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THE EVALUATION OF PUNISHMENTS AND REWARDS
IN LEARNING THE MAZE BY HUMANS

Being

A Thesis Presented to the Graduate Council in Partial
Fulfillment of the Requirements
For the Degree of Master of Science

By

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Fort Hays Kansas State College.

Approved by:

H. B. Reed
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Date May 16, 1934

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Chairman of Graduate Council

Gift



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August Albert Lind

6/26/34

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THE EVALUATION OF PUNISHMENTS AND REWARDS IN LEARNING THE MAZE BY HUMANS

I. INTRODUCTION

A. Problem

The general problem of this investigation was the evaluation of reward and punishment for learning the maze by humans. Specifically, we wish to test Thorndike's (23) statement that pleasantness stamps in the right and unpleasantness stamps out the wrong; and furthermore, to find out what combination of pleasantness and unpleasantness in relation to right and wrong movements or choices is the most effective.

B. Summary of Relevant Literature

In reviewing a small part of the vast amount of material on Learning -- limiting the reading somewhat to the Laws of Effect -- we may mention the generalizations made by Thorndike in his line-drawing experiment as reviewed by Cason (24). His results seemed to show that E's saying "Right" and "Wrong" at the proper time improved S's chances for success. It was thought that E's speaking the words "Right" produced the effects of satisfyingness, and the word "Wrong" produced annoyingness. We wish to test this hypothesis of Thorndike's by a maze experiment and further to prove that there is enough evidence for the fact that cues ARE used to overthrow

Thorndike's statement to the contrary. Also that pleasure is only second to satisfaction and pain follows annoyance rather than vice-versa. Rather it is our belief that the pleasure-pain hypothesis must give way to "Identifiability" altogether. The results of Miss Trowbridge's (11) line-drawing experiment show that a percentage of success for the correct* procedure was 54.8 while that for the "R-W"¹ procedure was 22.6. This seemed to show that improvement in the line-drawing function is not particularly dependent upon the "satisfying" and "annoying" effects of the words "right" and "wrong". "Cues" played the larger role, rather than pleasure-pain effects.

Spencer and Bain, perhaps the originators of the law of effect, overemphasized the importance of pleasures and pains in human learning. H. Cason (24) states that "unpleasant feelings have a more positive and insistent character and they play a more important role in both animals and humans". Cason, disproving Thorndike's pleasure-pain theory by referring to investigations by G. S. Snoddy², and others,

*E told S the length of the line he had drawn as soon as possible after he had finished drawing it.

¹ E said "right" as soon as possible after S drew the line if the line was within 1/8 inch of a 3-inch line. E said "wrong" in all other cases. This procedure was the same as that used in Thorndike's (24).

² G. S. Snoddy An experimental analysis of a case of trial and error learning in the human subject -- Psychol. Monog., vol. 28, No. 124, 1929. "The sides that were DIFFICULT and UNPLEASANT were the sides where IMPROVEMENT took place, and the sides that were EASY and PLEASANT were the sides where NO IMPROVEMENT WAS MADE. On those sides (of the star) ... where every movement is followed by a feeling of satisfyingness, practically no improvement takes place from the first circuit to the end of practice.

further says: "In practically all of these investigations, measures were obtained of the efficiency of learning Pleasant and Unpleasant activities, and the averages of the two groups compared. The results show quite clearly that the overlapping between the two groups of measures is much more significant than the slight and generally unreliable differences between the averages."

II. METHOD

A. Materials

To solve this problem we use a maze consisting of wire threaded on a smooth three-ply board, and having quite a simple design. For as Hunter (28) says "so far as disturbance by chance factors during learning is concerned, the simpler the maze the more dependable its data." Husband (9) also states that his T-maze, somewhat similar to the design of the maze used in the present problem, was most easy to learn, compared with three other mazes of more difficult design, e. g. his S, F, and X patterns.

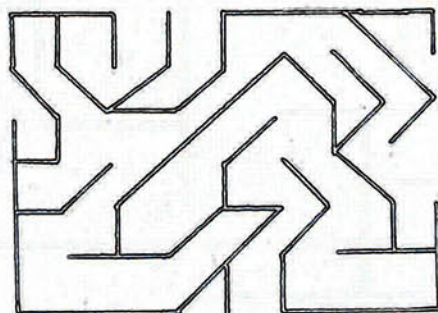


Figure 1. Maze L used for the final test on all S's.

The wire threaded on the board made it possible for S's to follow the maze by keeping a preferred finger on the wire. The mechanism was supplied with two number six dry cells and an induction coil so that S could be shocked by E at any multiple choice with the pressing of a button. Runways along the true path are of various lengths, as are also the side tracks. Each choice on the maze has two or three alternatives, right, left, or straight ahead.

In order to increase the reliability of the final results the S's were divided into equal groups after having threaded a maze of the same type but different in design from the one used finally in the investigation. This preliminary maze was constructed with strips of cardboard, about one-fourth inch wide, on a piece of compe-board (12" x 18") and having a design as in figure 2. It is believed the design used minimized as much as possible any chance for partial learning transfer to the final maze.

