HYPOTHESIS BEHAVIOR AND AN ATTEMPT TO EXTINGUISH IT IN A LEARNING SITUATION

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HYPOTHESIS BEHAVIOR AND AN ATTEMPT TO EXTINGUISH IT IN A LEARNING SITUATION

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DEDICATION

To my wife, whose understanding and moral encouragement were of utmost help in the writing of this paper.

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INTRODUCTION

Recently, the problem of language communication has been experimentally treated by several psychologists (3, 5, 9, 11, 12, 15). All of these studies have dealt mainly with the nature and conditioning of concept behavior. McGaughran (10) successfully predicted language behavior on the basis of previous object sorting. In another study, Verplanck (14) found that he could condition some overt, motor human behavior (as scratching one's head, rubbing one's nose, etc.) by reinforcing the particular response with a pencil tap. At the end of conditioning, the subjects, for the most part, could not state what the response was to which they were conditioned. Verplanck followed up with another study in which he attempted to manipulate verbal behavior. In this study, (15) Verplanck attempted to condition and extinguish statements of opinion. Verplanck found, that during a period of friendly conversation about almost anything, statements of opinion increased per unit of time when E said either "yes" or nodded his head affirmatively, and decreased when E disagreed by shaking his head negatively or said nothing. During the conversation the S had at no time suspected that he was in any kind of an experimental situation. In the above study opinions consisted of statements such as: I think. . . , I believe. . . , One should. . . , It is

necessary to. . . , etc. That verbal behavior can be manipulated experimentally without the subject's awareness of it, is given further credence in several recent investigations, in addition to those of Verplanck. Greenspoon (8) found that the proportion of plural nouns voiced ad libitum by the subjects could be increased through reinforcement by having the E say "mm-hmm," whenever such a response was made, and decreased by having the E say "mm-mm," without the S's awareness as to why the rate of plural nouns increased in one case and decreased in the other. Cohen et al (4) studied the reinforcement in the modification of verbal patterns. The subjects were presented with six pronouns and eighty verbs, and asked to make up sentences. The authors found that by differential reinformcement of pronouns they could manipulate the S's verbal behavior without his awareness. By reinforcing all sentences starting with pronouns I and We, they found that there was a gradual increase in the frequency of sentences starting with the two pronouns. They were also successful in later extinguishing the use of the two pronouns.

Green (7) studied discrimination learning under various schedules of fixed ratio of reinforcement, using stimulus cards with a number of black and white circles arranged in different patterns. He found that Ss would learn to verbalize the correct rule about which group of stimuli were right irrespective of the schedule of reinforcement. In as yet an unpublished study (16), Verplanck and

Oskamp suggested that hypothesis formation behavior was the next step for experimental investigation. In this preliminary study, Verplanck and Oskamp subjected a given hypothesis about card sorting to the procedure of partial reinforcement under conditions which allowed the experimenter to determine the rate at which this hypothesis occurs relative to the occasions on which it might occur. The method required the S to state aloud all the rules he tried so that they could be selectively reinforced or non-reinforced. In this study Verplanck used 30 undergraduate students from Stanford University divided into three experimental groups. All subjects were asked to sort a deck of 110 trading cards with blank faces and different pictures on their back into right and left hand piles. The cards could be readily classified into two groups on the basis of "one" versus "two or more" objects in the picture, and this was the rule Verplanck used. The cards could also be classified according to other principles, such as: borders vs non borders, animals vs non animals, etc . . . .

The three experimental groups were: group P, which was differentially reinforced for placement and did not have to state hypothesis; group PH, which in addition to being differentially reinforced for placement was asked to state a rule prior to placement; and group H, where reinforcement was based not on placement but on statement of a particular hypothesis--"the experimentally correct one."

In all cases reinforcement followed placement of the card and the subjects were not aware whether they were being reinforced for placement or for statement of hypothesis. For all Ss each placement was followed by E saying either "yes" or "no".

