

James, William, The Principles of Psychology, Vol. 1, New York, Henry Holt, 1950, xii - 689 p.

In Chapter 11, on attention, the experimental evidence to 1890 was presented, on the relation between attention and memory. There were supporting discussions in Chapter 6, in which attention was given as a condition for consciousness, and in Chapter 16, on memory. There was recognition that degree of learning is related to degree of attention, a view since supported by incidental learning studies.

Jenkins, John G., "Instruction as a Factor in 'Incidental Learning'", in the American Journal of Psychology, Vol. 45, No. 3, issue of July 1933, p. 471-477.

One of many studies that showed that incidental learning is less effective than intentional learning. The first recognition of the importance of set in incidental learning, with evidence that some subjects form covert sets to learn, despite experimental instructions, and that others notice and retain some incidental items even though they are not set to learn any. Provided supporting evidence for the conclusion that incidental learning may not be appropriate for testing the validity of the reinforcement principle. A landmark in the history of incidental learning studies.

Jensen, Arthur A., "The Validity Personality Inventory", in Acta Psychologica, Vol. 14, No. 4, 1958, p. 314-325.

The most readily accessible description of the A-I, with normative data from a variety of samples, and correlations with other personality measures, including the A-scale.

Jessor, R., and R. N. Hammond, "Construct Validity and the Taylor Anxiety Scale", in the Psychological Bulletin, Vol. 54, No. 3, issue of May 1957, p. 161-170.

The authors objected to the use of the A-scale in attempts to validate the theory of emotionally-based drive, because design of the scale was governed by an interpretation of anxiety and not the drive construct. Spence (1958) took issue with this criticism.

Kausler, Donald H., and E. Philip Trapp, "Motivation and Cue Utilization in Intentional and Incidental Learning", in the Psychological Review, Vol. 67, No. 6, issue of November 1960, p. 373-379.

An evaluation of the effect of drive or activation level on incidental learning, with the conclusion that task and positional variables are also relevant. This study led directly to the present investigation. Strongly recommended.

-----, E. Philip Trapp and Charles F. Brewer, "Intentional and Incidental Learning under High and Low Emotional Drive Levels", in the Journal of Experimental Psychology, Vol. 58, No. 6, issue of December 1958, p. 452-455.

Using the same task as Bahrick (1954) but manipulating A-scale defined drive, instead of incentive, these investigators found no difference between drive groups in incidental learning. A later endeavor to explain their results (Kausler and Trapp (1960)) suggested the variables that were manipulated in the present study.

Kohn, Hugh, "Effects of Variations of Intensity of Experimentally Induced Stress Situations upon Certain Aspects of Perception and Performance", in the Journal of Genetic Psychology, Vol. 85, Second Half, issue of December 1954, p. 289-304.

Shock threat interfered with acquisition or retention of irrelevant detail in a story that subjects studied. Led to the inference that drive level, manipulated by shock threat, affects incidental learning.

McGeogh, John A., and Arthur L. Irion, The Psychology of Human Learning, (2nd Ed.), New York, Longmans, Green, 1952, xxiv - 596 p.

On pages 211-215 there is a critical discussion of incidental learning, with the argument that a set-to-learn is probably evoked whenever a set-to-read or a set-to-observe are aroused by instructions. It would seem to follow that incidental learning differs from intentional learning primarily in degree, but that it is not essentially different, and also that the effect of set will interfere with an attempt to validate the role of reinforcement in learning with an incidental learning model. A useful though dated discussion.

Malmo, Robert B., "Anxiety and Behavior Arousal", in the Psychological Review, Vol. 64, No. 5, issue of September 1957, p. 276-287.

Drew attention to the relationship between the Hull-Spence drive construct and the activation principle, and included a suggestion that the A-Scale could be used to select subjects for studies of physiological aspects of motivation. This was the article that led the writer to consider the use of the A-Scale for selecting subjects for a study of cue utilization under conditions of high and low activation.

Maltzman, Irving, Jack Fox and Lloyd Morrisett, Jr., "Some Effects of Manifest Anxiety on Mental Set", in the Journal of Experimental Psychology, Vol. 46, No. 1, issue of July 1953, p. 50-54.

Subjects high on the A-Scale were less successful in shifting from a dominant set to a direct solution, in solving Luchins water jar problems. Provides support for contention that increased activation interferes with cue utilization.

Martin, Barclay, "The Assessment of Anxiety by Physiological Behavioral Measures", in the Psychological Bulletin, Vol. 58, No. 3, issue of May 1961, p. 234-255.

Provided evidence that anxiety is not associated with a clear-cut pattern of physiological-behavioral responses which would differentiate it from a general state of arousal under conditions of increased activation. As such, the evidence provided indirect support for Spence's contention that anxiety contributes to drive level.

Mechanic, Arnold, "The Distribution of Recalled Items in Simultaneous Intentional and Incidental Learning", in the Journal of Experimental Psychology, Vol. 63, No. 6, issue of June 1962, p. 593-600.

A succinct discussion, with references, of the "differential response" hypothesis and its relation to task competition. Mechanic's findings, that differential responses to incidental material offset the effect of competition from a hard intentional task, were not supported in the present study.

Myers, Carry C., "A Study of Incidental Memory", in Archives of Psychology, Vol. 4, No. 26, issue of February 1913, 108 p.

Because of the extensive review of the literature, pertinent to incidental learning, prior to 1913, this was a useful historical reference. The experiments carried out by Myers himself convinced him of the importance of experience and utility in determining what would, and what would not, be perceived and retained.

Noble, Clyde E., "An Analysis of Meaning", in the Psychological Review, Vol. 59, No. 6, issue of November 1952, p. 421-430.

Association values of paralog and nouns, with meaningfulness defined in terms of average number of written associations in sixty seconds. Paired-associate response terms for the pilot study and main investigation were drawn from this list.

Osgood, Charles E., "The Nature and Measurement of Meaning", in the Psychological Bulletin, Vol. 49, No. 3, issue of May 1952, p. 197-237.

The mediation hypothesis, summarized in connection with Osgood's theory of meaning. Osgood contended that meaning was related to the numbers and kinds of mediating responses relating verbal stimuli to previous learning.

-----, Method and Theory in Experimental Psychology, New York, Oxford University Press, 1953, viii - 800 p.

Ostensibly an evaluation of the literature on certain key problems in psychology, this volume provided a lengthy, documented interpretation of learning in terms of the author's mediation hypothesis. Incidental learning was dealt with solely in terms of its significance, or, rather, lack of significance, as a critical problem for reinforcement theorists. The prime source on the mediation hypothesis.

Postman, Leo, and Pauline Austin Adams, "Studies in Incidental Learning: IV. The Interaction of Orienting Tasks and Stimulus Materials", in the Journal of Experimental Psychology, Vol. 51, No. 4, issue of April 1956, p. 329-333.

