THE EFFECTS OF BLINDS AND FREQUENCY IN LATENT LEARNING

By

Philip Keister Jensen

AN ABSTRACT

Submitted to the School for Advanced Graduate Studies of Michigan State University of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

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ABSTRACT

A group of three experiments was run to test the elicitation theory explanation of latent learning. This explanation depends on two factors, avoidance of blind alleys due to stimulus satiation, and frequency, or sheer numerical predominance of true path experience. In Study I with an N of 21 the Buxton-Haney type of experiment was duplicated. The maze was converted to a six unit multiple Y maze. After periods of handling and acclimation which were identical the animals were divided into control and experimental groups. The control animals were left in the acclimation maze while the experimental group explored the test maze for a total of six hours on two days. In a series of sixteen test trials run on four days the experimental animals demonstrated latent learning after the introduction of food. The difference was at the 1% level of confidence as measured by the White T or T' non-parametric test. In Study II with an N of 21 the effects of the blinds were eliminated by restricting the training and exploration mazes to single paths with no culs. Otherwise the identical procedures were maintained. No differences were found between the groups. Study III with an N of 30 again used identical procedures but this time the maze was in a free condition with Y type choice points but with no blinds or true paths and thus with neither of the two elicitation theory factors operative. In the test trials no difference was found between the

experimental and control groups. Some evidence of an early interference in the experimental animals was found. This was easily explainable only in terms of elicitation theory. On the basis of these results the following conclusions were reached:

1) Study I presents difficulties for a reinforcement explanation while satisfying either cognitive or elicitation theory.

2) Study II, while not clear in its design, indicates that frequency is a minor factor when compared to the satiation controlled avoidance of blinds. This study offers no difficulties for elicitation theory, while not fitting into either cognitive or reinforcement frameworks.

3) Study III presents difficulties for a cognitive explanation while satisfying either reinforcement or elicitation theory.

4) Elicitation theory appears to date as the most satisfactory and useful theoretical framework.

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Dedication

First to Dr. M. R. Denny, without whose theoretical framework and constant assistance, this experiment would never have existed. Second to Dr. Dietze, Dr. Johnson, and Dr. Rokeach for their consideration and aid in the last four years.

CONTENTS

TABLES

FIGURES

THE EFFECTS OF BLINDS AND FREQUENCY IN LATENT LEARNING

Introduction

Since 1929 one of the major fields of controversy in the field of learning theory has centered around the so-called latent learning studies. In 1951 Thistlethwaite (35) in his review of this area listed seventy-six references. Since then at least thirty more studies have been published. Unfortunately the limits of this group of studies are rather nebulous and the interrelations between them are often far from obvious. The term latent-learning has come to cover a large and heterogenous area.

Blodgett (2) in his original study was the first to use the name latent learning. He intended it to apply to any learning which might occur without being manifest in performance. The question which he attempted to answer was whether performance could be tied to learning as tightly as the Watson type behaviorists appeared to imply. Since that time the Reynold's (26) repetition of Blodgett has shown that the learning in this type of study is reflected in improved performance. The animals learn to avoid the blinds within short periods, as little as fifteen minutes (35). By the time the test trials are run the lack of use of the blinds is an established part of the animals performance. In more recent years the emphasis has changed to the presence or absence of reinforcement as a necessary factor in learning. The question of the presense of learning without a change in overt behavior has come to

be of secondary importance. As a result the term latent learning has come to cover nearly any study designed to demonstrate learning without obvious reward or reinforcement. Since the idea of reinforcement or drive reduction is central to many theorists including Hull, these studies have come to take the form of either a disproof of reinforcement theory or a refutation of previously demonstrated experiments.

One of the attempts to systematize these studies is that of Thistlethwaite. He list four major types of experiments in this field.

1) The Blodgett type. The animal is given a number of unrewarded trials in the maze. A goal object is then introduced and the test trials are run. (13, 23, 26, 39, 40).
2) Buxton-Haney type. The animal is permitted to explore the maze for a given period of time. A goal object is then introduced and the test trials are run (3, 5, 12, 16, 20, 21, 28).
3) The animal is first satiated, then given a series of trials in a maze in which a relevant goal object is present. The rat is then put under the relevant drive and the test trials are run (17, 31, 34, 36).
4) Either hungry or thirsty animals are given a series of trials in a maze in which an irrelevant goal object is present. The drive is then reversed and a series of test trials are run for the formerly irrelevant but now relevant goal (4, 11, 21, 32, 33).

A close inspection of these varieties and their crossed offspring shows that they include a large field. Any attempt at a full treatment of all of the variations which would be necessary to a complete understanding of this area would be a tremendous undertaking.

Types I and II are in nature considerably simpler than types III and IV. In the latter the final goal object is present at all times and an irrelevant drive is introduced into the experimental design. The degree of additional complication this introduces is seen in the highly contradictory and as yet unsystematized results which have been produced by these types of studies (4, 11, 17, 31, 32, 34, 36).

The results in studies of types I and II, on the other hand, show at least some degree of conformity, notwithstanding a few dissenting voices (23, 26). In general the results obtained seem to agree that if the animals are permitted to familiarize themselves with the maze, either by free exploration or by a series of forced trials, they will make fewer errors in the test trials than the control animals who have never seen the maze (3, 12).