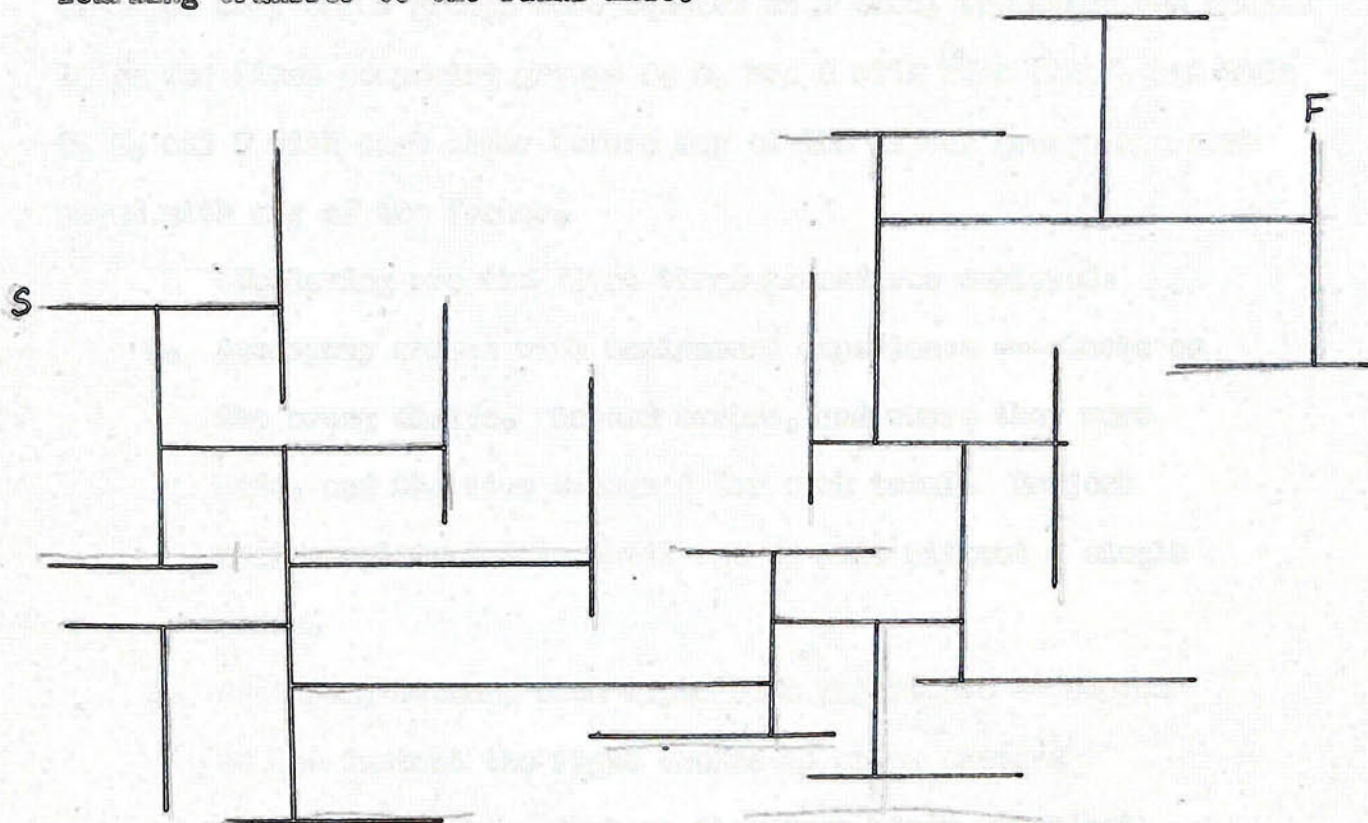


Figure 2. Design used for preliminary maze.

B. Subjects

The seventy-eight volunteers from among the four classes, graduate students, and professors of Fort Hays Kansas State College, who offered themselves as S's, showed an unusual interest in the investigation merely as a psychological laboratory experiment, and without any knowledge of the different methods or the information sought. From the first call as well as the second, those S's whose scores were exceptionally high or low were discarded so that only sixty-six were finally selected as S's for the final maze.

C. Methods Employed

It should be noted that although six different methods were employed only three groups were equated at a time, therefore the reason later for first comparing groups A, B, and C with each other, and then D, E, and F with each other before any of the latter groups are compared with any of the former.

Following are the first three procedures employed:

- A. Accompany errors with unpleasant experience -- shocks on the wrong choice. Record errors, and where they were made, and the time consumed for each trial. Subject must complete trials until one is made without a single error.
- B. Accompany success with unpleasant experience -- shocks at the instant the right choice is made. Record number of shocks and where they were given. Subject

must complete trials until all the right moves are made on first attempt at every multiple choice.

- C. Accompany ^{error} success with pleasant experience, and ^{right?} error with multiple unpleasant experience -- saying "right" on right ^{wrong?} choice, and "wrong" plus a shock on ^{right} wrong choice.
- D. No reward nor reproof with right or wrong moves. Same records and repeats as above.
- E. Wrong moves accompanied with pleasantness. State "right" in wrong moves. Make no comment in right moves. Same records and repeats as above.
- F. Reward with right, but no reproof with wrong moves. State "right" in right moves. Make no comment in wrong moves. Same records and repeats as above.

