

THE EFFECTS OF REINFORCEMENT AND
INTENSITY ON ORIGINALITY AND
CREATIVITY

By

DENNIS EDWARD MERCADAL

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Louisiana State University

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Thesis Approved:

Donald K. Fromme

Thesis Adviser

Lay T. Bann

Edith H. Wainman

N. N. Smith

Dean of the Graduate College

896824

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In the sixth century before Christ a slave told this tale, which has survived till the present day. I find this story particularly apt to my own situation as Aesop said in one paragraph what took me 75 pages to describe.

Here is the tale of "The Wind and the Sun" as follows:

The Wind and the Sun were disputing which was the stronger. Suddenly they saw a traveller coming down the road, and the Sun said: "I see a way to decide our dispute. Whichever of us can cause that traveller to take off his cloak shall be regarded as the stronger. You begin." So the Sun retired behind a cloud, and the Wind began to blow as hard as it could upon the traveller. But the harder he blew the more closely did the traveller wrap his cloak round him, till at last the Wind had to give up in despair. Then the Sun came out and shone in all his glory upon the traveller, who soon found it too hot to walk with his cloak on.

"Kindness Effects More Than Severity."

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CHAPTER I

INTRODUCTION

Many books have been written about creativity. These efforts have centered on autobiographical information, personality characteristics, speculation, or factorial studies of creative responses. While such information is valuable, it is remarkable that there has been very little experimentation with the parameters of creativity. One stumbling block is that creativity is regarded as a complex mental process which cannot be studied under experimental conditions. It is felt by this writer that that idea is wrong. Creativity, like other higher mental functions, such as memory, can be subjected to experimental investigation.

Consistent with this view, this paper will investigate the effects of reward and punishment on creativity. When a sufficient number of parameters influencing creativity can be delineated, then these variables can be used for the practical purposes of enhancing creativity. Such a goal is certainly worth pursuing.

Before going further, some attempt should be made to delineate what is meant by creativity. This project is best approached by defining the term "originality". An original response is defined as an unique, novel, or uncommon

response. Now, a creative response can be novel or unique, but it also encompasses much more. Creativity is a term commonly used to designate the landmark discoveries of civilization. To attempt to adequately define creativity would be futile because not enough is known about its attributes. However, it is assumed that originality is an essential component of creativity. It is further assumed that originality is positively related to creativity. As originality increases so should creativity. Originality should be one index of creativity.

There are some tests which have been used to measure creativity. Two such measures, the Plot Titles Test and the Alternate Uses Test, will be used in this study. These tests are the best available measures today, but they are still crude approximations of what most people mean by creativity.

CHAPTER II

STATEMENT OF THE PROBLEM

The purpose of this experiment is to compare the effects of different types of reinforcement on creativity. More explicitly, the effects of weak and strong reward of original responses will be compared with the effects of weak and strong punishment of common responses.

It is predicted the four types of reinforcement mentioned will have a differential effect upon a variety of dependent variables. The dependent measures will be: number of original responses, latency of responses, resistance to extinction, scores on the Plot Titles Test, scores on the Alternate Uses Test, measures of self-confidence, and the subject's ratings of his own creative abilities. All of these dependent variables are related either directly or indirectly with creativity.

CHAPTER III

THEORETICAL FORMULATIONS

A number of theorists have attempted to delineate the personality characteristics of the creative individual. Freudian theory emphasizes the importance of a secure sense of self, adequate trust, and moderate rather than severe superego pressure (Shafer, 1958). Crutchfield (1962) emphasizes the trait of self-confidence. Barron (1963) finds original individuals are more independent, self-assertive, have a preference for complexity, and make conspicuously little use of the mechanism of repression. Mednick (1963) distinguishes between creative and noncreative individuals in terms of association gradients. In a review of the experimental literature, Dellas and Gaier (1970) find certain consistencies in the personality characteristics of creative people. Most characteristics previously mentioned are present, but also delineated are high motivation and a greater willingness to take risks.

It is expected that reward and punishment will have differential effects upon the personality traits mentioned and consequently will influence the individual's ability to produce original responses. In addition to the personality theorists mentioned, the theoretical views of both Spence

and Marx will be used to predict the effects of punishment and of reward on creativity.

In Freud's theory the individual uses regression in the service of the ego to unlock unconscious material used in creativity. Defense mechanisms are temporarily suspended to allow this process to occur. For such a suspension of defense mechanisms to take place, the individual must possess certain personality characteristics.