The results indicated that the H subjects stated the correct hypothesis significantly better than did the PH subjects and that every member of the H group stated the correct hypothesis more often than he placed the cards correctly, that is, hypothesis about simple card sorting discriminations did not show a 1:1 relationship with actual card sorting behavior. Verplanck failed, however, to elaborate on the nature of the relationship. Although the study indicated that statements of hypothesis could be conditioned by reinforcement, little mention is made about extinction of hypothesis statements. The results which may be said to be indicative of the fact that some type of extinction is possible were to the effect that all subjects learned to sort cards correctly into the two piles, but many near the end of the session were unable to state the correct principle according to which they were sorting the cards. From the above studies two tentative conclusions can be drawn. The first is that verbal statements follow the laws of operant learning and extinction, and the second is that we often learn to perform a task but fail to know the principle according to which we perform.

The purpose of this study is essentially to extend on the findings of Verplanck and Oskamp, that is, to discover the type of relationship between hypothesis behavior and card sorting task, and to attempt to measure the extinction of hypothesis behavior.

The present study is concerned with four questions:

(1) Will S accurately state the rule at the end of learning but prior to extinction when placement is consistently reinforced?

(2) What type of verbal behavior follows when the placement of cards is neither reinforced nor punished while hypothesis statements are continuously punished?

(3) What happens when the card sorting behavior is reinforced randomly 50 per cent of the time while hypothesis behavior is being punished (extinguished)?

(4) What will be the relationship between card placement and hypothesis statement under the above conditions?

METHOD

Apparatus

One hundred eleven trading cards of the type used by Verplanck were employed. Each card had a blank face and a picture on the back, 95 were different and 16 were duplicates. Thirty-nine of the cards contained flowers and forty-one had animals. The remaining pictures were miscellaneous. All of the cards could be classified according to many different principles, such as flowers vs non flowers, animals vs non animals, one vs two or more objects, cards with borders vs non bordered cards, etc.

Subjects

Forty-eight undergraduate students at Michigan State University of whom 24 were males and 24 females were randomly assigned into two groups. Half of each group was tested under condition 1, and the other half under condition 2. Additional 12 subjects were run in a control group in which the subjects were never extinguished.

In the present study there were two groups and two experimental conditions:

Group A (Ga)

For the subjects in this group the correct solution to the initial problem was "all cards with animals go in the

right hand pile," and the solution to the second problem following the extinction session was "all cards with flowers go in the right hand pile." In this group S was told "This is an experiment that involves sorting a deck of trading cards into right and left hand piles. Here is a deck of cards and you are to sort them. After the placement of each card I will tell you whether your placement is correct or not; if your placement is correct I will say 'right,' and if your placement is incorrect I will say 'wrong'." If subjects had finished sorting the deck before reaching the criterion, a new deck was given to them by the experimenter. Each placement was considered one trial. Cards placed incorrectly were left in the pile in which they were placed and only the top card of each pile was visible to the S. When S reached the criterion (12 successive correct placements), he was asked to state the rule according to which he sorted the cards. If the S failed to solve the initial task in 200 trials, he was discarded from the rest of the experiment, as it was felt that it would be impossible to evaluate his subsequent performance following extinction.

Group B (Gb)

The procedure for this group was the same as for Group A except that the problem involving flowers was given first, and following extinction, the animal vs non animal discrimination task was presented. This group differed from Group A in that the order of presentation of the two problems was reversed.

After the S had correctly solved the initial problem, irrespective of the group that he was randomly assigned to, he was again randomly assigned to one of the two experimental conditions.

Condition 1.

Under this condition, all hypothesis statements made by the subjects were called "wrong," while nothing was said about where the subjects placed cards.

In this condition the S was told "Now we will do a different problem. In the last problem after you had finished sorting the cards correctly, I asked you to state the rule according to which you sorted them. This time, I want you to state a rule before you place each card, and this time I will tell you whether your rule is correct or not. I will not tell you anything about the way that you place the cards, but I still want you to place them into two piles, a left hand pile, and a right hand pile. Remember, state a rule before placing each card, and do not place the card until I have told you whether your rule is correct or incorrect." The S was then given a reshuffled deck of cards. The first three rules that the S stated were always judged "wrong." The next simple rule, provided it was not used for groups A and B was judged "right." The subject continued sorting the cards until this rule had been stated five consecutive times, and consequently rewarded five consecutive times. The purpose of the above part of the

procedure, which was the same in condition 2, was to show the subject, prior to extinction of statements of hypothesis, that a problem could be solved even if some of the initial hypotheses were incorrect.