Compared effect on incidental learning of two orienting procedures, making meaningful associations to stimulus items, and matching stimulus items with geometric figures. An experiment in the Postman et al. series on the effect of various task and procedural variables on incidental learning, this concluded with the generalization that an orienting task which favors discrimination of stimulus items is unlikely to interfere with intentional learning. Suggested investigation of the procedural variable in the present study.

-----, and Pauline Austin Adams, "On Recent Studies of the Law of Effect in Incidental Learning", in the American Journal of Psychology, Vol. 70, No. 4, issue of December 1957, p. 642-646.

A review of studies designed to test the hypothesis that reinforcement has no effect on acquisition and retention when the subject is not motivated. Concluded that the reinforcement principle was not likely to be refuted with studies involving symbolic verbal reinforcement. A useful overview.

-----, and Laura W. Phillips, "Studies of Incidental Learning: I. The Effects of Crowding and Isolation", in the Journal of Experimental Psychology, Vol. 48, No. 1, issue of July 1954, p. 48-56.

First of a series of studies showing the effect on incidental learning of task and procedural variables known to affect intentional learning. Here, color isolation was not found to have a significant effect on either intentional or incidental learning.

-----, and Virginia L. Senders, "Incidental Learning and Generality of Set", in the Journal of Experimental Psychology, Vol. 36, No. 2, issue of April 1956, p. 153-156.

Under each of five different sets, subjects learned material irrelevant to the set. Provides experimental evidence for conclusion that generality of set interferes with possibility of testing reinforcement principle in an incidental learning study.

Saltz, Eli, and Arthur J. Hoehn, "A Test of the Taylor-Spence Theory of Anxiety", in the Journal of Abnormal and Social Psychology, Vol. 54, No. 1, issue of January 1957, p. 114-117.

An endeavor to explain results in A-Scale studies as due to the relationship between an increase in task complexity and an increase in anxiety. Drive groups did not differ in performance on competition and non-competition lists previously found to be equally difficult for low-drive subjects. Taylor (1958) provided a reasoned disagreement.

Saltzman, Irving J., "Comparisons of Incidental and Intentional Learning with Different Orienting Tasks", in the American Journal of Psychology, Vol. 69, No. 2, issue of June 1956, p. 274-277.

One of a series of studies by Saltzman et al. on the orienting task in incidental learning, this demonstrated that the orienting task can interfere with intentional learning, a finding confirmed in the present study.

Scheffe, Henry, "A Method for Judging All Contrasts in the Analysis of Variance", in Biometrika, Vol. 40, Parts 1 and 2, issue of June 1953, p. 87-104.

A conservative method for testing the significance of contrasts among a set of means calculated in the analysis of variance. Comparisons need not be planned in advance. This article gives the mathematical basis for the technique.

Shellow, Sadie Myers, "Individual Differences in Incidental Memory", in Archives of Psychology, Vol. 10, No. 64, issue of May 1923, 77 p.

An important review of the early literature on incidental learning, with advice for future investigators, including recognition of the requirement for an orienting task to ensure perception of the material to be learned.

Siegmán, Aron W., "The Effect of Manifest Anxiety on a Concept Formation Task, a Nondirected Learning Task and on Timed and Untimed Intelligence Tests", in the Journal of Consulting Psychology, Vol. 20, No. 3, issue of June 1956, p. 176-178.

High scorers on the A-Scale remembered fewer Bender-Gestalt figures that they had copied earlier than low-scorers. Supports the conception that drive or activation level is related to cue utilization and incidental learning.

Silverman, Robert E., "Anxiety and the Mode of Response", in the Journal of Abnormal and Social Psychology, Vol. 49, No. 4, issue of October 1954, p. 538-542.

This study provided support for the task competition hypothesis, but results are debatable because incidental learning was in response to auditory stimulation. Drive level, manipulated by shock threat, also reduced incidental learning.

-----, and Bernard Blitz, "Learning and Two Kinds of Anxiety", in the Journal of Abnormal and Social Psychology, Vol. 52, No. 3, issue of May 1956, p. 301-303.

High-drive, as measured by the A-Scale, was associated with less incidental learning than low-drive. Kausler and Trapp (1960) suggested that the positioning of incidental cues was critical in this study.

Spence, Kenneth W., Behavior Theory and Conditioning, New Haven, Yale University Press, 1956, x - 262 p.

The most complete single statement of Spence's theory of learning, including an evaluation of the role of drive in human verbal learning, with experimental evidence.

-----, "A Theory of Emotionally-Based Drive (D) and Its Relation to Performance in Simple Learning Situations", in the American Psychologist, Vol. 13, No. 3, issue of March 1958, p. 131-141.

The best single statement of Spence's theory of emotionally-based drive, in which experimental evidence was presented and the critics annihilated.

-----, I. L. Farber and H. H. McFann, "The Relation of Anxiety (Drive) Level to Performance in Competitive and Non-Competitive Paired-Associates Learning", in the Journal of Experimental Psychology, Vol. 52, No. 5, issue of November 1956, p. 296-305.

The A-Scale study in which it was first argued that a paired-associates task was appropriate for testing the theory of emotionally-based drive in a complex learning situation. High-drive subjects did better on a non-competitive task and low-drive subjects on a competitive task.

Spielberger, Charles D., Leonard D. Goodstein and W. Grant Dahlstrom, "Complex Incidental Learning as a Function of Anxiety and Task Difficulty", in the Journal of Experimental Psychology, Vol. 56, No. 1, issue of July 1958, p. 58-61.

Found an interaction between task difficulty, drive measured by the A-Scale, and incidental memory for Bender-Gestalt figures, that supports the Spence theory of emotionally-based drive, in that high-drive subjects were better on easy items and low-drive subjects on hard items.

Standish, H. K., and A. A. Champion, "Task Difficulty and Drive in Verbal Learning", in the Journal of Experimental Psychology, Vol. 59, No. 6, issue of June 1960, p. 361-365.

Demonstrated that the relationship between drive, as measured by the A-Scale, and complex (paired-associates) learning held when response tendency competition was varied by inter-list rather than intra-list means.

Taylor, Janet A., "The Relationship of Anxiety to the Conditioned Eyelid Response", in the Journal of Experimental Psychology, Vol. 41, No. 2, issue of February 1951, p. 81-92.

The study that introduced the A-Scale to psychology. Showed that an increase in drive as measured by the A-Scale facilitated performance on a simple learning task.

-----, "A Personality Scale of Manifest Anxiety", in the Journal of Abnormal and Social Psychology, Vol. 48, No. 2, issue of April 1953, p. 285-290.

An account of the origin and development of the A-Scale, including a list of the items, with directions in which they are keyed.

-----, "The Effects of Anxiety Level and Psychological Stress on Verbal Learning", in the Journal of Abnormal and Social Psychology, Vol. 57, No. 1, issue of July 1958, p. 55-60.