Type I studies however have an inherent weakness of design which renders them more difficult of interpretation than type II experiments. Since in the type I studies the animals are run through a series of trials in the true maze prior to reward, it is impossible to establish adequate controls for them. Normal procedure is to avoid control groups and instead use a series of groups of animals with differing numbers of prereward trials.

It will be seen that this technique leaves differences in results as possibly due to many different factors such as degree of maze experience or difference in drive level. If the animals, in what could be called the control group, are rewarded from the very first trial there is the large difference in maze familiarity, drive levels, and handling at the point of comparison with the experimental animals. This cannot be overcome by merely leaving the controls in a simple maze type enclosure for the appropriate length of time. The difference would then be that of progress through a maze, versus the limited movement necessitated by the control apparatus. Likewise the controls cannot be run for an equivalent series of trials in a different maze since this would produce interference which could vitiate any positive results. This criticism is not as applicable to the type II study since the controls can be given a period of exploration of the correct length. The type I study necessitates some method of duplicating the experience of being run through a maze without retracing. The type II only needs free exploration, which can be simply arranged for the controls.

Type II studies then are the most open to satisfactory interpretation. It is interesting to note that this is paralleled by the consistency of their results (3, 5, 12).

The central significance of the latent learning studies in modern learning theory is reflected by the number of explanations which attempt to cover the available data. These explanations tend to fall into three groups: first, those of the S-R theorists

such as Hull, Spence, and Meehl and MacCorquodale; second, those of the cognitive theorists typified by Tolman and Thistlethwaite; third, the explanations based primarily on contiguity of which Guthrie and elicitation theory (6) are examples. There are of course other approaches such as those of Wolpe (41) with his physiological orientation and Seward, who, despite his S-R leanings, invokes the central mechanism of surrogate response (27). We shall concern ourselves with the three major groups.

Meehl and MacCorquodale present the most satisfactory of the explanations of the S-R reinforcement theorists. They propose this hypothesis:

"In the prereward trials the response of taking the correct path at a choice point builds up a slightly greater habit strength than that of turning into a blind alley. On the critical trial when a rat finds food in the goal box, a food drive is conditioned to maze cues. The next time the animal is put back in the maze this secondary drive is activated along with the primary hunger drive. When multiplied by the degree of habit strength already existing, it thus increases the difference in reaction potential between the two responses. The result is an abrupt fall in the number of errors." (29)

Their position then depends primarily upon a differentiation of response before the introduction of food, and secondarily upon the rat not having been exposed to food previously in the maze or a highly similar setting.

Tolman, as the originator of the theoretical framework within

which the latent learning studies were run, offers this viewpoint. As the rat progresses through the maze a cognitive map is built up. A series of expectancies are established on the basis of place learning of what leads to what. When reward is introduced the animal utilizes these expectancies in such a manner as to progress through the maze and reach the goal object with a minimum of effort.

The third group of theories offers two differing explanations. First, Guthrie while never directing himself to the area in question would apparently predict that non-rewarded animals would perform as well as rewarded animals in a Blodgett type study. Since the animals leave each section on a correct response, the final chain of appropriate responses should build up rapidly in both groups. For Guthrie the reward serves merely as a final removal from a stimulus situation. In this case, Blodgett type, the animals are all removed from the situations by doors which prevent retracing, thus the presence or absence of reward should be entirely irrelevant. This is not the case. With the introduction of reward, marked differences appear in the performance, contrary to Guthrie's predictions.

Secondly, in elicitation theory we find another form of contiguity theory. It may be briefly condensed as follows.

Definitions:

MOE--any manipulable and observable aspect of the universe.

Stimulus--an abstraction referring to the relationship of a given MOE to a MOE_2 (aspect of behavior), such that an elimination of a specified portion of the efferent nervous

system will eliminate MOE_2.

Response--a class of MOE_2s for a class of organisms.

Elicitation--a relationship between stimulus and response, which occurs whenever a class of stimuli immeadiately precedes a response class.

Postulates:

Satiation--With continued or repeated presentation all stimuli lose or partially lose the property of eliciting responses as a decay function of the duration or frequency of presentation.

Acquisition--Any stimulus which closely precedes in time any response acquires an increment to its ability to elicit this response.

Stimulus Generalization--This is the transfer of response tendency from one stimulus to another.

In the complete system as presented in the unpublished paper, "Elicitation Theory II: The Formal Theory and Its Applications to Instrumental Escape and Avoidance Conditioning" by M.R. Denny and H.M. Adelman, there are ten definitions and four postulates. The above constitutes the core of the system.

Elicitation theory presents an explanation for both types I and II based on its postulates of satiation and acquisition. The apparent learning produced in latent learning studies is not due to cognitive structuring. Rather the cues of the blinds because of the temporary confining of the animal become satiated, which

produces in the animal an apparent tendency to avoid them. Likewise the cues of the changing true path come to elicit approach responses even when the animal is retreating from the blinds. In the exploratory period the rat is learning to avoid the confining choice of the blinds as was suggested by Reynolds and Meehl and MacCorquodale (23). At the same time a second factor which may be operative is frequency. The standard multiple unit maze is constructed in such a manner as to force the rat, whether in trials or free exploration, to spend more time responding to the cues of the true path than to the blinds. Avoidance responses are being acquired to the blinds at the same time that approach responses are being conditioned to the true path. With the introduction of reward the various approach responses to the true path rapidly chain backward producing the apparent difference between experimental and control animals. To test this interpretation of latent learning the following study was designed.