At the end of the five consecutively reinforced trials the S was told "you have solved the problem correctly. Now that you understand how to go about solving this type of a problem, let us do another problem. Again state a rule before you place each card and I will tell you whether your rule is correct or incorrect, but do not place the card until I tell you whether your rule is correct or not." The cards were again reshuffled and given to the subject.

The S was now given 30 extinction trials, where every hypothesis that was stated was judged "wrong" by E. After 30 extinction trials E said: "O.K., let us do another problem. In this problem you do not have to state rules anymore, just sort the cards and I will tell you if your placements are correct or incorrect." The pre-determined pattern in this part of the procedure depended on whether the particular subject was in group A or in group B. If the S was in group A, the present problem was to sort the cards so that all cards with flowers went in the right hand pile, as initially the problem was that all cards with animals went in the right hand pile, and all cards without animals went in the left hand pile. If S was in group B, he was now given the animal problem. Thus there was a counter-balancing procedure for the two problems.

When S reached the criterion, E asked the S to state the rule according to which the subject had sorted the cards. If the subject failed to state the rule, or stated the incorrect rule, he was given a recognition sheet with 12 hypotheses and asked to select the one he thought was correct, or closest to the way in which he was sorting the cards. (See Appendix.)

The purpose of the recognition sheet was to find out how punishment might be effecting extinction. Was the subject sorting cards without any implicit rule, that is, was it the ability to formulate hypotheses that had been extinguished, or were the overt statements of these hypotheses temporarily suppressed due to punishment? In other words, did extinction involve only the overt statements of hypotheses. If S were unable to recognize the correct rule when presented with the recognition sheet, our first notion would seem to be supported, but if the S is able to correctly recognize the hypothesis, the second notion would appear to be supported.

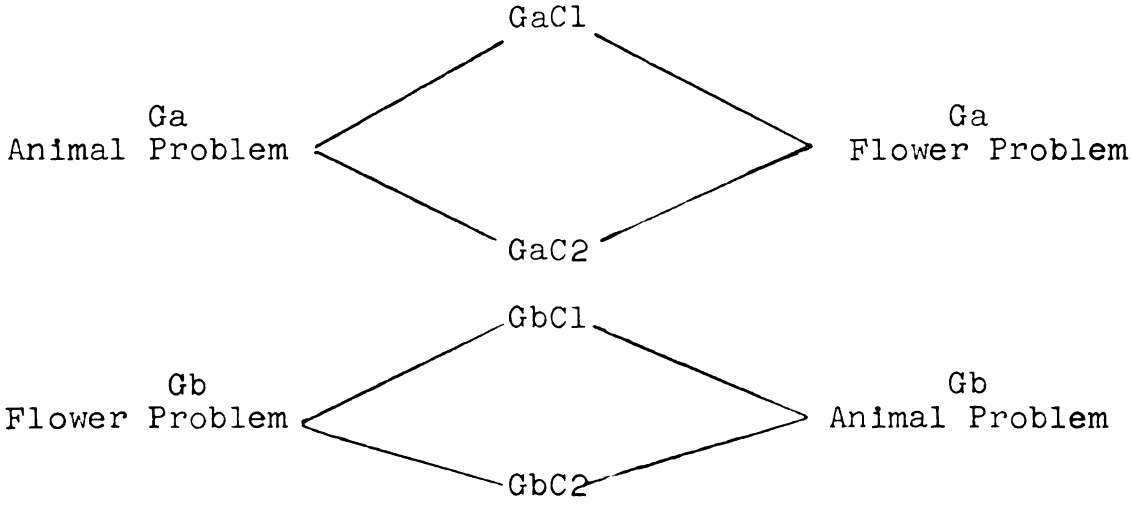
Condition 2

Under this condition, all hypotheses made by the subjects were also judged incorrect, but 50 per cent of the placements were randomly called "right," and the rest "wrong."