Showed that differences between drive groups on a verbal learning task were related to drive and not to task-irrelevant responses. Discussed and rejected Child's suggestion that competing task-irrelevant responses are more strongly aroused in high-drive subjects. Also argued against the idea advanced by Saltz and Hoehn that complex tasks arouse more anxiety (drive) than easy tasks.

Underwood, Benton J. and Rudolph W. Schulz, Meaningfulness and Verbal Learning, Chicago, Lippincott, 1960, viii - 430 p.

An evaluation of the literature on the relationship of meaningfulness, defined in various ways, to verbal learning. Experimental evidence was cited for the authors' contention that "generated value" and "pronunciability" afford the most satisfactory measures of meaningfulness of verbal trigrams. Techniques described in this book were used in the present study.

Wallace, Isabel, "Incidental Memory", Thesis 14 in Edwin A. Kirkpatrick, "Studies in Development and Learning", in Archives of Psychology, Vol. 2, No. 12, issue of March 1909, p. 79-88.

Demonstrated wide individual differences in retention of irrelevant details of an illustrated lecture. This is the paper in which the adjective "incidental" was first used in connection with learning and memory. Wallace's conclusion that there were marked individual differences in incidental memory is in accordance with findings in the present study.

Witmer, Louise K., "The Association Value of Three-Place Consonant Syllables", in the Journal of Genetic Psychology, Vol. 47, No. 2, issue of December 1935, p. 337-359.

Association values of consonant syllables, defined in terms of percentage of subjects who gave an association to a syllable within four seconds. From this list were drawn stimulus members of paired-associates used in the pilot study, hard incidental items for the main investigation, and half of the items in the main investigation retention task.

APPENDIX 1

The A-Scale as a Measure of Drive.

The development of the Taylor Manifest Anxiety scale (A-Scale)¹, a decade ago, provoked a veritable flood of studies on the relationship between A-Scale scores and an ever-increasing list of other response variables. As Jenkins and Lykken² commented, the cynic might be tempted to ascribe the vast number of studies simply to availability of a test which is easy to give to large groups of subjects and which purports to measure "manifest anxiety".

Jenkins and Lykken notwithstanding, it is important to emphasize that the A-Scale does not purport to measure manifest anxiety, except insofar as anxiety is conceived as contributing to drive level. It was developed as a measure of drive, a construct in the Hull-spence theory of behavior. The claim for validity of the A-scale must rest not on its relationship to other psychological and physiological

1. Janet A. Taylor, "A Personality Scale of Manifest Anxiety", in the Journal of Abnormal and Social Psychology, Vol. 48, No. 2, issue of April 1953, p. 285-290.

2. James J. Jenkins and David T. Lykken, "Individual Differences", in Paul R. Farnsworth (ed., and Winn McNemar (associate ed.), Annual Review of Psychology, Vol. 8, 1957, Palo Alto, California, Annual Reviews Inc., p. 79-112.

measures of anxiety, or emotionality, or neuroticism, but on evidence that it yields a measure of drive strength. If one has a theory that leads to predictions about the effect on behavior of manipulating a variable, and an instrument that is said to measure that variable, one may claim that the instrument is valid if its use as a measure of the variable leads to experimental results that support the theory. The purpose of this appendix is to consider the adequacy of the A-Scale as a measure of drive.

Much of the criticism directed against the A-Scale reflects a singular lack of comprehension of the Spence theory of emotionally-based drive. The essence of this theory was presented in Section 6 of Chapter I. The theory is explicit, and studies which do not conform to its boundary conditions as to subject, task, and environmental variables can scarcely be accepted as bearing, either on the adequacy of the theory or on the validity of the A-Scale.

1. The Measurement of Response-Inferred Drive.

Spence and his co-workers have used two methods to vary the strength of emotionally-based aversive drive states in studies with human subjects to test implications of the theory of emotionally-based drive, direct variation of the intensity of a physical stimulus and indirect, response-inferred variation, based on scores on the A-Scale.

One of the assumptions of the theory is that emotional responsiveness contributes to drive strength. Another is that the magnitude of a reflex response is related to emotional responsiveness, through the latter's contribution to drive strength. An obvious test of the theory is possible if one can identify subjects varying on the emotional continuum. One would expect that subjects high in emotional responsiveness would be more readily conditioned with a noxious unconditioned stimulus than subjects low in emotionality.

Taylor³ conceived the possibility of manipulating emotional responsiveness with a pencil-and-paper test. She asked five clinicians to select from amongst two hundred items from the Minnesota Multiphasic Personality Inventory those items most descriptive of Cameron's⁴ account of chronic anxiety reactions. She selected for further analysis sixty-five items on which there was at least 80-percent agreement, reduced the number of items to fifty after statistical analysis, revised twenty-eight of the items to simplify vocabulary and sentence structure, and gathered normative and reliability data on the final scale.

3. Janet A. Taylor, op.cit.

4. Norman Cameron, The Psychology of Behavior Disorders, Boston, Houghton Mifflin, 1947, p. 147, 254-256.

One indication of the marked surge of interest in "manifest anxiety" is the number of modifications of the original A-Scale. These include a short form with only twenty items⁵, a forced-choice version⁶, a short form of the forced-choice version⁷, simplified versions of both the original and the forced-choice version for use in United States Army training research⁸, a form for use with children⁹, and a short form of the children's scale¹⁰. Most of these revisions were developed for clinical trial, and not for use in studies to test implications of drive theory.

5. A. w. Bendig, "The Development of a Short Form of the Manifest Anxiety Scale", in the Journal of Consulting Psychology, Vol. 20, No. 5, issue of October 1956, p. 384.

6. Charles E. Heineman, "A Forced-Choice Form of the Taylor Anxiety Scale", in the Journal of Consulting Psychology, Vol. 17, No. 6, issue of December 1953, p. 447-455.

7. Richard Christy and Stanley Budnitzky, "A Short Forced-Choice Anxiety Scale", in the Journal of Consulting Psychology, Vol. 21, No. 6, issue of December 1957, p. 501.

8. Joseph C. Hammock, Anxiety Scales for Use in Army Training Research, United States Department of the Army Staff Memorandum, Washington, George Washington University Human Resources Research office, June 1954, viii - 33 p.

9. Alfred Castaneda, Boyd R. McCandless and David S. Palermo, "The Children's Form of the Manifest Anxiety Scale", in Child Development, Vol. 27, No. 3, issue of September 1956, p. 317-326.

10. Nissim Levy, "A Short Form of the Children's Manifest Anxiety Scale", in Child Development, Vol. 29, No. 1, issue of March 1958, p. 153-154.