TABLE I. Preliminary Maze Results

Subjects	Total time in seconds	Total Errors	Number of Trials
HP-13	110	7	5
VK-9	150	2	2
HH-28	200	13	4
MS-34	255	13	5
FW-31	385	14	6
CC-3	405	18	6
CH-39	465	19	8
LW-7	500	22	8
LH-19	520	45	12
AH-4	550	26	6
PE-14	565	29	8
BH-18	600	30	7
OK-10	600	19	9
PE-21	605	31	8
EC-22	620	28	12
VK-36	675	16	6
FY-32	675	38	10
HS-5	690	42	9
BB-37	690	36	11
VJ-1	695	21	9
ME-12	700	48	13
IB-23	720	32	13
ET-2	735	33	7
WS-35	780	42	15
MG-38	780	45	14
BS-40	780	35	12
ET-15	790	56	15
MW-25	840	41	12
DM-11	885	37	6
JE-8	990	58	15
WM-26	1030	45	11
HR-29	1375	60	20
Total	20875	1024	311
Average	632.6	31.9	9.4

TABLE II. Preliminary Maze Results
(For Groups D, E, and F)

Subjects	Total time in seconds	Total Errors	Number of Trials
K-41	570	26	4
B-42	720	60	13
M-43	1110	26	14
O-44	540	40	9
S-45	945	33	10
K-46	1305	42	10
C-47	745	33	6
R-48	1100	33	6
G-49	630	21	4
B-50	720	40	10
P-51	300	7	2
F-52	1200	46	16
M-53	570	38	5
C-54	390	12	6
B-55	945	72	12
H-56	765	29	8
L-57	680	32	7
W-58	825	44	8
M-59	780	22	5
H-60	1005	58	10
S-61	730	23	5
R-62	720	28	4
B-63	1110	68	13
B-64	270	11	3
I-65	630	38	8
M-66	1005	28	12
W-67	360	27	7
S-68	270	18	5
F-69	1320	55	15
G-70	675	34	8
S-71	720	23	6
L-72	640	37	8
V-73	330	5	2
Total	24625	1109	261
Average	746.2	33.6	7.91

D. Grouping

The method by which each of these S's were grouped to make three groups (eleven S's in each group) from TABLE I and three groups from TABLE II, was as follows: From the upper end of the scores (lowest) the first score for method A, the second for B, the third for C, the fourth for C, the fifth for B, the sixth for A, the seventh for A, the eighth for B, etc., etc. After a trial average and S. D. were calculated it was decided to shuffle some of the scores around to make more comparable averages and S. D's, since these were the two factors used in equating the groups.

TABLE III

(Showing A, B, and C Grouping from Preliminary Test Scores)

Group A (shock errors)		Group B (shock corrects)		Group C ("right" for errors, "wrong" for corrects)	
Subject	1st test score	Subject	1st test score	Subject	1st test score
HP-13	110 sec.	VK-9	150 sec.	CC-3	405 sec.
MS-34	255 "	HH-28	200 "	CH-39	465 "
FW-31	385 "	AH-4	550 "	LW-7	500 "
EG-22	620 "	GK-10	600 "	LH-19	520 "
VK-36	675 "	PE-21	605 "	GY-33	525 "
HS-5	690 "	FY-32	675 "	FB-14	565 "
VJ-1	695 "	BB-37	690 "	BH-18	600 "
WS-35	780 "	MC-38	780 "	ME-12	700 "
ET-15	790 "	BS-40	780 "	IB-23	720 "
DM-11	885 "	MW-25	840 "	ET-2	735 "
JE-8	990 "	WM-26	1030 "	HR-29	1375 "
Total	6875 "	Total	6900 "	Total	7110 "
Obt. Av.	625 "	Obt. Av.	627.3 "	Obt. Av.	646.4 "
S. D.	238.8 "	S. D.	240.5 "	S. D.	240.5 "

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TABLE IV

Showing C, D, and E grouping from Preliminary Test Scores
on Basis of Time (Seconds)

Group D (no reward or punishment)		Group E ("right" for errors)		Group F ("right" for corrects)	
Subject	Score	Subject	Score	Subject	Score
B-64	270	S-68	270	P-51	300
C-54	390	W-67	360	V-73	330
O-44	540	K-41	570	M-53	570
G-49	630	I-65	630	L-72	640
L-57	680	G-70	675	R-62	720
B-50	720	B-42	720	S-71	720
H-56	765	M-59	780	S-61	730
S-45	945	W-58	825	C-47	745
M-66	1005	H-60	1005	B-55	945
M-43	1110	B-63	1110	R-48	1100
F-52	1200	F-69	1320	K-46	1305
Total	8255		8265		8305
Obt. Ave.	750.45		751.37		755
S. D.	282		292		275

E. Procedure

Some six or seven days elapsed before each S was called in to perform individually, as before, the second and final maze (Fig. 1). Each S was seated opposite E at a low table upon which the maze was placed, covered, of course, so that no inspection could be made while instructions were given. Each S, regardless of the method used, was given the same instruction as follows: "You are to thread this maze as quickly and as accurately as possible, having your eyes closed or looking away from the maze, and using only one finger tip in feeling

your way. Should you experience an unpleasant feeling you must decide what to do about it without further questioning." (Now uncovering the maze and indicating merely the start and the finish, the S is told to) "Close your eyes, or look away. Ready. Begin."

Then the experimenter applied the procedures of the method in which the subject was placed according to the foregoing explanations. It would possibly be of interest to note the method of keeping records of trials, errors, places or error, and time. A sheet was made up on which were drawn fifteen reproductions of the maze, the size of Fig. 1, numbered from one to fifteen trials, and, as the maze was threaded, each "wrong" was checked on the sketch at the point of error. Below each sketch was room for time recorded.