Subjects

The animals used in this experiment were 77 rats. These were mixed between albino, N 42, and hooded, N 35, strains. Both males, N 40, and females, N 37, between the ages of 90 and 150 days were used. The animals were systematically assigned to each of the six groups in such a manner that age, sex, and breed were as evenly distributed as possible.

Apparatus

Two mazes were constructed for this study. See Figure I. Both of these were constructed with the floor and walls made of unpainted wood and the top covered with half inch hardware cloth. The floors of both mazes were single sheets of half inch plywood. The six inch walls consisted of half inch boards. Each straight stretch of the mazes had the top hinged separately so that any section could be opened independently for easy access to the animal for either insertion or removal. It will be noted that each of the mazes has the appearnace of a series of hexagons, in the larger maze seven, in the smaller maze two. A series of blocks were constructed which could be inserted into the alleys at any of the points marked in Figure I. These blocks were of unpainted wood and so arranged as to present a flat surface to the rats. The mazes were constructed with no specific starting box or goal box. The animal could be inserted at any point. When food was introduced into the maze it was done in cups of the same width as the alleys which necessitated the animals climbing over them to pass. Two thin cardboard blocks which could be inserted between

the sections of the top were used to prevent the animals from leaving the goal region during the test trials. By the presence and location of the stationary blocks the mazes could be converted into any number of patterns. This study utilized three of these. First with no blocks of any type in the maze we have the free maze. In this condition there are no blinds of any type and an infinite number of what will prove after the introduction of reward to be true paths. The idea of a multiple true path is not original but the use of hexagons which present a continual sequence of Y type choice points under any direction of travel has not to the knowledge of the author been previously investigated. The sequence of Y choices permits a more direct comparison with the standard multiple T and Y mazes by assuring a symmetry of choice which the rectangular or circular maze lacks, both at each choice point and between choice points. The second condition into which these mazes may be converted is the multiple Y maze, which will be called the classical maze. Here there is a starting point and an end as well as a single true path and an assortment of blinds. The final condition available is obtained by moving all the blocks in so that the animal cannot leave the true path at any time; this will be referred to as the true path condition. These mazes demonstrate a versatility which permits a great degree of latitude for the experimental design. The smaller maze permits acclimation of animals in a highly similar environment yet lacks the complexity which might cause excessively emotional behavior. When blinds are

desired the blocks are placed in a position three inches back from the end of the straight section of the blind and on either side. Thus the blocks are invisible until the animal has committed himself to the blind. The lighting was indirect, coming from frosted windows on three sides and from four shielded lights hung overhead. The maze in operation was located away from any walls and always in approximately the same position.

Experimental Design

This experiment was divided into three separate studies. Study I constituted a control. It was run with the classical type maze and duplicates the Haney-Buxton studies. It was a control for the other two studies. It was intended to prove that the handling techniques, drive levels, and mazes used in this experiment would produce the expected latent learning. In this study both of the factors which elicitation theory claims produce the Blodgett effect are operative. Blind alleys are present and elicit avoidance responses as a result of stimulus satiation. At the same time frequency, or the forced use of the true path to a greater degree than the blinds, is present.

In Study II the maze was used in the true path condition during the free exploration period. The rats were subjected to the effects of frequency, in that they were confined to the true path, but they were not given an opportunity to learn the avoidance responses to the blinds. In the test trials the maze was in classical condition with the blinds present. Thus this study served as a check on the relative efficacy of the two factors involved.

Finally in the crucial Study III [illegible] was left with no blocks in the free condition. Thus neither blinds nor frequency were operative and a final check of the predictions from elicitation theory was possible.

Procedure

The treatment of each animal in each group may be divided into four periods. The handling period first; then the time in which the animals were accustomed to the small maze; third the exploratory period in which the control animals remained in the small maze while the experimental animals were placed in the large maze; and finally, the test trials in which food was introduced and the animal's progress was recorded.

Study I--

Handling--The animals were put on a diet of seven grams per day of Purina Laboratory Chow. Unlimited water was available at all times except when the animals were in the mazes. Each day the animals were handled in groups of about twelve for a total time of one half hour. The handling consisted primarily of being picked up and put down. This period lasted for seven days.

Acclimation--The animals were introduced into the small maze in the classical condition with two blinds and a true path of eight straightways. This is the same length as the true path in the large maze. The animals were placed in the maze in varying places, permitted twenty minutes of free exploration, and removed from whatever place they occupied. This was repeated for four days

to familiarize the animals with the type of maze in which they would be fun. On the first and fourth days the blocks were in one position, on days two and three the sides of the blocks were reversed so that the sequence of turns was also reversed. On days one and three of this period food was placed in the maze in two cups. The position of the cups was varied through four positions in the apparent true path, the cups being in each place for ten minutes. On days two and four neither the cups nor the food were present. Thus a partially reinforced food expectation for the maze environment was produced. The animals were placed in the maze in groups of about six. The quantity of food consumed was deducted uniformly from the remainder of the seven grams which was presented immediately afterward in the individual home cages the rats occupied throughout the experiment.