The only other difference between conditon 1 and condition 2, was substituting the following for condition 1:

At the end of the 5 consecutively reinforced hypotheses S was told "You have solved the problem correctly, and now that you see how to go about solving this type of a problem, let us do another problem. Again I want you to state a rule before you place each card, and I will tell you whether your rule is correct or incorrect, but in addition I will also tell you whether your placement is correct or incorrect." The S was then given 30 extinction trials where each hypothesis that he made was called "wrong," while half of his placements were judged correct and the other half incorrect according to a previously established random pattern.

The design, therefore, consisted of two groups, half of each group being tested under condition 1, and the other half under condition 2. Schematically the design may be represented in the following manner:



Criteria for Learning

The criterion of 12 successive placements constituted correct solution of the problem. Solution of two problems

was involved. The two correct solutions were:

1. All cards with animals go on the right, everything else goes on the left.
2. All cards with flowers go on the right, everything else goes on the left.

Half the subjects got problem one first and the other half, problem 2. A placement was judged correct if the S placed a card with a picture of an animal on the right, or a card without an animal on the left. In problem 2 a placement was correct if a picture of a flower was placed on the right, or a picture without it on the left.

Criterion for Extinction

Extinction trials were those in which every hypothesis statement that S made was punished by having the E say "wrong." Thirty trials or three consecutive failures to state a hypothesis on the part of the subject constituted the extinction period.

Although the study is exploratory in nature, the design was established to permit investigation of some specific problems. Basically the author was interested whether extinction can occur, and the extent to which it does; and the type of relationship existing between hypothesis behavior and actual card sorting in conditions C1 and C2.

RESULTS

It was assumed that the two card sorting problems would be of equal difficulty. As can be seen in Table 1 however, during the initial problem, sorting cards according to the flowers vs non flowers principle proved more difficult than sorting the cards according to the animal vs non animal principle. The t for this difference with 39 degrees of freedom, yielded a value of 2.447 which is significant at the .05 level of confidence. Another interesting but unexpected finding is that the number of trials to criterion, for the two problems following extinction under 50 per cent random reinforcement for placement, remains relatively the same as before extinction, but following extinction where card placements were consistently not reinforced the flower problem now required fewer trials, while the animal problem became more difficult. Comparative date for the control group is presented in Table 2.

In order to analyze the effect of extinction on the subsequent statement of hypotheses it was necessary to find whether the difference in the difficulty of the two problems would contaminate the evaluation of hypothesis behavior. The best way of doing this was to determine whether the difference between the mean gain or loss in trials to criteria (shift score), from the task prior to

TABLE 1

DISTRIBUTION OF THE NUMBER OF TRIALS TO CRITERION FOR TWO PROBLEMS PRIOR TO, AND FOLLOWING EACH OF TWO EXTINCTION PROCEDURES

Prior to Extinction of Hypotheses Statements		Following Extinction			
		Following C2 (50% random reinf. of placement)		Following C1 (No reinf. of placement)	
Flowers First (N-20)	Animals First (N-20)	Animal Second (N-10)	Flowers Second (N-10)	Animal Second (N-10)	Flowers Second (N-10)
18	31	14	27	18	51
38	13	30	30	19	43
41	15	52	13	80	44
31	68	34	135	22	35
92	33	23	65	13	91
66	71	71	67	135	83
41	30	34	64	26	13
97	30	18	51	140	47
102	22	56	96	86	31
57	56	22	23	92	39
68]	20]				
59]	29]				
34]	35]				
35]	53]	Scores for these Ss following extinction appear in columns 5 and 6, respectively.			
54]	28]				
81]	59]				
34]	90]				
47]	18]				
69]	38]				
50]	31]				
M 55.70	38.50	35.40	57.10	63.10	47.70
Mdn 52.50	31.00	32.00	57.50	53.00	43.50
σ 23.53	20.84	15.26	37.80	49.77	23.21

TABLE 2

THE DISTRIBUTION OF THE NUMBER OF TRIALS TO CRITERION FOR TWO PROBLEMS IN THE CONTROL GROUP

	Flowers First	Animals Second	Animals First	Flowers Second
	43	18	12	14
	40	19	37	18
	48	48	56	98
	80	24	30	89
	38	16	46	37
	59	80	26	32
M	51.33	34.17	34.50	48.00

extinction to the task following extinction significantly for the two problems. Table 3 gives the distribution of this difference and the method used for calculating the mean shift score. As can be seen in Table 4, the $\underline{t}$ value of .8409 is not significant. We may therefore conclude that the difference in the difficulty of the two problems should not influence the rest of the analyses.