Some investigators have been decidedly sceptical about the validity of the original A-Scale as a measure of drive. Bendig and Vaughan expressed a typical opinion. They wrote that research with Taylor's scale was "dogged by contradictory results [. . .]. The general impression one receives [. . .] is that the relationship between the Manifest Anxiety Scale and learning is, like extrasensory perception (ESP), a delicate flower that blooms only in certain environments."¹¹

The test has also been criticized time and again as of little value for diagnosing anxiety states. This criticism is irrelevant. Neither Taylor nor Spence has ever claimed that the A-Scale has any clinical validity as a diagnostic instrument, nor that it is, or should be, highly related to other psychological or physiological measures of anxiety or emotionality. Taylor¹² welcomed such studies, incidentally, as throwing light on those scoring high and low on the A-Scale, and so yielding information that should broaden the usefulness of drive theory. At the same time,

11. A. W. Bendig and Charles J. Vaughan, "Manifest Anxiety, Discrimination and Transposition", in the American Journal of Psychology, Vol. 70, No. 2, issue of June 1957, p. 286-288.

12. Janet A. Taylor, "The Effects of Anxiety Level and Psychological Stress on Verbal Learning", in the Journal of Abnormal and Social Psychology, Vol. 57, No. 1, issue of July 1958, p. 55-60.

she emphasized the major purpose of the scale--to select subjects for tests of hypotheses generated by drive theory.

More to the point are criticisms aimed at the adequacy of the A-Scale as a measure of drive, and of drive theory itself.

Jessor and Hammond¹³ objected to the use of the scale in studies to validate the theory. Since the usefulness of the A-Scale as a measure of drive depends on its construct validity--the degree to which its properties conform to the nomological network of the drive concept--they argued that failure of data to fulfill predictions derived from the theory in studies where the A-Scale was used to select subjects high and low in drive was confusing, since it could be due either to faults in the theory or to absence of construct validity in the scale. The A-Scale characteristics should have been determined by the properties of drive, and not by a definition of anxiety. Spence¹⁴ found these criticisms to be distorted and mendacious. He insisted that the development of the A-Scale had been guided

13. R. Jessor and R. R. Hammond, "Construct Validity and the Taylor Anxiety Scale", in the Psychological Bulletin, Vol. 54, No. 3, issue of May 1957, p. 161-170.

14. Kenneth A. Spence, "A Theory of Emotionally-based Drive (D) and Its Relation to Performance in Simple Learning Situations", in the American Psychologist, Vol. 13, No. 3, issue of March 1958, p. 131-141.

by hypothetical properties of the drive construct. There were at the time definite theoretical notions about what lay behind differences in drive level, particularly in aversive conditioning. Implications of other parts of drive theory with respect to emotional responsiveness were so well confirmed that the A-Scale would have been abandoned if its use had led to findings that did not support the theory.

Spence¹⁵ has also argued that it is an invalid criticism to say that the A-Scale does not reflect differences in drive level because there is no independent evidence that the test measures emotionality or anxiety. Such a criticism is comparable to saying that differences in the strength of a puff of air directed at the eye do not produce differences in drive strength because there is no direct evidence that a strong puff produces more emotional responsiveness than a weak puff. This particular assumption is tested by deriving implications concerning differences to be expected in other types of learning situations. Confirmation tends to support the assumption that A-Scale scores are related to drive level.

15. Idem, Behavior Theory and Conditioning, New Haven, Yale University Press, 1950, p. 221.

Child¹⁶ suggested that A-scale scores also reflected differences in other dimensions such as differential habit tendencies. Specifically, the relative inefficiency of high A-scale subjects on complex tasks might be due to evocation of task-irrelevant responses. In a test of this interpretation, Taylor¹⁷ compared the performance of high- and low-drive subjects on a simple verbal learning task under neutral and verbal stress conditions. High-drive subjects were superior to low-drive subjects (as predicted from the theory) under both conditions, but both groups showed a significant decrement under stress. In other words, with a relatively simple task, stress and A-scale level affected performance in opposite directions. This was taken as evidence that the A-scale reflected drive level and that stress led to task-irrelevant responses. Had the A-Scale also reflected tendencies to task-irrelevant responses, the high score group would not have been superior to the low score group under neutral conditions, while stress would have aroused more extra-task responses in the high A-Scale group, and so have reduced or even reversed

16. I. I. Child, "Personality", in Paul H. Farnsworth (ed.) and Quinn McDemar (associate ed.), Annual Review of Psychology, Vol. 5, 1954, Palo Alto, California, Annual Reviews Inc., p. 149-171.

17. Janet A. Taylor, 1958, op.cit.

the differences found under neutral conditions.

Early studies with the A-scale conveyed the impression that anxiety, as a component of drive, was "arbitrary", in the sense that it affected the probability of all responses. Spence¹ modified or clarified the role of anxiety, stating that drive is, in part, a function of the magnitude of anxiety conceived as the emotional response to aversive stimulation. It would follow that anxiety contributes to drive level not in all situations, but only in those situations that the subject interprets as in some way threatening. High-drive subjects, as defined by A-scale scores, are said to be relatively responsive to noxious stimulation.

2. The A-scale as conditioning trailer.

The Spence theory of the role of drive states in conditioning and complex learning has received quite satisfactory support in experimental studies. Certainly, one cannot cast this theory aside, as disproven by the evidence, or as less successful in incorporating observed facts than another. The evidence is also quite convincing that the A-scale measures aversive or emotional drive.

18. Kenneth C. Spence, 1958, op.cit.

In the original A-scale study, Taylor¹⁹ hypothesized that subjects high in drive, in terms of A-scale scores, would be conditioned more readily than subjects low in drive. She gave the A-scale to introductory psychology students, some weeks before the conditioning study, taking care to ensure that they did not know why they were tested. The high-drive group of thirty subjects included the top 10 per cent of the score distribution, with scores ranging from 24 to 36. The low-drive group, also of thirty subjects, included the bottom 10 per cent, with scores of 7 or less. The unconditioned stimulus was a puff of air directed at one eye. The conditioning stimulus was an increase in intensity of light from a milk glass window. Subjects were directed to blink on a warning signal ("ready"), a few seconds before the unconditioned stimulus, so as to reduce the possibility of random, spontaneous blinking. Half the subjects in each group were told that the strength of the unconditioned stimulus would increase during conditioning trials and half that it would decrease. In fact, the unconditioned stimulus was of constant strength. The differential instruction did not affect the development of the conditioned response.

19. Janet A. Taylor, "The relationship of anxiety to the Conditioned Eyelid response", in the Journal of Experimental Psychology, Vol. 41, No. 2, issue of February, 1951, p. 81-92.

The prediction from the theory concerning the multiplicative effect of drive strength and habit strength ($L = H \times D$) was borne out. Not only was the median number of conditioned responses significantly greater for the high-drive group in every block of ten trials, but also the difference between high and low groups tended to increase in successive blocks of trials.

Taylor's findings were confirmed by Spence and Farber (1953)²⁰ and by Baron and Connor²¹. They were extended to differential eyelid conditioning by Spence and Farber (1954)²² and Spence and Leecroft²³. The relationship between drive level, measured by the electrodermal response, and ease of conditioning persisted with changes in the strength of the

20. Kenneth G. Spence and I. J. Farber, "Conditioning and Extinction as a Function of Anxiety", in the Journal of Experimental Psychology, Vol. 45, No. 2, issue of February 1953, p. 110-119.