Exploration--The animals were now divided into two groups in a systematic manner as described earlier. One group, the control group, was placed in the small maze for a period of three hours on each of two days. The position of the blocks was again reversed to change the location of the true path and the blinds between the first and second days. The other group, the experimental animals, was placed in the large maze for the same periods of time. The blocks and true path were held constant in the classical position. During this period the feeding was a continuation of the seven gram diet presented entirely in the home cage after completion of exploration. Once again the entrance of the animals into both mazes was systematically varied and the removal was on a basis

of the animal's position at the expiration of the three hour period. The rats were inserted six at a time.

Test trials--Both the control and experimental groups were treated alike. Food in the form of a 60-40 wet mash, as in the acclimation period, was placed at the position shown in Figure I. The rat was placed in the maze, also as shown in Figure I. The distance the rat travelled was measured in terms of stretches. One stretch was recorded each time the entire body of the rat entered a new straightway. Retracing was permitted and scored in the same manner. Thus the scores varied from a minimum of eight including the starting stretch to an indefinite number. Likewise the time elapsed from the entrance to the maze until the entrance to the goal stretch was recorded. When the rat reached the food the movable block was inserted at a distance of two stretches, just past the last blind, in order to confine the animal to the goal area. A period of thirty seconds was allowed for the rat to eat from the time of placing the movable block. At the end of the first trial the animal was removed to an individual holding cage while about five more animals were run in a similar manner. The rat was then given a second, third, and fourth trial, with, in each case, the requisite period in the holding cage. At the end of the fourth trial the rat was returned to its home cage and fed an additional seven grams after a delay of half an hour. This procedure was repeated for four days making a total of sixteen trials for each animal. The maze was in the classical condition.

Study II--

Handling--Identical with Study I.

Acclimation--The same as I, with the exception of the maze being in true path condition.

Exploration--The same as I except that the mazes were both in the true path condition.

Test trials--The same as I, except that the use of the classical maze, when used in this study, followed the true path condition instead of the classical condition. There was a change in mazes presented to the animals between the last two periods in this study. This was necessary to obtain error scores.

Study III--

Handling--Identical with Study I.

Acclimation--The same as I, with the exception of the maze being in free condition. The food cups were rotated through all eight non-junction corners, staying five minutes in each place. No blocks were manipulated.

Exploration--The same as in I except that the mazes were both in free condition, which again made a rotation of block positions in the controls unnecessary.

Test trials--The same as I, with the exception of the maze being in free condition which necessitated the use of two movable blocks both located just beyond the last junctions to confine the animal to the goal area.

In all three studies when food was present in the large maze, scent controls of additional mash were located at various points

around and within the maze to prevent the location of the food by scent alone. The rats were run as close to nine in the morning as possible at all times. The six groups were broken up into smaller groups of about six each. Thus some rats from each of the six major groups were run at different times in the overall schedule controlling for such possibilities as tracking in the maze by floor changes, or changes in handling techniques.

Hypotheses

1) In Study I, the experimental group will traverse fewer stretches than the control group during the test trials ("Latent" learning).
2) In Study II, the experimental group will either traverse fewer stretches than the control group in the test trials or will show no significant difference.
3) In Study III, there will be no significant difference in the number of stretches traversed by the experimental and control groups in the test trials (No "latent" learning).

Results

The time data were deemed to be unwieldy and relatively meaningless because of excessive variability, and thus the distance data or number of stretches was the measure of performance employed. Since a minimum score of eight stretches was possible with an indefinite upper limit the distribution of scores was highly skewed. It was therefore decided, in the computation of levels of significance, to use White's non-parametric T or T' test. In this test the scores of the two groups to be compared are combined into a single ranked sequence. The total of the rank numbers for each of the groups is added up, either this sum for the smallest group (which is called T) or a function of it (called T') is then compared with a predetermined table (7). The table gives two scores for each number of animals in the groups. If the score T or T' is smaller than either of these, the difference between groups is significant at the one percent level. If it is smaller than only one, then it is significant at the five percent level of confidence.

The median score for each animal for each day was computed (Tables 1, 2, and 3). The scores for both the experimental and control groups were combined and ranked, after which the test of significance as described above was applied. Each day's results were treated separately. Thus for each of the four days a test of the presence or absence of a difference was made.

Study I--One animal in the control group was discarded after freezing in the maze for five successive trials. Since this militated against the hypothesis it was considered justifiable.