Moderate rather than severe superego pressure is a personality characteristic favorable to the creative process in the individual. Anxiety will limit the degree to which a person may achieve a moderate superego (Shafer, 1958).

If the person does not possess a high degree of trust of others, then regression will be impaired. Also, fear of punishment will limit the individual's ability to trust others (Shafer, 1958).

In Freudian theory punishment produces anxiety and guilt. Early unassimilated trauma is revived which produces distrust, insecurity, and a harsh superego. The subsequent arousal of defense mechanisms impairs the creative process. Freudian theory predicts that punishment will impair creativity.

According to Crutchfield (1962), the creative person maintains his own independent opinions despite the opposing views of others. This happens because the individual is confident of the value of his ideas and of his own self-worth. Without the tenacity made possible by a

self-confident attitude, the individual would give into group pressures.

One of the more important traits Barron's theory (1963) delineated as a characteristic of creative people is a minimal use of repression. Creative individuals are much more likely to be receptive to new ideas. Barron compares a noncreative person with a totalitarian state or with a neurotic. All three depend upon repression in maintaining stability. Although Barron does not explicitly state it, repression is usually thought to be brought about by anxiety which is a by-product of punishment. It may be expected that a punishment schedule will increase repression and will constrict creativity.

One further personality trait will be examined. Dellas and Gaier (1970) cite research suggesting that the creative individual is an impulsive person; he is more willing to take risks than individuals low in creativity. Anderson and Cropley (1966) go as far to state their research indicates the most important distinction between creative and noncreative individuals is a willingness to take risks. The creative individual is indifferent to the fear of making mistakes, of social disapproval, and of the anxiety of separateness.

Anderson and Cropley's research bears some relation to investigations associated with achievement and risk taking. There are two types of achievement motivation. One is directed to the avoidance of failure. The other is oriented

to the attainment of success (Birney, Burdick, and Teevan, 1969). Subjects motivated primarily by hope for success are more willing to take risks than subjects dominated by fear of failure (Moulton, 1965). Subjects motivated by fear of failure are also characterized by high anxiety. Further research indicates subjects who are high in fear of failure are exposed to more punishment than those not dominated by fear of failure (Birney, Burdick, and Teevan, 1969). Punishment, fear of failure, unwillingness to take risks, and lack of creativity, therefore, appear to be related.

With respect to the trait of independence, research demonstrates that subjects motivated by fear of failure are more likely to give in to group pressures than are subjects not motivated by fear of failure (Birney, Burdick, and Teevan, 1969). Similarly, subjects who are high in hopes for success are more independent than those who score low (Byrne, 1966). A theory has been formulated in which reward produces hope for success motivation (Birney, Burdick, and Teevan, 1969). Therefore, one may expect that reward, hope for success, independence, and creativity are related.

Mednick (1963) hypothesizes a creative individual is characterized by a flat associative gradient. That is, relatively remote associations have a good probability of being evoked. A noncreative individual has a steep associative hierarchy, or a few responses have a high probability of being evoked. More remote associations have a low probability.

Mednick does not state how these associational gradients are formed. One possible reason for the difference is the reinforcement histories. A person with a history of positive reinforcement has a flat gradient. A steep gradient is produced by a history of punishment. Such an interpretation is consistent with the constricting effect punishment produces. Research supporting the constricting response effect will be reviewed later.

Mowrer's avoidance hypothesis states that as a result of punishment, fear is conditioned to internal stimuli characteristic of the punished act. The fear produces avoidance behavior, and the avoidance behavior is reinforced by drive reduction. The stronger the habit strength of the avoidance behavior, the greater is the probability that the fear stimulus evokes it. Mowrer's theory does not take into account the conditioned emotional response, a side effect of noncontingent punishment, which produces a general inhibitory effect on behavior. When the habit strength of the avoidance response is weak, the general inhibitory effect is especially prominent. The organism literally does not know what response produces the aversive stimulus, or what response allows him to avoid it. The result is a constriction of all responses. When the habit strength of the avoidance response becomes stronger (i.e., the organism knows which responses prevent the punishment and which produce the punishment), then only the punished response is suppressed. The degree of strength of the general inhibi-

tory effect is contingent upon the habit strength of the avoidance response. Because the habit strength of original responses by definition is low, it may be expected that the general inhibitory effect caused by punishment will be significant, especially at the outset of originality training. As training progresses, the general inhibitory effect is less prominent.