Learning was completed at one sitting. Backtracking was counted as an error, although S was informed of his mistake. When the method called for the use of shocks the E applied same at the instant the finger movement indicated the choice was made. There was no uniformity as to the effect the shock produced on each S. This could have been remedied had the Whipple Pressure-Pain Balance been used. No special finger was designated to be used, nor were the other fingers bandaged to avoid any feeling ahead. The duration of each session was from ten to thirty minutes, the intervals between trials five to ten seconds, and the number of trials three to twenty. The responses were recorded on a sheet about 9" x 14", having fifteen reproductions of the maze so that each error could be indicated by E instantly by placing a dot at a similar location in the diagram.

Following are the results of the second maze:

TABLE V

Group A (Shock Errors)

Subject	Total Time Sec.	Total Errors	No. of Trials
ET-15	330	4	2
HP-13	390	3	3
HS-5	480	23	7
VK-36	540	11	6
EG-22	585	24	8
FW-31	585	18	9
DM-11	705	26	8
VJ-1	740	16	5
JE-8	900	47	15
MS-34	930	18	6
WS-35	990	33	10
Totals	7175	223	79
Obt. Ave's.	652.27	20.27	7.18
S. D.	221.56	11.98	3.38
σ (Av.)	66.795	3.61	1.02

Group B (Shock corrects)

MG-38	450	9	3
MW-25	630	12	4
PE-21	705	11	6
AH-4	750	22	7
BS-40	765	6	3
HH-28	765	13	7
BB-37	765	16	11
WM-26	975	26	8
VK-9	1080	19	8
GK-10	1215	36	10
FY-32	1230	19	7
Totals	9330	189	75
Obt. Av's	848.18	17.18	6.82
S. D.	237.4	8.38	2.5
σ (Av.)	71.57	2.22	.75

TABLE V (Continued)

Group C ("right" for errors, "wrong" for corrects)

Subject	Total Time Sec.	Total Errors	No. of Trials
LH-19	390	3	3
IB-23	420	15	6
PB-14	510	15	7
CC-3	630	28	11
CH-39	765	13	6
LW-7	780	11	4
ET-2	780	37	12
CY-33	900	4	3
BH-18	1035	21	11
ME-12	1140	15	8
HR-29	1185	19	11
Totals	8535	181	81
Obt. Av's.	775.91	16.45	7.36
S. D.	261.43	9.38	3.21
σ (Av.)	78.92	2.83	.97

TABLE VI

Comparisons between the A, B, and C groups

	Basis Total Time	Basis Total Errors	Basis Trials
B (shock corrects) minus A	195.91	3.09	0.36
σ (diff.) B-A	97.90	4.23	1.27
B (shock corrects) minus C	72.27	0.73	0.54
σ (diff.) B-C	103.31	4.58	1.40
C ("right errors") minus A	123.64	3.82	0.18
("wrong" corrects) σ (diff.) C-A	106.46	3.60	1.23

III. RESULTS

A. Methods A, B, and C Compared

We see that from the difference in total time between the obtained averaged of methods A (shock errors) and C ("right" for errors, "wrong" for corrects) the subjects of method C took on the average 123.64 seconds longer to thread the maze successfully. But from the σ (diff.) of the two methods we find that there is no reliable difference, since the standard error of the obtained difference is 103.31 seconds where it should have been only one-third as much as the difference between the obtained averages to show any significant differences between methods A and C when considering Total Time to learn each. By their coefficient of reliability $\left(\frac{D}{\sigma(\text{diff.})} \right)$, or 1.2, we find from standard calculations that there are 88 chances in 100 that method A is superior to method C. In comparing B (shock corrects) and C ("right" for errors, "wrong" for corrects), the actual difference in total time between the obtained averages (72.27 seconds) is less than their σ (diff.) which is 106.46 seconds. This shows that these two methods are also not significantly different. But in comparing A (shock errors) with B (shock corrects) we find that the coefficient of reliability shows a fairly dependable difference of 97 chances in 100 that method A is superior to method B when considering Total Time taken to learn.

Furthermore when making similar inspections in comparison of total errors and trials we find no reliable difference between the three methods employed, the σ (diff.) in each case being greater than the difference between the obtained averages. Therefore neither one of these methods is more effective than the other on basis of number of errors or trials.

B. Methods A, B, and C compared
(after first trial)

Now an inspection of check sheets indicates that most errors were made, and the most time was consumed in the first trial, therefore we have constructed a table showing total time and total errors after the first trial:

TABLE VII
Showing Total Time and Errors
After the First Trial
Group A (shock errors)

Subject	Total Time After 1st Trial	Total Errors After 1st Trial
ET-15	180 seconds	0
HP-13	210 seconds	1
HS-5	360 "	18
BK-36	360 "	7
EG-22	435 "	17
FW-31	480 "	17
DM-11	600 "	18
VJ-1	470 "	11
JT-8	765 "	44
MS-34	660 "	12
WS-35	810 "	28
Totals	5330 "	173
Obt. Av.	484.54 "	15.72
S. D.	179 "	3.47
σ (av.)	53.96 "	1.05

TABLE VII (continued)
Group B (shock corrects)

Subject	Total Time After 1st Trial	Total Errors After 1st Trial
MG-38	240 seconds	3
MW-25	330 "	8
PE-21	390 "	7
AH-4	480 "	17
BS-40	255 "	1
HH-28	495 "	10
BB-37	585 "	13
WM-26	645 "	19
VK-9	780 "	15
GK-10	975 "	31
FY-32	780 "	13
Totals	5995 "	137
Obt. Av.	541.36 "	12.45
S. D.	225 "	2.38
σ (av.)	67.83 "	.72