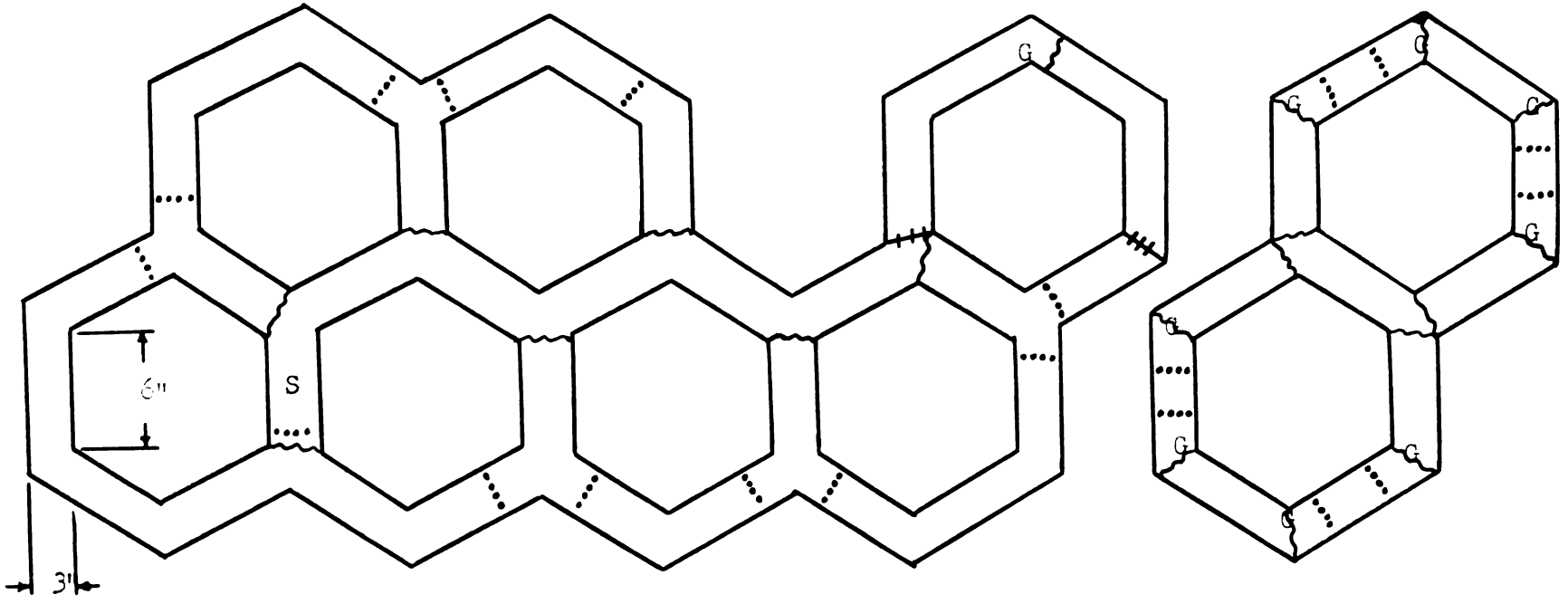
In Table 4 the final results as listed below are shown. With a score of less than 61 or less than 74 necessary for the 5% and 1% levels of confidence, the obtained scores for the four days in succession were respectively 64.5 which just misses significance, 70.5 which is at the 1% level, 70.0 which is also at the 1% level, and 76.5 which is at the 5% level of confidence. The learning curve for both groups is shown in Figure 2.

Study II--One animal in the control group was dropped because of freezes, three animals from the experimental group were also thrown out for the same reason. As a result the levels were computed both with and without these animals. In Table 4 the results are again shown. In neither manner of computation were results found which even approached significance. The learning curves are shown in Figure 2.

Study III--The results are shown in Table 4. There is no evidence of a significant difference on any day. The learning curves are again presented in Figure 2. An examination of the graphs in Figure 2 reveals that significance as determined by White's T or T' does not fall at the point of the largest absolute difference between medians.

Figure 1

The Seven and Two Unit Mazes with Positions for Blocks



S Starting point for test trials
G Location of reward when present
•••• Blocks in Classical Maze
~~ Blocks in True Path maze
+++ Movable blocks for goal area

Table I

MEDIAN NUMBER OF STRETCHES TRAVERSED BY ANIMALS OF STUDY I FOR FOUR DAYS

Animals	Day A	Day B	Day C	Day D
Experimental				
12	15.5	8.5	8.2	9.0
13	10.5	8.8	8.5	8.5
14	11.0	9.5	8.2	9.0
15	10.0	8.2	9.0	8.2
16	9.5	8.5	8.0	8.2
17	14.0	8.5	8.2	8.0
38	11.0	9.2	8.5	8.5
39	12.5	11.0	9.5	8.8
40	21.0	12.5	10.5	10.5
41	11.5	10.0	8.2	8.2
42	10.0	9.5	8.5	8.2
Medians	11.2	9.2	8.5	8.5
Control				
1	17.0	10.2	9.0	9.5
2	11.0	11.5	9.0	9.0
3	10.5	9.5	8.5	8.0
5	16.0	12.5	12.5	11.5
25	x	18.5	10.2	10.5
26	x	14.0	10.2	10.2
24	10.8	11.5	10.0	9.8
27	11.0	9.5	10.5	8.8
28	31.5	11.5	10.2	9.2
29	20.0	10.5	10.2	10.0
Medians	16.5	11.5	10.2	9.6

X** the animal refused to run on two or more trials

Table II

MEDIAN NUMBER OF STRETCHES TRAVERSED BY ANIMALS OF STUDY II FOR FOUR DAYS

Animals	Day A	Day B	Day C	Day D
Experimental				
44	12.5	13.5	12.5	16.0
45	12.5	10.5	9.8	8.5
46	9,2	8.5	9.0	8.2
47	17.5	8.5	9.5	8.5
65	22.0	10.8	11.0	8.5
67	13.0	8.5	8.0	8,0
68	10.5	9.5	11.5	8.2
69	10.5	8.2	8.0	8.0
70	x	10.5	8.2	8.0
Medians	12.7	9.5	9.5	8.2
Control				
58	10.5	9.2	8.2	8.5
59	10.5	9.5	8.5	8.2
60	14.5	11.5	11.0	8.5
61	33.0	10.0	11.0	8.0
62	10.2	8.5	8.2	8.0
63	12.0	9.5	9,5	9.0
71	10.5	10.5	9.5	8.5
72	13.5	14.0	10.0	9.5
74	18.0	9.5	8.5	8.5
75	15.0	10.5	9.0	8.0
76	12.0	12.5	10.5	12.5
77	10.0	10.5	8.5	9.0
Medians	12.0	10.2	9.2	8.5