21. Martin L. Baron and James G. Connor, "Eyelid Conditioning Responses with Various Levels of Anxiety", in the Journal of Experimental Psychology, Vol. 60, No. 5, issue of November 1960, p. 310-315.

22. Kenneth G. Spence and I. J. Taylor, "The Relation of Anxiety to Differential Eyelid Conditioning", in the Journal of Experimental Psychology, Vol. 47, No. 1, issue of February 1954, p. 127-134.

23. Kenneth G. Spence and I. J. Taylor, "Differential Conditioning and Level of Anxiety", in the Journal of Experimental Psychology, Vol. 48, No. 5, issue of November 1954, p. 399-403.

unconditioned stimulus²⁴. When subjects who had not been given the A-scale were divided randomly into two groups, the amount of conditioning was a function of the strength of the air puff²⁵.

Hilgard, Jones and Kaplan²⁶ were unable to replicate the differential conditioning study findings. Spence²⁷ noted that they used only twenty subjects, divided into two groups on the basis of A-scale scores after conditioning. The great variability of individual conditioning could account for the failure to find an effect of drive on learning when such small groups were used.

Bindra, Paterson and Strzelecki²⁸ used the A-scale to select subjects for a study in which the conditioning

24. Kenneth W. Spence and Janet Taylor, "Anxiety and Strength of UCS as Determiners of the Amount of Pavlovian Conditioning", in the Journal of Experimental Psychology, Vol. 42, No. 3, issue of September 1951, p. 183-188.

25. Kenneth W. Spence, "Learning and Performance in Pavlovian Conditioning as a Function of Intensity of UCS", in the Journal of Experimental Psychology, Vol. 45, No. 1, issue of January 1953, p. 57-63.

26. Ernest H. Hilgard, Cyril V. Jones and Sylvia J. Kaplan, "Conditioned Discrimination as Related to Anxiety", in the Journal of Experimental Psychology, vol. 42, No. 2, issue of August 1951, p. 94-99.

27. Kenneth W. Spence, 1956, op.cit. p. 183.

28. Balbir Bindra, Alan L. Paterson and Joanna Strzelecki, "On the Relation Between Anxiety and Conditioning", in the Canadian Journal of Psychology, Vol. 7, No. 1, issue of March 1955, p. 1-6.

stimulus was a door bell, the unconditioned stimulus a lollipop on a stick, and the unconditioned response salivation, measured by increase in weight of a cotton roll held in the mouth. There were no systematic differences between high- and low-drive groups in either acquisition or extinction of the conditioned response. This study lends support to the argument that anxiety does not contribute to drive level in a situation that the subject does not interpret as threatening.

The warning signal used by Spence, Taylor and their co-workers has been criticized as itself likely to affect the outcome of conditioning studies. Caldwell and Cromwell²⁹, replicating a study by Spence, Farber and Taylor³⁰, supported the relationship between A-Scale scores and conditioning. However, they suspected that the warning signal gave subjects a cue to expect the onset of the conditioning stimulus, and so increased the likelihood of a voluntary response, to avoid the airpuff. Some of their subjects confirmed their suspicions, on questioning.

29. Donald F. Caldwell and Hue L. Cromwell, "Replication Report: The Relationship of Manifest Anxiety and Electric Shock to Eyelid Conditioning", in the Journal of Experimental Psychology, Vol. 57, No. 5, issue of May 1959, p. 348-349.

30. Kenneth W. Spence, I. E. Farber and Elaine Taylor, "The Relation of Electric Shock and Anxiety to Level of Performance in Eyelid Conditioning", in the Journal of Experimental Psychology, Vol. 48, No. 5, issue of November 1954, p. 404-408.

Prokasy and Truax³¹ did not use a warning signal. They suggested that high-drive subjects reacted more than low-drive subjects to the warning of the imminent onset of the noxious stimulus, with a consequent increment to drive strength and so to conditioning scores. Spence and Keynant³², however, did not use a warning signal when they conditioned subjects high and low on the A-Scale to press a telegraph key when a tone sounded, but to ignore a visual signal. There was a significant difference in the predicted direction between high- and low-drive groups in the amount of conditioning.

King et al.³³ conditioned subjects both with and without the warning signal, and found no difference between drive groups without the signal, and a tendency for low-drive subjects to condition more readily than high-drive subjects with the signal, contrary to earlier studies.

31. William F. Prokasy Jr. and Charles A. Truax, "Reflex and Conditioned Responses as a Function of Manifest Anxiety", in the American Journal of Psychology, Vol. 72, No. 2, issue of June 1959, p. 262-264.

32. Kenneth W. Spence and Robert G. Keynant, "Conditioning Preference of High- and Low-anxious Ss in the Absence of a Warning Signal", in the Journal of Experimental Psychology, Vol. 60, No. 3, issue of September 1960, p. 146-149.

33. Margaret C. King, Gregory A. Gimble, John Gorman, and Richard A. King, "Replication Report: Two Failures to Reproduce Effects of Anxiety on Eyelid Conditioning", in the Journal of Experimental Psychology, Vol. 62, No. 5, issue of November 1961, p. 532-533.

Prokasy and Whaley³⁴ carried out a similar study. Their findings disagreed with a conclusion of Spence and Heynant³⁵, in that the warning signal depressed rather than elevated the overall level of responding, while, in the absence of the signal, there was no significant difference between drive groups.

The issue has yet to be resolved, since experimental findings are contradictory.

3. The A-Scale in Serial-Learning Studies.

Spence and his associates have used serial learning and paired-associates tasks in tests of predictions from drive theory about learning in complex situations. The requirement is for a task that would produce strongly competing responses, and serial learning was chosen initially because it was known to result in perseverative and anticipatory tendencies.

Taylor and Spence³⁶ used a verbal maze which presented subjects high and low on the A-scale with a series of twenty

34. William F. Prokasy Jr. and Francis J. Whaley, "Manifest Anxiety Scale scores and the warning signal in Classical Conditioning", in the Journal of Experimental Psychology, Vol. 63, No. 2, issue of February 1962, p. 119-123.

35. Kenneth S. Spence and Robert C. Heynant, op.cit.

36. Janet A. Taylor and Kenneth S. Spence, "The relationship of Anxiety Level to Performance in Serial Learning", in the Journal of Experimental Psychology, Vol. 44, No. 1, issue of August 1952, p. 61-64.

choices between two verbal responses. Results agreed with the predictions from the theory about the relative superiority of low-drive subjects in complex learning. Hughes, Sprague and Lendig³⁷ were unable to replicate the finding, perhaps because they used a four- instead of a two-second rate of presentation. Decreasing the rate of presentation might have facilitated discrimination of incorrect responses.