Group C ("right" for errors, "wrong" for corrects)

LH-19	240 seconds	1
IB-23	315 "	11
FB-14	290 "	12
CC-3	540 "	23
CH-39	555 "	11
LW-7	540 "	8
ET-2	630 "	34
GY-33	540 "	2
BH-18	765 "	15
ME-12	900 "	12
HR-29	915 "	16
Totals	6230 "	145
Obt. Av.	566.36 "	13.18
S. D.	221.65 "	2.98
σ (av.)	66.82 "	0.90

TABLE VIII
Comparison between the A, B, and C Groups
Using data after first trial

	Basis Total Time	Basis Total Errors
B (shock corrects) minus A (shock errors)	56.82	-3.27
σ (diff.) B-A	86.09	1.27
B (shock corrects) minus C ("right" for errors, "wrong" for corrects)	-25.00	2.54
σ (diff.) B-C	85.88	1.38
C ("right" for errors) minus A ("wrong" for corrects) (shock errors)	81.82	0.73
σ (diff.) C-A	94.70	1.15

The most evident conclusions from these results are that method B (shock corrects) shows not only practical equal advantages with the other two methods, but that in point of errors after first trial there is an outstanding superiority of method (B) over A (shock errors). And when we investigate the coefficient of reliability $\left\{ \frac{D}{\sigma \text{ (diff.)}} \right\}$, or 2.57 we find that there are 99.5 chances in 100 that method B (shock corrects) is superior to method A (shock errors).

C. Methods D, E, and F compared

We should expect some degree of correlation of an individual's first maze record with the second maze results, Tables II and III. A

study of the figures in these two tables did not warrant the calculation of a coefficient of correlation.

It was thought that the poor correlations between the individual results of the foregoing was due to lack of similarity of materials of which the mazes were constructed. So to bring conditions more favorable to obtaining a correlation between preliminary and final maze results E constructed a wire maze as illustrated below for the preliminary runs to be used in the subsequent investigations of the next three procedures.

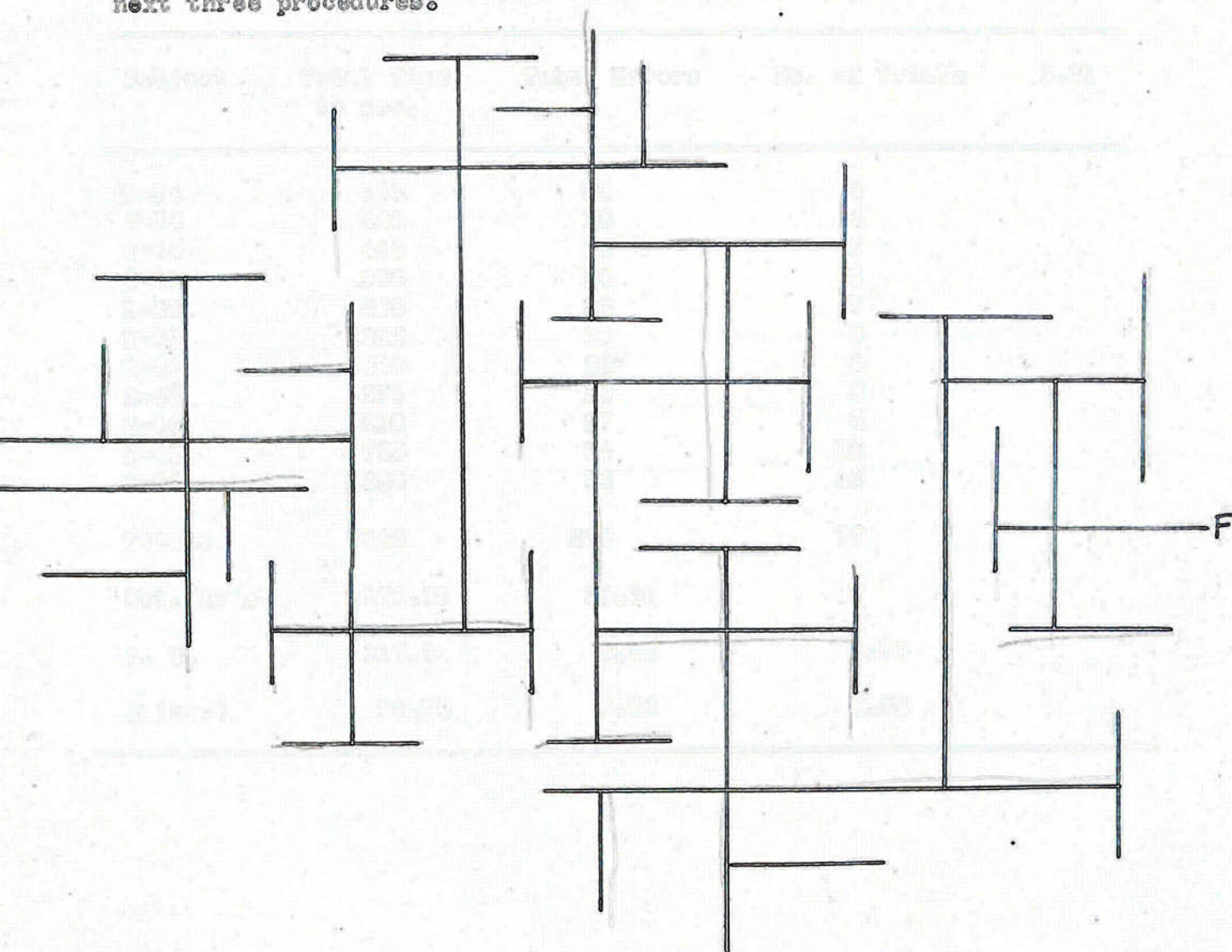


Figure 3. Preliminary maze used in second group of procedures

To each subject was read the same instructions as heretofore indicated before he began the threading of the second maze. Now we have the results of the second maze as performed by groups D (no rewards or punishment), E ("right" for errors), and F ("right" for corrects):