X** the animal refused to run on two or more trials

Table III

MEDIAN NUMBER OF STRETCHES TRAVERSED BY ANIMALS OF STUDY III FOR FOUR DAYS

Animals	Day A	Day B	Day C	Day D
Experimental				
6	10.0	12.5	12.5	9.0
7	31.5	22.5	16.0	15.5
8	38.0	17.0	13.0	11.0
9	14.5	12.5	14.0	10.2
10	30.5	22.5	15.5	14.0
11	26.5	21.0	17.0	20.5
30	14.5	10.0	12.5	15.0
31	37.5	36.5	13.0	14.0
32	20.0	13.0	12.0	9.2
33	23.0	32.5	20.0	20.0
53	13.5	15.0	10.0	15.0
54	12.5	13.0	8.2	8.2
55	18.5	15.0	12.5	8.2
56	30.0	13.0	15.0	10.0
57	11.5	11.2	11.2	11.0
Medians	20.0	14.8	12.8	11.3
Controls				
18	14.5	12.5	10.0	11.0
19	13.5	14.0	9.5	14.0
20	14.5	16.5	10.8	14.5
21	11.5	18.5	11.2	11.2
22	11.0	16.5	10.5	18.5
23	15.0	13.0	12.5	13.0
34	14.0	16.5	15.5	14.5
35	34.0	21.5	16.0	18.0
36	18.5	10.0	16.0	9.0
37	15.0	13.0	10.2	9.0
48	27.0	17.5	16.0	12.0
49	10.0	12.0	11.0	11.0
50	34.5	16.0	20.5	20.5
51	38.5	19.0	14.0	21.5
52	37.5	13.0	11.0	10.5
Medians	14.8	16.0	11.2	13.0