One of the questions asked in the first part of this paper was whether punishment of hypothesis statements would produce extinction of verbal hypothesis behavior, and if so, was it extinction of the ability to formulate hypothesis, or was it extinction of the verbal statements of hypotheses.

In order to establish whether any form of extinction took place, a X^2 for correlated proportions was calculated on the number of subjects who succeeded or failed to state the correct hypotheses on task 1 prior to extinction and on task 2 following extinction (2,6). As the two experimental extinction procedures did not result in differential ability to state the corrrect hypotheses, we felt justified in combining the data for subjects in the two conditions.

Table 5 presents the statistical analysis for the difference between the two proportions, p_i and p_{ii}(6). The obtained $\underline{z}$ pf 4.11 and X^2 of 16.82 with 1 degree of freedom indicate that the difference between the two proportions would occur by chance less than once out of a thousand.

TABLE 3

CALCULATIONS OF THE MEAN SHIFT DIFFERENCE BETWEEN SCORES FROM CARD SORTING TASK PRIOR TO EXTINCTION TO CARD SORTING TASK FOLLOWING EACH OF TWO DIFFERENT EXTINCTION PROCEDURES

No Reinforcement for Placement						50% Random Reinforcement for Placement					
Anim. 1st	Fl. 2nd	(Xi) Dif. F-A	Fl. 1st	An. 2nd	(Xii) Dif. A-F	Anim. 1st	Fl. 2nd	(Yi) Dif. F-A	Fl. 1st	An. 2nd	(Yii) Dif. A-F
20	50	31	68	18	-50	31	27	- 4	18	14	- 4
29	43	14	59	19	-40	13	30	17	38	30	- 8
35	44	9	34	80	46	15	13	- 2	41	52	11
53	35	-18	35	22	-13	68	135	67	31	34	3
28	91	63	54	13	-41	33	65	32	92	23	-69
59	83	24	81	135	54	71	67	- 4	66	71	5
90	13	-77	34	26	- 8	30	64	34	41	34	- 7
18	47	29	47	140	93	30	51	21	97	18	-79
38	31	- 7	69	86	17	22	96	74	102	56	-46
31	39	8	50	92	42	56	23	-33	57	22	-35
401	477	76	531	631	100	369	571	202	583	354	-229

$$\text{Mean shift} = \frac{\sum_{1}^{10} (Y+C-X) + \sum_{1}^{10} (X+C-Y)}{2n} = \frac{100 + 76}{20} = 8.80$$

$$= -\frac{229 + 202}{20} = -1.35$$

TABLE 4

TEST OF SIGNIFICANCE FOR THE DIFFERENCE BETWEEN MEAN SHIFT SCORES FROM CARD SORTING TASK PRIOR TO EXTINCTION, TO CARD SORTING TASK FOLLOWING EACH OF TWO DIFFERENT EXTINCTION PROCEDURES

	Mean	Variance	S. D.	t	P
50% Random Reinf. of Placement	-1.35	1072.38	32.75	.8409	Ns.
No Reinf. of Placement	8.80	1841.06	42.91		

TABLE 5

X^2 FOR CORRELATED PROPORTIONS FOR FREQUENCY OF FAILURE AND SUCCESS IN STATING THE CORRECT HYPOTHESIS ABOUT A CARD SORTING TASK PRIOR TO AND FOLLOWING EXTINCTION OF HYPOTHESIS STATEMENTS

	Test II		
Test I	Failure	Success	Total
Success	40	30	70
Failure	0	10	10
Total	40	40	80

p_i = .8688 (corrected)

p_{ii} = .5062 (corrected)

$p_i - p_{ii}$ .0883

z = 4.11 P .001

X^2 = 16.82 P .001

All S's who failed to state the correct hypothesis were given a recognition sheet consisting of 12 possible rules. All 10 subjects who failed to state the correct hypothesis recognized the correct rule. The probability of such an event occurring by chance is $(1/12)^{10}$. We may safely say that something other than chance operated in the recognition of the rule.