TABLE IX

Individual Achievements of Groups D, E, and F in the Final Maze

Group D (no reward or punishment)

Subject	Total Time in sec.	Total Errors	No. of Trials	3.31
B-64	555	22	4	
C-54	405	10	4	
O-44	465	30	6	
G-49	270	14	3	
L-57	480	30	7	
B-50	1200	36	8	
H-56	840	22	6	
S-45	375	20	8	
M-66	810	37	8	
M-43	780	34	10	
F-52	1260	35	13	
Totals	7440	280	77	
Obt. Av's.	676.36	26.36	7	
S. D.	317.5	8.42	2.73	
σ (av.)	95.75	2.54	0.82	

TABLE IX (continued)

Group E ("right" for errors)

Subject	Total Time in sec.	Total Errors	No. of Trials	3.31
S-68	630	17	4	
W-67	420	15	4	
K-41	420	5	3	
I-65	825	30	7	
G-70	570	14	6	
B-42	300	16	8	
M-59	1200	12	11	
W-58	750	32	8	
H-60	585	19	8	
B-63	570	25	9	
F-69	1080	24	10	
Totals	7350	224	78	
Obt. Av's.	668.18	19	7.1	
S. D.	213	5.096	2.23	
σ (av.)	64.30	1.54	0.67	

Group F ("right" for corrects)

P-51	660	4	4	
V-73	420	2	3	
M-53	540	11	4	
L-72	690	21	6	
R-62	690	22	6	
S-71	720	16	6	
S-61	435	16	5	
C-47	360	11	7	
B-55	660	22	11	
R-48	360	11	7	
K-46	690	18	7	
Totals	6225	152	65	
Obt. Av's.	566	13.82	5.91	
S. D.	135.2	5.28	1.90	
σ (av.)	40.78	1.595	0.57	

TABLE X

Comparisons between the D, E, and F groups

	Basis Total Time	Basis Total Errors	Basis Trials
D (no rewards or punishments) minus E ("right" for errors)	8.18	7.36	0.10
σ (diff.) D-E	115.32	2.97	1.06
D (no rewards or punishments) minus F ("right" for corrects)	110.36	12.54	1.09
σ (diff.) D-F	104.07	3.00	1.00
E ("right" for Errors) minus F ("right" for corrects)	102.18	5.18	1.19
σ (diff.) E-F	76.07	2.21	0.88

Again studying the comparisons, TABLE IX, we note that the σ (diff.) in total time and in trials of methods D (no rewards or punishment) and E ("right" for errors), -- also for methods D and F ("right" for corrects) -- show no reliable difference in the methods. However, when considering D and E on the basis of total errors there is quite a significant difference in favor of method E ("right" for errors) for the obtained difference (D-E), near three times the σ (diff.), approaches absolute reliability. That means there were less errors made when verbally rewarding for making the wrong move than when neglecting to punish or reward for making right or wrong moves.

When comparing results for methods F ("right" for corrects) with E ("right" for errors) we find a measurable difference in time, errors, and trials, moreso in point of errors, but in all three cases decidedly in favor of F. Another significant difference in methods

was shown by comparing D (no rewards or punishment) with F ("right" for corrects) on the basis of total errors. Their differences in obtained averages of 12.54 is over four times the σ (diff.) of 3.00, which means that the difference in favor of F is absolutely reliable when considering total number of errors made before reaching success.

D. Methods D, E, and F compared
(after first trial)

TABLE XI

Showing total times and errors in Groups D, E, and F
after first trial

Group D (no reward or punishment)

Subject	Total time (in seconds) after first trial	Total Errors after first trial
B-64	435	14
C-54	300	7
O-44	345	24
G-49	165	10
L-57	380	26
E-50	1020	30
H-56	600	15
S-45	250	14
M-66	650	32
M-43	735	30
F-52	1060	30
Totals	6050	235
Obt. Av.	550	21.36
S. D.	252	8.73
σ (av.)	76	2.63

TABLE XI
(continued)

Group E ("right" for errors)

Subject	Total time (in seconds) after first trial	Total Errors after first trial
S-68	510	9
W-67	240	8
K-41	180	2
I-65	705	22
G-70	450	9
P-42	210	12
M-59	1000	10
W-58	430	25
H-60	465	15
B-63	450	18
F-69	900	17
Totals	5540	147
Obt. Av.	478.2	13.36
S. D.	187	4.97
σ (av.)	56.30	1.50

Group F ("right" for corrects)

P-51	390	2
V-73	210	1
M-53	420	10
L-72	480	13
R-62	570	17
S-71	480	9
S-61	345	14
C-47	210	6
B-55	570	17
R-48	285	7
K-46	555	13
Totals	4510	109
Obt. Av.	410.00	10.00
S. D.	126.65	4.28
σ (av.)	38.1	1.29

Consistent with the plan of studying the results of procedures (A), (B), and (C), we here also show results after the first trial, and a table of comparison of these results immediately following.