Table IV

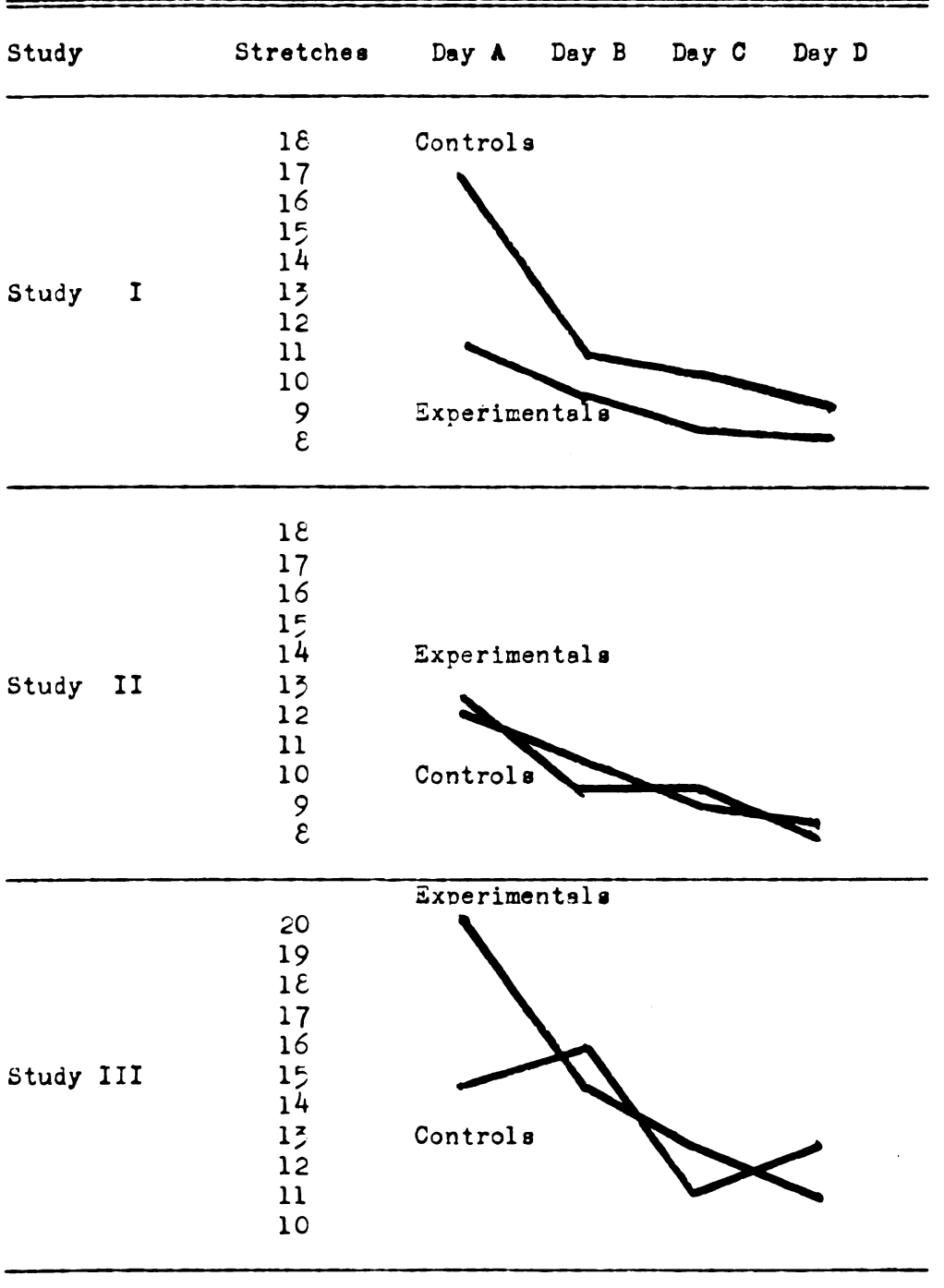
WHITE'S T OR T' TEST OF SIGNIFICANCE APPLIED TO STUDIES I, II, AND III

Study		Day A	Day B	Day C	Day D	Maximum Score 1% Levels	5%
Study I	T	135.5	149.5	150.0	143.5	74	81
	T'	84.5	70.5**	70.0**	76.5*		
Study II-- Without dropped animals							
	T	106.0	85.5	101.5	86.5	63	71
	T'	92.0	112.5	96.5	111.5		
With dropped animals							
	T	165.0	154.5	172.0	157.0	109	119
	T'	147.0	157.5	140.0	155.0		
Study III	T	240.0	239.0	251.5	213.5	171	185
	T'	225.0	226.0	213.5	251.5		

**Significant at the 1% level of confidence
*Significant at the 5% level of confidence

Figure 2

LEARNING CURVES BASED ON MEDIAN SCORES OF STRETCHES TRAVERSED BY ANIMALS FOR FOUR DAYS



Discussion

Hypothesis 1 was adequately substantiated. That is, the classical type of latent learning was obtained with frequency and blinds both operative. Hypothesis 2, which is patently indeterminate, was also substantiated. There was no apparent difference between the experimental and control groups when only frequency was operative. Hypothesis 3 was also substantiated, with neither blinds nor frequency operative there was no evidence of latent learning.

In Study I the results agreed closely with those of earlier exreriments. With a six-unit maze and six hours of pre-exploration latent learning was apparent to some degree on the first day's runs, became very significant on the second and third days, and finally on the last day, as the runs became asymptotic, began to disappear. It is clear that the handling techniques and feeding procedures used in these studies produce a marked example of latent learning using such low power statistical methods as the T or T' test (7).

The results of Study II deserve some explication. The two groups performed in an identical manner and, of the five animals which refused to run, four were in this study. The learning curves produced fall close to those of the first study, though at no point do they reach the mastery of the maze situation shown in the experimental animals in that study. While these results apparently satisfy the predictions for elicitation theory which are relatively indeterminate on this point, it is the opinion of the author that the failure of this study to show a minimal amount

of latent learning was due to the radical change in stimulus situation between the training and the test trials. This was the only study in which the animals were subjected to mazes arranged in two different conditions. In the training periods the mazes were simple true paths, but in the test sequence they were the multiple choice point classical mazes. This change from no choice to six choices and from a simple straightway of eight stretches to about twice that much available floor space was too great. The change in stimulus field to an unfamiliar situation was complete enough to mask any effect that the minor variable of frequency could have had. The change was drastic enough to cause four of the twenty-four animals to refuse to run. It cannot even be certain that the food expectation carried over to the new situation. Another possibility is that the factor of frequency is of no practical importance in this type of a learning situation. Any decisions on the merits of Study II will have to await further investigations.

Study III with neither blinds nor frequency operative produced exactly the expected absence of latent learning. That this situation is different from the closed forms of the maze is shown by the drop of distance from over 17 to 12 shown by Study III as opposed to drops of from 12 or 13 to just over 8 shown in Figure 2 Studies I and II. The maze is quite learnable since the absolute savings in distance were as great in this study as in the other two. It is doubtful if the curve would ever reach quite the

lowness exhibited in the other two studies since varied responses will lead to the goal instead of a single correct pattern. An interesting point emerged from the first day's runs. Though not significant the experimental animals took a median of five more stretches or a mean of about two per trial more than the control animals who had had no experience in the large maze whatsoever. This appears to suggest some degree of interference rather than assistance produced by the exploration period. This could be termed "negative latent learning." In the elicitation analysis of this situation neither blinds nor frequency served to emphasize the available true paths during exploration but the animals did make a continual series of approach responses to all sections of the maze. The control animals on the other hand made no responses whatsoever in exploration to the specific cues of the large maze. Thus when food was introduced in the test trials the increment due to frequency would be equal in both groups. In the control group it would be competing against weaker alternatives than in the experimental group which had all of the cues conditioned to approach regardless of the area of the maze. The absolute increment would be the same but the relative increment would be larger in the controls than in the experimentals. This difference being a small one would be dissapated rapidly in the final chaining of responses.

Let us now see how these results fit into the interpretations offered by the previously mentioned theorists.