Another way in which we evaluated the effects of punishment of hypothesis behavior on subsequent statement of hypotheses was to compare performance of a control group, who had never undergone extinction, with performance of the experimental group. All 12 controls stated the correct rule following both problems. In the experimental group all 40 subjects stated the correct rule following the solution of the initial task (problem) but only 30 out of 40 subjects were able to state the correct rule following solution of the second problem. The probablity of obtaining such a distribution is .0520.[1]

Table 6 shows the frequency with which subjects, under two different extinction procedures, placed cards in accord with and counter to the stated hypotheses. It can

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[1]Probability was computed by using Fisher's exact probability test for X^2 analysis when expected frequencies are less than five (6).

$$P = \frac{(a+b)!\ (a+c)!\ (b+d)!\ (c+d)!}{N!} \left(\frac{1}{a!\ b!\ c!\ d!}\right)$$

TABLE 6

FREQUENCY OF CARD PLACEMENTS "SAME" AND "OPPOSITE" TO THE STATED HYPOTHESIS DURING EXTINCTION OF HYPOTHESIS STATEMENTS UNDER TWO EXPERIMENTAL CONDITIONS[a]

No Reinf. of Placement Condition 1		50% Random Reinf. of Placement Condition 2	
Same	Opposite	Same	Opposite
30	0	19	11
26	4	29	1
30	0	29	1
7	23	5[b]	5[b]
30	0	7	23
30	0	25	5
30	0	9[b]	3[b]
30	0	30	0
5	25	11	19
30	0	30	0
29	1	24	6
30	0	15	15
25	5	24	6
26	4	27	3
24	6	25	5
28	2	17	13
30	0	17	13
30	0	8	22
29	1	30	0
30	0	21	9
Mdn 29.68[c]		24.00[c]	

[a]Out of 30 placements.

[b]Not included in computing the median as the two subjects refused to continue stating hypothesis after 10 and 12 trials respectively.

[c]Over-all median for C1 and C2 combined = 27.50.

be seen that most subjects consistently place cards according to the stated hypothesis, but the few who do not, place them consistently in contrast to the stated hypothesis. Thus there exists somewhat of an "all or none" affair: For most Ss, most of the cards are placed in accordance with the punished hypotheses, and in fewer cases, most cards are placed counter to the punished hypotheses.

In the extinction procedure, where placement was randomly judged "right" 50 per cent of the time and "wrong" rest of the time, placements in line with the stated hypotheses are less frequent than in the condition where nothing is said about placement. Table 7 presents the percentages of "same" and "opposite" placements under the two conditions. A median test for "same" placement between the two extinction conditions yields a X^2 of 5.1722 with degrees of freedom equal to 1, which is significant at the .05 level of confidence. The median analyses is presented in Table 8.

We may therefore conclude that although "same" placements are higher than "opposite" placements in both extinction procedures, subjects who had 50 per cent random reinforcement for placement had significantly fewer "same" placements than subjects who were told nothing about the correctness of their placements.

TABLE 7

PERCENTAGE OF CARD PLACEMENTS "SAME" AND "OPPOSITE" AS THE STATED HYPOTHESES FOR TWO TYPES OF EXTINCTION

	Same	Opposite
50% Random Reinforcement of card Placement (C1)	71.85	28.15
No Reinforcement of Card Placement (C2)	85.17	14.83

TABLE 8

MEDIAN TEST FOR "SAME" PLACEMENTS BETWEEN C1B AND C2B

	C2	C1	Total
Below the Median	13	6	19
Above the Median	5	14	19
Total	18	20	38

$X^2 = 5.1722$ df = 1 $p < .05$

DISCUSSION OF RESULTS

On the basis of results from other studies (3, 7, 10, 12) we expected that once the subjects learned to sort cards into the two piles during the initial task they would correctly verbalize the rule according to which they learned the discrimination. This expectation was borne out as all 40 subjects in the experimental group and the 12 controls stated the correct rule. However, 8 of the 48 subjects initially used in the study never did learn to sort the cards correctly within 200 trials and had to be discarded.[1]