TABLE XII

Comparisons between methods D, E, and F after first trial

	Basis Total Time	Basis Total Errors
D (no rewards or punishment) minus E ("right" for errors) σ (diff.) D-E	71.9 94.48	8.00 3.03
D (no rewards or punishment) minus F ("right" for corrects) σ (diff.) D-F	140.00 84.98	11.36 2.82
E ("right" for errors) minus F ("right" for corrects) σ (diff.) E-F	68.20 67.95	3.36 1.97

The obtained difference between the average and the σ (diff.) of D (no reward or punishment) and E ("right" for errors) on basis of errors after the first trial show a significant difference and a coefficient of reliability of 99 cases out of 100 in favor of E, but method F ("right" for corrects) again shows superiority to either D or E with a coefficient of reliability of 100 out of 100 chances (in point of errors), which of course is not unexpected.

TABLE NO. XIII

Data for All Groups

	Total times		Trials to learn		Total errors		(After first trial)			
							Total times		Total errors	
	Av.	S.D.	Av.	S.D.	Av.	S.D.	Av.	S.D.	Av.	S.D.
2 Group A	652 sec.	221	7.18	3.38	20.27	11.98	3 484 sec.	179	15.72	3.47
4 Group B	848 "	237	6.82	2.5	17.18	8.38	4 541 "	225	12.45	2.38
5 Group C	776 "	261	7.36	3.21	16.45	9.38	6 566 "	221	13.18	2.98
4 Group D	676 "	317	7.00	2.73	26.36	8.42	5 550 "	252	21.36	8.73
3 Group E	668 "	213	7.10	2.23	19.00	5.10	2 477 "	187	13.36	4.97
1 Group F	566 "	135	5.91	1.90	13.82	5.28	1 410 "	126	10.00	4.28

E. Comparison of all six methods

The next five tables show a comparison of the six methods with each other. This comparison was considered feasible since all groups threaded the same maze, even though they were not equated from exactly the same preliminary maze.

	Method 1	Method 2	Method 3	Method 4	Method 5
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99					
100					

TABLE NO. XIV

Comparing the six methods on basis of total time

	F	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	A	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	E	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	D	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	C	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*
F ("right" for corrects) minus																				
A (shock errors) minus	86	78	1.10	86																
E ("right" for errors) minus	102	76	1.34	91	15.9	93	.16	56												
D (no reward or punishment) minus	110	104	1.06	85	24.1	117	.21	58	8.2	115	.07	53								
C ("right for errors "wrong" for corrects) minus	210	88	2.31	99	124	103	1.2	88	108	102	1.7	96	100	124	.8	79				
B (shock corrects) minus	282	82	3.44	100	196	98	2.0	98	180	96	1.9	97	172	120	1.4	93	72	106	.67	74

* Chances in 100 that difference is greater than zero

TABLE NO. XV

Comparing the six methods on basis of total errors

	F	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	C	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	B	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	E	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	A	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*
F ("right" for corrects) minus																				
C ("right" for errors "wrong" for corrects) minus	2.6	3.2	.81	79																
B (shock corrects) minus	3.4	2.6	1.3	90	.7	3.6	.2	58												
E ("right" for errors) minus	5.2	2.2	2.3	99	2.6	3.2	.8	79	1.8	2.6	.7	76								
A (shock errors) minus	6.5	4.0	1.6	95	3.8	4.6	.8	80	3.1	4.2	.7	77	1.3	3.0	.4	66				
D (no reward or punishment) minus	12.5	3.0	4.2	100	9.9	3.8	2.6	99	9.2	3.3	2.8	99	7.4	3.0	2.5	99	6.1	4.4	1.4	91

* Chances in 100 that difference is greater than zero

TABLE NO. XVI

Comparing the six methods on basis of trials

	F	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	B	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	D	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	E	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*	A	σ (diff.)	$\frac{D}{\sigma \text{ (diff.)}}$	*
F ("right" for corrects) minus																				
B (shock corrects) minus	.91	.94	.97	83																
D (no reward or punishment) minus	1.1	1.0	1.1	86	.18	1.1	1.6	56												
E ("right" for errors) minus	1.2	.88	1.4	91	.28	1.0	.28	62	.10	1.1	.10	54								
A (shock errors) minus	1.3	1.2	1.1	86	.36	1.3	.28	62	.18	1.3	.14	56	.08	1.2	.07	53				
C ("right" for errors "wrong" for corrects) minus	1.5	1.1	1.3	90	.54	1.2	.44	67	.36	1.3	.28	62	.26	1.4	.19	57	.18	1.4	.13	55

* Chances in 100 that difference is greater than zero

TABLE NO. XVII

Comparing the six methods on basis of time (after first trial)

	F	σ (diff.)	$\frac{D}{\sigma(\text{diff.})}$	*	E	σ (diff.)	$\frac{D}{\sigma(\text{diff.})}$	*	A	σ (diff.)	$\frac{D}{\sigma(\text{diff.})}$	*	B	σ (diff.)	$\frac{D}{\sigma(\text{diff.})}$	*	D	σ (diff.)	$\frac{D}{\sigma(\text{diff.})}$	*
F ("right" for corrects) minus																				
E ("right" for errors) minus	68	68	1	85																
A (shock errors) minus	75	66	1.1	87	6.3	79	.1	54												
B (shock corrects) minus	131	78	1.7	96	63	88	.6	74	57	86	.7	74								
D (no reward or punishment) minus	141	85	1.7	95	72	94	.8	77	65	93	.7	76	8.6	102	.09	54				
C ("right" for errors "wrong" for corrects: minus	156	77	1.6	94	88	87	1.	84	82	86	.9	83	25.	95	.26	60	16	101	.16	56