The difficulties encountered by reinforcement theorists in this entire area are marked. Meehl and MacCorquodale's interpretation,

as presented in several places (9, 23, 24, 29), does not deal primarily with the Buxton type study but rather with the Blodgett type. The explanation they offer seems to hinge upon the building up of differential response strengths through reinforcement via the exploratory drive. Upon the introduction of food in the maze situation a food drive becomes conditioned to the maze cues, producing, in combination with the hunger drive and earlier differential reinforcement at the choice points, a sudden difference in performance. Thistlethwaite criticizes this type of explanation on the basis of the lack of reason for a differential reinforcement of choice points when free exploration (Type II) is permitted rather than trials (Type I). Even assuming some type of exploratory drive it is difficult to understand why the true path choices would be differentially reinforcing. It would also appear, using Hullian concepts, that more conditioned work inhibition would be accumulated to the more used true path responses which should produce an increase in blind entries. The reinforcement theorist thus has difficulty with the classical type Study I. The data from Study II are more troublesome for the re-inforcement theorist than for the elicitation theorist. If there is an exploratory drive it should be reinforcing to some extent in the true path situation. This reinforcement would always come to the same response patterns, since no others are available. Thus some degree of learning should occur and manifest itself in the test trials. This is especially true in the case of a system which

emphasizes kinesthetic chaining. However the difference between the training and test situations may be appealed to for an explanation of the lack of differences.

The result of Study III, where there is no difference between choices, is what would be predicted by either Hull or by Meehl and MacCorquodale. Since there is no way of having a degree of differential reinforcement in this situation, there will be no difference between the experimental and control animals.

If these theorists can satisfactorily explain the Buxton type experiments, which appears to be very doubtful, then this experiment offers few, if any, new difficulties for them.

Tolman and the cognitive theorists generally assume some type of cognitive map or generalized place learning. The results of Study I fit into this interpretation perfectly, as expected. With Study II the same difficulty becomes apparent that also exists for reinforcement theory. Some degree of place learning should be produced to be utilized in the later test trials. Once again the same appeal to the difference between training and test mazes appears possible. The findings of Study III present considerable difficulty for Tolman, however. In Thistlethwaite's review the following quotations appear:

"It has been found that latent learning is most easily demonstrated under the following conditions: The maze environment to be mastered is complex or otherwise yields reliable measurements of individual differences in maze performance; the reward introduced is highly demanded or is associated with a highly demanded

goal object; and the response by which the learning is manifested is not associated with a relevant reward during the non-reward trials." (p.107)

"The results of Karn and Porter suggest, although the differences here are not statistically significant, that unrewarded exploratory experience in the maze has greater effect on maze performance than pretraining which does not include such exploration." (p.104)

The maze is certainly complicated and capable of measuring differences in performance; the reward is highly desired after eleven days on half diet; the particular response, which manifests the learning, has had no opportunity to be associated with the reward or with any other reward than possible exploratory ones; and finally free exploration of six hours has been permitted. In other words the conditions favoring latent learning have been consistently maximized in this series of studies. This is further demonstrated by the results of Study I which are excertionally clear cut. Yet in Study III nothing resembling latent learning is apparent. In fact the experimental animals are possibly slower in learning on the first day of testing than the controls. If something like place learning or a cognitive map is operative it should certainly be apparent under these conditions. One of the explanations the cognitive theorists can present for the differences between Studies I and III is the additional complexity of the free maze, which may have been too difficult for the occurence of latent learning in the six hours available. This seems unsatisfactory

in view of the learning exhibited in the test trials. In less then ten minutes of maze running with food present the same amount of reduction of stretches traversed, in absolute terms, was exhibited by all animals as in Studies I or II. Thus under any circumstances, six hours of free exploration under hunger drive with food expectations established should produce according to Tolman some degree of latent learning. Neither can it be argued that the drive level was too high to permit incidental learning since Study I serves as a control on this point. The suggestion that the choice points do not produce true mental alternatives for the rats in the exploration period also fails to hold up. The alternate choice points offer the same opportunities for discrimination as with the food present. Even the expectancies of the rats are similar since a food expectation is present, albeit in differing amounts, in both periods. Although these results are not necessarily inconsistent with Tolmanian theory they nevertheless present a definite problem to the presently presented versions thereof.

The results of this group of studies then offer definite difficulties to both the cognitive and reinforcement approaches as typified by Tolman, Thistlethwaite, and Meehl and MacCorquodale. Study II which is indeterminate with respect to the elicitation position is contradictory to the other positions. Of the various explanations available the most satisfactory appears to be that of elicitation theory.

Summary and Conclusions

A group of three experiments were run to test elicitation theory's explanation of latent learning in terms of avoidance of blinds and sheer numerical predominance of true path experiences. In the first study the maze was a six unit multiple T maze. After periods of handling and acclimation which were the same for both groups, the control animals were left in a maze like environment while the experimental group was permitted to explore the maze itself for six hours. In a series of sixteen test trials run on four days the experimental animals showed latent learning at the one percent level of confidence. In the second study the identical routine was maintained but the training periods utilized only the true paths, not the blinds in the mazes. In the test trials the two groups showed no differences. The third study again used identical procedures but this time the maze was in a free condition with no true path or blinds at any time, thus neither blinds nor frequency was operative. There was no significant difference between the experimental and control groups, though on the first day the controls traversed fewer stretches. On the basis of these results the following conclusions were reached:

1) Study I presents difficulties for a reinforcement explanation while satisfying either cognitive or elicitation theory.

2) Study II, while not clear in its design, indicates

that frequency is a minor factor compared to the satiation occuring in blinds. It offers no difficulties for elicitation theory, while not fitting into either cognitive or reinforcement frameworks.

3) Study III presents difficulties for a cognitive explanation while satisfying either reinforcement or elicitation theory.

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