Farber and Spence³⁸ found high-drive subjects inferior to low-drive subjects on another serial task--a stylus maze--with the greatest difference at the most difficult choice points. Axelrod, Cowen and Heilizer³⁹ replicated the study, but found no significant differences between high- and low-drive groups.

Montague⁴⁰ found high drive subjects superior in serial anticipation of an easy list of nonsense syllables

37. J. B. Hughes II, J. I. Sprague and A. W. Lendig, "Anxiety Level, Response Alternation and Performance in Serial Learning", in the Journal of Psychology, Vol. 38, Second Half, issue of October 1954, p. 421-426.

38. I. E. Farber and Kenneth W. Spence, "Complex Learning and Conditioning as a Function of Anxiety", in the Journal of Experimental Psychology, vol. 35, No. 2, issue of February 1956, p. 120-125.

39. Howard S. Axelrod, Maury L. Cowen and Fred Heilizer, "The Correlates of Manifest Anxiety in Stylus Maze Learning", in the Journal of Experimental Psychology, Vol. 51, No. 2, issue of February 1956, p. 131-136.

40. Ernest K. Montague, "The Role of Anxiety in Serial Note Learning", in the Journal of Experimental Psychology, Vol. 45, No. 2, issue of February 1953, p. 91-96.

and inferior on a difficult list, which accords with predictions from the theory. "Difficulty" was defined in terms of association value and intra-list similarity. Nicholson⁴¹ failed to replicate Montague's results, but Sidowski and Mason⁴², like Montague, found high-drive subjects superior to low-drive subjects in serial anticipation of an easy list of nonsense syllables. Kalish et al.⁴³ found no significant differences between drive groups in learning a hard list under a non-stress condition.

Saltz and Hoehn⁴⁴ contended that Spence and others had confused the difficulty level of learning material with response competition. If so, task difficulty and not response competition might be the significant factor in the lack of success of high-drive subjects on complex material.

41. William M. Nicholson, "The Influence of Anxiety Upon Learning: Interference or Drive Increment?", in the Journal of Personality, Vol. 26, No. 3, issue of September 1958, p. 303-319.

42. Joseph L. Sidowski and Robert C. Mason, "Drive, Verbal Performance, and Muscle Action Potential", in the Journal of Experimental Psychology, Vol. 60, No. 6, issue of December 1960, p. 365-370.

43. H. I. Kalish, N. Garnezy, G. L. Rodnick and H.C. Bleke, "The Effects of Anxiety and Experimentally-Induced Stress on Verbal Learning", in the Journal of General Psychology, Vol. 59, First Half, issue of July 1958, p. 77-95.

44. Eli Saltz and Arthur J. Hoehn, "A Test of the Taylor-Spence Theory of Anxiety", in the Journal of Abnormal and Social Psychology, Vol. 51, No. 1, issue of 1956, p. 114-117.

They developed lists of nonsense syllables that were equally difficult for low-drive groups in terms of trials to criterion, although the lists differed markedly in association values and intra-list competition. High-drive subjects did no worse than low-drive subjects on easy lists with strong response competition, but were much less successful than low-drive subjects on difficult lists with no response competition. Taylor⁴⁵ noted that Galtz and Hoehn had apparently used intellectually heterogeneous subjects, and so had not controlled a factor known to be related to task difficulty. She also disagreed with their interpretation of the data.

4. The R-Scale in Paired-Associates Studies.

Spence⁴⁶ eventually concluded that serial tasks were unsatisfactory for testing hypotheses respecting inter-response competition because there was no way of manipulating the relative strength of competition associated with each response. He recommended an appropriate paired-associate learning, which presents subjects with the task of forming more or less isolated stimulus-response associations. One can manipulate stimulus-response units so that competition between units is maximized or minimized.

45. Janet A. Taylor, 1958, op.cit.

46. Kenneth W. Spence, 1958, op.cit.

Taylor and Chapman⁴⁷ demonstrated the superiority of high-drive subjects in a simple paired-associate learning task. Spence, Farber and McFann⁴⁸ confirmed this finding, using paired adjectives instead of paired nonsense syllables. They also found low-drive subjects superior in learning competitive paired-associate lists. Studies by Ramond⁴⁹, by Spence, Taylor and Ketchel⁵⁰, by Standish and Champion⁵¹, and by Besch⁵² in general supported predictions from drive theory respecting the interaction of response competition

47. Janet A. Taylor and Jean P. Chapman, "Anxiety and the Learning of Paired-Associates", in the American Journal of Psychology, Vol. 68, No. 4, issue of December 1955, p. 671.

48. K. W. Spence, J. B. Farber and H. H. McFann, "The Relation of Anxiety (Drive) Level to Performance in Competitive and Non-Competitive Paired-Associates Learning", in the Journal of Experimental Psychology, Vol. 52, No. 5, issue of November 1956, p. 296-305.

49. C. K. Ramond, "Anxiety and Task as Determiners of Verbal Response", in the Journal of Experimental Psychology, Vol. 46, No. 2, issue of August 1953, p. 120-121.

50. Kenneth W. Spence, John Taylor and Rhoda Ketchel, "Anxiety (Drive Level) and Degree of Competition in Paired-Associates Learning", in the Journal of Experimental Psychology, Vol. 52, No. 5, issue of November 1956, p. 306-310.

51. K. W. Standish and R. A. Champion, "Task Difficulty and Drive in Verbal Learning", in the Journal of Experimental Psychology, Vol. 59, No. 6, issue of June 1960, p. 361-365.

52. Norma Fredenburg Besch, "Paired-associates Learning as a Function of Anxiety Level and Shock", in the Journal of Personality, Vol. 27, No. 1, issue of March 1957, p. 116-124.

and drive strength, defined by S-Scale scores, in paired-associate learning. Korchin and Levine⁵³ found high-drive subjects inferior on difficult paired-associate false equations, but there were no significant differences between groups on an easy paired-associate task.

A study by Heilizer, Axelrod and Cowen⁵⁴ did not support the theory. However, they did not reject subjects with S-Scale scores above 7, which is customary in studies by Spence and his associates. They used self-descriptive adjectives as stimuli and nonsense syllables as responses, and did not control response tendency competition. Half the stimulus words were emotionally charged, a condition which may have interacted with sex and experimenter variables to confound results.

Levitt and Goss⁵⁵ suggested that a procedural technique they used might have raised the anxiety of both

53. Sheldon J. Korchin and Seymour Levine, "Anxiety and Verbal Learning", in the Journal of Abnormal and Social Psychology, Vol. 54, No. 2, issue of March 1957, p. 331-341.

54. Fred Heilizer, Howard C. Axelrod and Harry S. Cowen, "The Correlates of Manifest Anxiety in Paired-Associate Learning", in the Journal of Personality, Vol. 24, No. 4, issue of June 1956, p. 463-474.