* Chances in 100 that difference is greater than zero

TABLE NO. XVIII

Comparing the six methods on basis of total errors (after first trial)

	F	σ (diff.)	$\frac{D}{\sigma}$ (diff.)	*	B	σ (diff.)	$\frac{D}{\sigma}$ (diff.)	*	C	σ (diff.)	$\frac{D}{\sigma}$ (diff.)	*	E	σ (diff.)	$\frac{D}{\sigma}$ (diff.)	*	A	σ (diff.)	$\frac{D}{\sigma}$ (diff.)	*
F ("right" for corrects) minus																				
B (shock corrects) minus	2.5	1.5	1.7	95																
C ("right" for errors minus "wrong" for corrects)	3.2	1.6	2.0	98	.73	1.2	.67	74												
E ("right" for errors) minus	3.4	2.0	1.7	96	.91	1.7	.55	71	.18	1.8	.10	54								
A (shock errors) minus	5.7	1.7	3.4	100	3.3	1.3	2.6	99	2.5	1.4	1.8	96	2.4	1.8	1.3	90				
D (no rewards or punishment) minus	11.4	2.8	4.1	100	8.9	2.7	3.3	100	8.2	2.8	2.9	100	8.0	3.0	2.6	99	5.6	2.8	2.0	98

* Chances in 100 that difference is greater than zero.

IV. CONCLUSIONS

A. Outstanding results

The most evident conclusions on basis of time, errors, and number of trials were that method B (shock corrects) wherein unpleasant experience accompanied success, showed up decidedly superior to method D, wherein no reward or punishment was given. Furthermore B (shock corrects) on basis of time after first trial showed equal advantages with A (shock errors) and C ("right" for errors and "wrong" for corrects). Furthermore, on basis of trials and errors after first trial, A (shock errors) and C ("right" for errors and "wrong" for corrects) show outstanding inferiority right along with D (no reward or punishment). And, furthermore, method E, errors accompanying pleasantness, on all bases except number of trials, was superior to D, wherein neither reward nor reproof accompanied right or wrong moves. Summarizing the foregoing we may say that a learner has the same success when punished for the right as when punished for the wrong, but that one may take less time learning when punished for the right rather than for the wrong. Most of the results in our investigation show that no one method is significantly superior to the others, save that method D is decidedly inferior, which shows that THERE IS NO MORE EFFECTIVE LEARNING WHEN PUNISHED FOR THE WRONG AS WHEN PUNISHED FOR THE RIGHT. The subjects evidently recalled the unpleasant experience or the response to the unpleasant stimuli as well as he did the pleasant. This is significant in view of the fact that Thorndike (28) states that pleasantness stamps in the right and unpleasantness stamps out the wrong.

B. Interpretation of results

Before going to the question of interpretation we shall mention one other investigation. Tolman, Hall, Bretnall, in their 'punch-board' maze, (25) have, in attempting to disprove Thorndike's (?) Law of Effect, found a few results similar to those of the present research. In that experiment the combination of stimuli including the shock retarded the learning. Likewise, we can point to the F group and say that since it had no shock it could learn unhindered. But what about groups C, D, and E, having no shocks, being decidedly inferior to group B wherein S was shocked on every right move? That then is opposing evidence to Tolman, Hall, Bretnall (25) who claim the shock a disrupting stimulus and then launch their Law of Disruption. Marion E. Bunch (16) also found that the shock decreased variability in the number of trials, time to learn, and total errors, and lessened the number of trials by fifty per cent, the time to learn by thirty per cent, and the number of errors by thirty per cent. Likewise, Crafts and Gilbert (27) in referring to shock say: "Such punishment is usually an incentive, a motivating condition."

Group A was shocked for choosing the wrong path and it learned sooner than did group C, who was merely told "right" for going in the cul-de-sac and "wrong" for choosing the right path. The shock was quite a punishment, but instead of a 'disruptor', it acted as a motivator³ (27) when interpreted rightly. Then the fact that group B, shocked in every right path, learned faster than did group A, shocked only in cul-de-sacs, may be interpreted as follows: The shock for B was more vivid because it received more shocks, anticipating pain at every right move, it therefore simply proved to be a more effective stimulus resulting in a motivation. In that point, then, we agree with Thorndike (21) that to tell S when he is right (our method B) aids learning more than to tell S when he is wrong (our method A). But we do not agree with Thorndike when the latter states that pain is synonymous with avoidance of the wrong, and that pleasure is synonymous with attraction to the right. This hypothesis may then be stated: The response following a stimulus or motivation does not depend on the KIND of stimulus nor even its VIVIDNESS, but on its INTERPRETATION or IDENTIFICATION, whether it be punishment for doing the right as well as for doing the wrong, or reward for doing the wrong as well as for doing the right.

With the feeling that this dissertation is not presented as final thought on the matter nor the results as found to be conclusively interpreted it is hoped that further investigation may yield even more beneficial results.

³ "Such punishment (shock) is usually an incentive, a motivating condition."

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