How can one account for the finding that it took more trials to learn the "flower" problem than the "animal" problem? As we had an equal number of male and female subjects solving both problems this difference does not appear to be

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[1]It is suspected that the reason for their inability to learn the task was due to concentration on the incorrect pile. All 8 stated that they just could not figure out what pattern of cards went into the left hand pile. When asked whether they ever considered looking at what cards were correct in the right hand pile, they frankly admitted that they never did. From the design of the study, it is easy to see why some subjects may have concentrated on the left hand pile. Since only 39 or 41 reinforcements were possible in the right hand pile and a total of 111 cards were used, the subjects would tend to have "left" placements reinforced more often than "right" placements. Thus it is not difficult to understand that some subjects could concentrate on the pile which yielded greater frequency of reinforcement. This assumption may also explain why some subjects took more trials to solve the problem than others.

a sex difference. It is therefore felt that the "flower" hypothesis is more difficult to conceptualize than the "animal" hypothesis. A reasonable assumption is that awareness of a principle may be a function of how often we come in contact with certain class of objects. We find animals all around us and many of us own some kind of a pet, and it is easier to learn something with which we have had some previous experience. That is to say that the new experience fits better into our schema. In other words, for subjects solving the animal problem more positive transfer was involved than with the flower problem since most of us do not have as highly developed a schema for flowers as for animals.

In the results we mentioned a rather puzzling finding, namely that following extinction, where no reinforcement for placement was given, the "animal" problem required more trials to criterion, while the "flower" problem required fewer trials. We can find no adequate explanation for this finding. One may argue that having exhausted all simple hypotheses during the thirty extinction trials subjects would be prone to think that the rule was a difficult one, and thus the very simplicity of the correct rule, would make the problem more difficult. But if this were the case, why shouldn't the same phenomenon occur in the group which underwent extinction where 50 per cent of placements were randomly reinforced. There does appear one possible explanation, however, a chance occurrence. If we look in column 5, of

Table 2, it can be seen that two subjects needed 135 and 140 trials to solve the problem. These two scores account to a great extent for the high mean. If we were to disregard these two scores, the mean would be 44.50 instead of 63.10. Thus it may be assumed that the mean of 63.10 is somewhat of an artifact and in reality the problem is not as difficult as the mean score would indicate it to be. This assumption appears even more plausible if we look at Table 2, where there is no difference in the difficulty of the animal problems for the control group irrespective whether it was solved prior to the flower problem or following it.

We find no evidence that the two differential extinction procedures produce different effects on subsequent verbal behavior. But the results do indicate that some form of extinction took place in 25 per cent of the experimental group. This inability to verbalize the correct rule is presumably not a chance phenomenon but is due to the punishment of verbal statements of hypotheses. It should be noted, however, that we did not punish one specific hypothesis as did Verplanck (16), but all hypothesis statements. We have no way of knowing which hypotheses underwent extinction and which did not, as generally the thirty stated hypotheses were different and thus punished only once. (An interesting, but hardly conclusive finding, was that both of the subjects who refused to state any more hypotheses during the extinction also failed to state the correct rule

following the solution of the second problem). Thus, we can only say that punishing verbal behavior results in some inhibition of subsequent correct verbalizations about the rule for a rational learning problem. Further, since all subjects who failed to state the correct hypothesis recognized it when presented with a recognition sheet, it seems that this inhibition is not permanent but only temporary. The original habit of verbalizing hypothesis statements is not extinguished but merely weakened or suppressed by punishment. As expected, the control group did state the correct hypothesis following each problem, as there was no interfering activity between the two problems which would inhibit the subject's verbalization.