55. Herbert Levitt and Albert D. Goss, "Stimulus Attributes and Drive in Paired-Associate Learning", in the Journal of Experimental Psychology, Vol. 62, No. 3, issue of September 1961, p. 243-252.

their drive groups to the same level, and so interfered with the drive effect. Studies by d'Abate⁵⁶ and Harleston and Cunningham⁵⁷ on the effect of manipulating the association values of paired syllables did not conform to drive theory restrictions for construction of competitive and non-competitive lists. Buchwald⁵⁸ found low-drive subjects superior in learned synonymous adjective pairs, contrary to theory predictions, but questioned whether his task material was appropriate for testing the theory, because of evidence from word association studies that the common responses to adjectives are often antonyms, and not synonyms.

Most of the studies of drive and verbal learning have used nonsense syllables and adjectives drawn from lists for which normative data as to association values were available. When paired-associates are made up on the basis of normative data, their pre-task habit strengths are

56. Luciano d'Abate, "Manifest Anxiety and the Learning of Syllables with Different Associative Values", in the American Journal of Psychology, Vol. 72, No. 1, issue of March 1959, p. 107-110.

57. Bernard W. Harleston and Scott L. Cunningham, "Task Difficulty and Anxiety Level as Factors Affecting Performance in a Verbal Learning Situation", in the Journal of Psychology, Vol. 52, First Half, issue of July 1961, p. 77-80.

58. Alexander L. Buchwald, "Manifest Anxiety Level, Verbal Response-Strength and Paired-Associate Learning" in the American Journal of Psychology, Vol. 72, No. 1, issue of March 1959, p. 89-93.

assumed to be roughly defined. Trapp and Klausler⁵⁹ noted that in such studies, it is assumed that the degree of task difficulty or competition is independent of drive measured by the A-scale. They found a significant relationship between A-Scale scores and association values of nonsense syllables, and concluded that one could question the methodology of studies controlling task difficulty in terms of association values.

Lee⁶⁰ gave her subjects one presentation and four initial trials on fifteen stimulus-response subjective pairs. She reasoned that this procedure would establish relatively precise pre-task habit strengths for each subject. After learning trials followed, on a "transfer list" made up of five pairs from the original list, five completely new pairs, and five pairs made by randomly pairing stimulus words with response words from the original list. Half of each group of subjects--high A-scale and low A-scale--learned the transfer list with a brief shock between trials, and the

59. E. Philip Trapp and Donald L. Klausler, "Relationship between A-Scale Scores and Association Values of Nonsense Syllables", in the Journal of Experimental Psychology, Vol. 59, No. 4, issue of April 1960, p. 215-217.

60. Lee Charlotte Lee, "The Effects of Anxiety Level and Shock on a Paired-Associate Verbal List", in the Journal of Experimental Psychology, Vol. 61, No. 2, issue of March 1961, p. 213-217.

rest learned it without shock. High drive, whether defined by shock or by the A-scale, facilitated performance when the dominant response was correct, and impaired performance when it was incorrect. In this study, differences between drive groups on a paired-associate task persisted even when action was taken to control relationship between association value and drive.

5. Conclusions.

The purpose of this review of a small part of the A-scale literature has been to study the claim that the A-scale is a satisfactory measure of drive, for use in studies on conditioning and learning. One thing that is clear is that subjects with high scores differ in some fundamental way from subjects with low scores. The difference is not large; the correlations between A-scale scores and conditioning rarely exceed .25. Not all of the studies have yielded results at an acceptable level of significance, but many of the findings have been in the direction predicted from drive theory. Where results have not supported the theory, it has usually been possible to find an explanation in some feature of the research design. The relationship between drive level and learning seems to be exceedingly complex, and apparently minor departures from the boundary conditions of the theory are enough to produce unexpected results.

However, the evidence suggests that it is reasonable to argue that what the A-Scale measures typically behaves very much as does the drive variable in the Hull-Spence theory, when the research design, including task material, is appropriate for testing the theory. In short, the A-Scale is judged to be a satisfactory measure of the drive construct.

A number of investigators have suggested other explanations for the relationship between A-Scale scores and learning scores. In so doing, they have set up alternate hypotheses, but they have not thereby refuted the theory of emotionally-based drive.

This is not to say that drive theory is "correct". (Hill⁶¹, for example, has questioned whether drive theory, as expressed by Spence, actually yielded the predictions said to be generated by it.) It does not (and it is not intended to) encompass all of the available empirical findings about the relationship between motivation and learning. It is possible that the theory may have to be modified to account for inconsistent findings in studies of the effect of A-Scale defined drive on reaction time and stimulus generalization, and the effect of food deprivation, muscular

61. Winfred F. Hill, "Comments on Taylor's 'Drive Theory and Manifest Anxiety'", in the Psychological Bulletin, Vol. 54, No. 6, issue of November 1957, p. 490-495.

tension and experimentally induced stress on learning. But, within certain boundary conditions, the theory and the findings are in general agreement. The requirement is to extend the boundaries bit by bit, modifying the theory as the facts dictate. It is certainly not enough to set up an alternate theory that does not find room for the studies of the interaction of habit strength and of drive strength, as measured by the A-Scale, in eyelid conditioning and paired associate learning.

APPENDIX 2

RELATIONS BETWEEN THE A-SCALE AND THE MPI.

The Maudsley Personality Inventory (MPI) was developed by H. J. Lysenck as a measure, on the verbal level, of two relatively independent dimensions of personality, identified by him both in a review of the literature to 1953 of objective personality research and in his own factor analytic studies. The two dimensions are Introversion - Extraversion (IE) and Neuroticism (N). Jensen¹ described the MPI, and reported on most of the normative data, in 1958.

The MPI was given at the same time as the A-Scale to two Carleton University introductory psychology classes from which subjects were selected for the incidental learning study described in this thesis. In this appendix, A-Scale results are compared with those reported by Taylor², and relations between the A-Scale and the MPI are compared with data summarized by Jensen.

Statistics reported by Taylor for 1971 introductory psychology students tested at the State University of Iowa

1. Arthur R. Jensen, "The Maudsley Personality Inventory", in Acta Psychologica, Vol. 14, No. 4, 1958, p. 314-325.

2. Janet A. Taylor, "A Personality Scale of Manifest Anxiety", in the Journal of Abnormal and Social Psychology, Vol. 48, No. 2, issue of April 1953, p. 285-290.

between September 1948 and June 1951 are shown in Table IV, together with comparable statistics for the original University sample of 169 students. The American sample was tested with the original version, including twenty-eight items that were later revised. Canadian sample scores are higher than those of the American sample, for reasons that are not immediately obvious. Taylor stated that the quartiles of distributions of A-scale scores of 68, airmen beginning basic training at Oakland Airforce Base and 201 Northwestern University night school students in introductory psychology closely agreed with those of the original normative sample. She also reported that quartiles of the distribution of scores of 229 introductory psychology students, tested with the revised A-scale, did not differ significantly from those of the normative sample, and she gave the mean of this sample of 229 cases as 14.94.