Spence (1963) finds that subjects scoring high on the Manifest Anxiety Scale are quicker to learn simple common word associations than are subjects scoring low on the Manifest Anxiety Scale. However, when uncommon associations are learned, subjects scoring low on this scale are superior. This indicates that novel responses are more easily learned by subjects low in anxiety. Keeping in mind that anxiety and punishment are intimately related, Spence's theory predicts punishment has a detrimental effect upon learning of original responses. The more intense the punishment, the more detrimental the effect will be.

Maltzman (1960) appears to be the first to define originality as a statistically uncommon word association. He further proposes that an original response is intrinsically reinforcing. It may be implied that once an individual attains a certain level of original responding, this rate maintains itself because of intrinsic reinforcement. That is, there is no extinction effect. This is contrary to the predictions of extinction being made in this experiment.

In summary the theories reviewed agree that punishment has a negative effect either on the personality characteristics necessary for creativity or directly on the creative response. Reward, because it does not produce the adverse side effects of punishment, has a facilitory effect on creativity. With regard to the more restricted concept of originality, Maltzman's theory predicts minimal extinction effects because of what he terms the intrinsic reinforcing properties of original responses.

CHAPTER IV

REVIEW OF EXPERIMENTS

Experiments already studying the effects of punishment and reward will be reviewed. These experiments together with the chapter on theoretical formulations will provide the rationale for the predictions made.

Reinforcement and Creativity

Hinton's (1968) results indicate punishment reduces creative problem solving performance. Werner (1971) learned praise is more effective than stress for high aptitude 9th graders in producing high scores on creativity tests. Ward, Kogan, and Pankove (1970) found that reward increases the number of creative ideas produced by children.

Maier (1940) detected that punishment produces rigidity in behavior in animals. Also, Racinkas and Vogel-Sprott (1969) uncovered evidence that punishment induces rigidity in alternative responses in humans. McManis and Bell (1968) found reward seekers take greater risks than punishment avoiders.

Anxiety and Creativity

Zdep (1966) discovered high creatives are less

anxious than low creative subjects. Similarly, Kobayshi (1970) found highly creative Japanese boys are less anxious than low creatives. Low anxiety subjects are superior on divergent production tasks (White, 1968). Guenther's (1966) results indicate that anxiety inhibits creative ability and higher cognitive processes, but can facilitate simple learning. Drawing upon this research and the previous chapter on theoretical formulations, it is predicted reward will be more effective than punishment in producing creative responses.

Magnitude of Reward

Spence (1956) analyzed the effects of differential magnitudes of food reward on hooded rats. The results indicate that increased amounts of food reward improve performances. Lehr (1970) and Cross (1964) confirmed Spence's findings. Siegel (1962) found with preschool children the probability of correct responses in discrimination learning increases as the amount of food reward increases; the data pointed to the prediction that an increase in reward magnitude facilitates performance. Using extrapolation, it is predicted an increase in magnitude of reward encourages creative responses.

Magnitude of Reward and Response Latency

Schrier (1961), using Rhesus monkeys and food reward,

discovered a decrease in response latency as food reward increased. It is predicted that response latency should decrease as the magnitude of reward increases.

Magnitude of Punishment

There are indications that as the intensity of punishment increases the suppression of responding increases (Cheyne and Walters, 1960). Therefore, it is hypothesized that high intensity punishment will suppress all responses much more readily than will low intensity punishment. It may be expected that the type of response most likely to be adversely affected by the suppression effect of the higher intensity is the unique response because of its lower probability of occurrence.

Magnitude of Punishment and Response Latency

It is also expected that a very high intensity punishment will produce a much greater latency of responding than will a low intensity punishment. The more intense punishment will produce a very strong conditioned emotional response which will, in turn, produce a stronger inhibition of behavior. One way this inhibition will manifest itself will be in response latency. This inhibition will be especially evident at the beginning of the training situation where the disruptive effects of anxiety will be at their greatest.

Parameters of Originality

Attempts have been made to study the effects of certain variables on originality. These variables are: originality training, instructions to be original, and the use of verbal rewards and punishments.

Proceeding with Maltzman's (1960) assumption of the intrinsic reinforcing properties of original responses, a number of investigators (Caron, Unger, and Parloff, 1963; Freedman, 1965; Kropp, 1972; and Maltzman, Brooks, Bogartz, and Summers, 1958) attempted to influence originality by requesting subjects to produce a variety of responses to lists of stimulus words during the training period. The explanation for the inconsistent results obtained by these investigators is twofold: the amount of intrinsic reinforcement which was present was not sufficient to maintain a high level of original responding, and the measures of originality which were used were possibly inadequate. It is possible the Remote Associations Test is a measure of convergent rather than divergent production (Jackson and Messick, 1965).