The most interesting results relate to the manner in which subjects place cards during each of the two extinction procedures. The immediate reaction of "If my rule is wrong then the card belongs in the opposite pile" generally does not occur. The subjects seem to take the attitude, that as long as their rule is wrong it does not really matter where they place the cards. This way of thinking is significantly more apparent in the group which was told nothing about their manner of placement, but it also exists to a large extent in subjects who were informed about the correctness or incorrectness of their placements. The "I don't care which pile the card belongs in" was further evident by the manner in which the subjects placed their cards. As

frustration over the inability to get the correct rule increased, as testified by subjects' comments to the effect: "Boy, am I stupid," "What the hell is the correct rule," "I bet you I'm the only one that can't do it," "Has any anyone else figured it out?," etc., they threw the cards down with increasingly greater force and an expression of utter disgust. Why then didn't they place the cards randomly? It may be fairly natural under frustration to throw the card into the pile about which S had just verbalized. A similar finding was reported by Bayton and Conley (2). There were few subjects, however, who may be said to have approached the problem more rationally. These subjects tended fairly consistently to place cards opposite to the stated hypotheses. An example of this was when a subject under 50 per cent random reinforcement of placement said: "If animals don't go on the right then I should place the card on the left. . . Ah since the placement is wrong, then the correct rule cannot be that animals go on the left."

Very tentatively it might be said that two types of people, who react differently to punishment or frustration, were being observed in the present study. Those who in spite of failure approach the problem rationally, and those who work by trial or error. As to which type of subject experiences greater frustration is yet another unanswered question.

SUMMARY

Forty undergraduate students at Michigan State University were tested on two card sorting tasks, one preceding and one following two experimental extinction procedures. This study did not test any specific hypotheses but the design was set up to answer four questions: (1) Will S accurately state the rule at the end of learning but prior to extinction when placement of cards is consistently reinforced, (2) what type of verbal behavior follows when the placement of cards is neither reinforced nor punished while hypothesis statements are consistently punished, (3) what happens when the card sorting behavior is reinforced randomly 50 per cent of the time while hypothesis behavior is being punished, and (4) what will be the relationship between card placement and hypothesis statement under the above conditions.

The results indicated that Ss do verbalize the correct hypothesis following the solution of the task which preceded extinction.

The two experimental extinction procedures did not result in differential ability to state the correct hypothesis, but 25 per cent of the subjects failed to state the correct rule following learning of the second problem. All of the subjects who failed to state the correct rule

following either of the two extinction procedures, recognized it when presented with a recognition sheet. It was, therefore, concluded that the ability to state the correct rule was temporarily inhibited as a result of punishment.

The group which underwent extinction where 50 per cent of card placements were randomly reinforced placed cards in a significantly different manner, in that their placements were less in line with the stated hypothesis than the group which was uninformed about the relative correctness of their placements.

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APPENDIX

RECALL - RECOGNITION SHEET

See if you can find the rule, among the 12 rules listed below, that most closely resembles the one that you think is correct in solving the last problem, and make a check mark next to it.

1. All cards with animals and borders go on the right.
2. All cards with borders go on the right.
3. All cards with scenery go on the left.
4. All cards with animals go on the left.
5. All cards with animals and borders go on the left.
6. All cards with dogs go on the left.
7. All cards with flowers go on the right.
8. All cards with dogs go on the right.
9. All cards with animals go on the right.
10. All cards with borders go on the left.
11. All cards with scenery go on the right.
12. All cards with flowers go on the left.

DATA SHEET FOR CONDITIONING OF CARD SORTING
TASK PRIOR TO AND FOLLOWING EXTINCTION

Name _____ Sex _____

Age _____ Class _____

Trial	Right	Wrong
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
.		
.		
.		
200		

Rule: _____

DATA SHEET FOR C1

Trial	Hypothesis	Wrong	Placement	
			Left	Right
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

DATA SHEET USED FOR EXTINCTION TRIALS
USED FOR C2

Random Sequem of Placement Reinf.	Trial	Hypothesis	Placement R.	Placement L.
R	1			
R	2			
R	3			
W	4			
W	5			
R	6			
W	7			
R	8			
W	9			
R	10			
W	11			
W	12			
W	13			
R	14			
R	15			
W	16			
W	17			
W	18			
R	19			
W	20			
R	21			
R	22			
W	23			
W	24			
W	25			
R	26			
W	27			
R	28			
R	29			
R	30			

R - right
W - wrong

L - left side
R - right side