There is some evidence that distributions of A-scale scores for university students are not as stable as Taylor's figures might suggest. For example, 75% of a distribution of students, from among whom Spence and Taylor selected subjects for a study of eyelid conditioning, was 11, and 25%

3. G. W. Spence and Janet Taylor, "Anxiety and strength of the UCS as determinants of the amount of eyelid conditioning", in the Journal of Experimental Psychology, Vol. 42, no. 2, issue of September 1951, p. 181-188.

Table IV.

Means and Certain Percentiles of a-Scale Distributions of
 American University Student Normative Sample (N:1971) and
 Carleton University Sample (N:175)

Statistic	Samples	
	American	Canadian
p.20	7	11
p.50	13	17
p.80	21	25
Mean	14.50	16.27

was 24. The corresponding scores in the Carleton University distribution were 11 and 25. In a serial learning study, Taylor and Spence⁴ reported p. 15 as 11 and p. 85 as 25.

In Table VI are shown means, standard deviations and intercorrelations of the I₁ and I₂ scales of the I₁I₂ for three mixed university samples, one American⁵, one British⁶, and one Canadian, the third being the 169 Carleton University students.

Differences among I₁ means are not statistically significant at the .05 level of confidence. The I₁ mean for the American sample is significantly lower than those of the British sample ($t = 3.68$) and the Canadian sample ($t = 4.18$).

Lord⁷ reported a correlation of $-.05$ between I₁ and the A-scale for his sample of 254 American university students. The corresponding coefficient for the Carleton University sample was $-.06$. The correlation between I₁ and the A-scale reported by Bendig was $.77$, and the corresponding statistic

4. Janet A. Taylor and Kenneth J. Spence, "The relationship of anxiety level to performance in serial learning", in the Journal of Experimental Psychology, vol. 44, no. 7, issue of August 1952, p. 61-64.

5. A. S. Bendig, personal communication, reported in Arthur L. Jensen, op.cit.

6. Emer. Wreadwell, personal communication, reported in Arthur L. Jensen, op.cit.

7. A. S. Bendig, "Extraversion, 'curticles', and manifest anxiety", in the Journal of Consulting Psychology, Vol. 21, no. 5, issue of October 1957, p. 324.

Table XVI

Means, Standard Deviations, and Intercorrelations of IE and
N Scales of MPI for Three Samples of University Students

Sample	IE		N		Intercorrelations
	Mean	S.D.	Mean	S.D.	
American (N:145)	27.6	7.6	21.0	9.7	-.20
English (N:64)	25.2	10.2	26.8	9.3	-
Canadian (N:169)	26.0	9.9	26.3	10.0	-.24

for the Canadian sample was .71. Differences between American and Canadian coefficients of correlation between the same series are not significant at the .05 level. All four coefficients are significantly different from zero beyond the .01 level.

APPENDIX 3

THE IDENTIFICATION TASK

Cross out any of the following words and consonant syllables
which you noticed while you were learning
the paired associates

wig	gen	rka	pot	neb	can	jim	thn
thx	pen	gap	npt	dtf	war	thm	bkd
car	job	drt	hlp	nbr	rsl	pnt	arz
vim	sap	wad	cup	bkn	leg	mpx	vet
sun	sob	lug	okg	sin	wit	hlt	prc
okp	rfd	fns	vat	fls	van	drl	ngr
fun	jam	gas	npl	lip	tyx	hos	mra
jar	rgd	log	fnd	fps	atr	cub	pot

NAME _____

RD LD

APPENDIX 4

ABSTRACT OF

The Effects of Drive, Task Difficulty and Orienting Procedure on Incidental Learning¹

The purpose of this experiment was to study the effect on incidental learning of varying drive, defined in terms of scores on the Taylor Manifest Anxiety Scale (A-Scale), incidental and intentional task difficulty, and the nature of the orienting task. The experiment provided, in addition, data on the effect of the independent variables on intentional learning, and on the effect of cue position on incidental learning.

Subjects were university students in introductory psychology. High- and low-drive extreme groups were matched for sex composition, with twenty-five subjects in each group.

Task difficulty was varied in terms of pre-experiment familiarity, or habit strength. Eight hard and eight easy verbal trigrams constituted the incidental task. Eight hard and eight easy intentional task paired-associates were matched for stimulus difficulty, but differed as to response difficulty.

1. Alfred Bryan Laver, doctoral thesis presented to the School of Psychology and Education of the University of Ottawa, Ontario, in October, 1962, xiv - 209 p.

Under one orienting condition, subjects spelled incidental stimuli aloud. Under the other, they were not instructed to do anything with incidental stimuli.

Within drive groups, task and procedural conditions were counterbalanced, so that there were two incidental items for each of eight task and procedural combinations of conditions. There were thirty learning trials.

The analysis of variance design used in investigating the effect of experimental variables on incidental learning involved replication degeneracy, because of the inclusion of the organismic variable, drive.

There were no statistically significant differences between drive groups in retention of incidental items, nor did drive interact with other variables. This finding was attributed in part to interaction between intentional and incidental task difficulty, with the result that the incidental lists did not conform to a boundary condition of Spence's drive theory, and in part to individual differences in pre-experiment incidental item habit strengths, which would obscure drive effects. An experiment to control the latter factor was suggested.

A third explanation, applicable to the "spelled aloud" condition only, was in terms of a cue position

ly synthesis, to the effect that an increase in drive, which ordinarily reduces utilization of peripheral cues, is offset by a requirement to make differential responses to incidental items, which bring them within the reduced perceptual range of high-drive subjects. This explanation did not account for findings under the "not spelled aloud" condition.

It was suggested, as the most satisfactory explanation, that, the richer the mediation network that gives meaning to a verbal incidental stimulus, the more likely it is that the stimulus will arouse a mediating response, leading to recognition and, on subsequent trials, to acquisition.

An experiment was recommended to study the interaction of drive and incidental cue position.

The high-drive group marked significantly more items on the incidental learning retention task than the low-drive group. The difference, almost entirely a function of the number of errors, was attributed to the possibility that the retention task was itself a noxious stimulus, which affected drive groups differentially.

The effect of incidental learning of competition from the intentional task was greater with hard than with easy paired-associates, whether or no subjects spelled incidental items aloud.

Retention of incidental items was lowest for easy incidental items and highest for intentional paired-associates. Differences in retention over the other three task difficulty combinations were not significant. Findings were not in accordance with predictions from analysis of task competition effects, but were explicable with the facilitation hypothesis. It is suggested that incidental learning was more affected by individual differences in monitoring responses than on task difficulty.

The requirement to perform the task itself allowed facilitated incidental learning but inhibited intentional learning.

Retention learning, acquisition curves for drive theory were not in accordance with predictions from the drive theory, perhaps because no attempt was made to ensure strong pre-experimental associative connections between stimulus and response. An experiment was suggested to verify the assumption that lack of interest is likely to not be sufficient condition for performance decrements. In drive theory, performance is predicted to be less readily than on a pair.