Maltzman, Bogartz, and Breger (1958) found that instructions to be creative increase original word associations. Ridley and Birney (1967) found instructions to be creative had facilitory effects on creativity as measured by the Unusual Uses Test. However, Gallup (1962) and Rosenbaum, Arenson, and Pamman (1964) noted that instructions do not increase originality in word

associations. The positive results indicate that simple instructions to be creative may be sufficient. The negative results indicate instructions alone are not always adequate. One could say that the intrinsic reinforcement which occurs is not adequate to maintain a high level of original responding.

McDonald and Martin (1967) controlled for the possible secondary reinforcing characteristics of original words by dividing their samples into groups differing in initial levels of production of remote associations. Half of the group was then reinforced on each trial for common associations; each correct trial was followed by the experimenter's comment "good" and each incorrect trial by "bad". The results indicate that on both number of correct responses and trials to criterion, the reinforced groups performed better than yoked controls.

Maltzman, Bogartz, and Breger (1958) found reinforcing with "good" does not produce a significant difference in originality. Maltzman, Simon, and Licht (1962) compared a group receiving verbal positive reinforcement for uncommon associations to a control group; they found no significant differences. There were, however, possible explanations for the negative results of the last two studies.

Maltzman, Bogartz, and Breger (1958) found the reward "good" does not produce significant differences in originality. One difficulty is that they were using a fixed ratio schedule (every fifth original response was

reinforced). This would presumably result in only 12-15 reinforcements per subject over 125 trials. This could cause confusion on the subject's part, especially at the outset. The proposed study uses a continuous reinforcement schedule.

Maltzman, Simon, and Licht's (1962) study also had methodological deficiencies. One problem was that the criterion for an original response was too low. Any word other than the three most frequently occurring words in the Minnesota Norms (Russel and Jenkins, 1954) was considered an original response. There are many words having more than three very common associations. Therefore, the experimenters were reinforcing some very common associations which confused many subjects. This difficulty can be circumvented by making the criterion for original responses more stringent. Another difficulty is that original responses do not occur on a great enough frequency. One reason for this is that the subjects are not instructed to give original associations; thus, the administration of reinforcement is limited. This difficulty can be removed by instructing the subjects to produce original responses.

Summary

The experimental results indicate that original and creative responses are influenced by their consequences. The results also indicate that reward is generally more effective than punishment when creative responses are

involved. An increase in the magnitude of reward facilitates performance; an increase in the magnitude of punishment can inhibit performance. The predicted rank order for the four types of reinforcement used in the experiment is: strong reward, weak reward, weak punishment, and strong punishment. This rank order should carry over to the extinction period even though an overall decrement of original responses is expected. Response latency should have the same rank order with strong reward having the shortest response latency.

CHAPTER V

DEFINITIONS

Strong reward was defined as the stimulus word "good", "very good", or "excellent". A monetary reinforcement of two cents for each original response was also given. A counter in front of the subject indicated how many original responses he had given.

Weak reward was defined as feedback that the response was original. Feedback was given by a counter mechanism.

Strong punishment was defined as the statement "wrong". The verbal reinforcement was coupled with a loss of two cents for each common response. A counting mechanism indicated to the subject his cumulative number of wrong responses.

Weak punishment was defined as feedback that the response was common. Feedback information was given by the counter mechanism.

An original response was defined as a response to a stimulus word which did not occur in the Connecticut Word Association Norms (Bousfield, 1961).

CHAPTER VI

DEPENDENT MEASURES

Originality

An original response has already been defined. It was the most important index of creativity. If there were an increase in the number of original associations, then this by itself would be worthwhile information.

Extinction

If there were an increase in the number of original responses, then one question which arises is whether this type of response can be extinguished by discontinuing reinforcement, or is the response itself intrinsically reinforcing. The question can be answered by observing the consequences of discontinuing reinforcement for 50 trials. It was expected that the impact of the four different types of reinforcers would carry over to the extinction period. Thus, the rank order of the four experimental groups in the extinction period would be the same as the rank order predicted for the training period. It was also expected that there would be an overall decrease in the number of original responses as trials progressed during the extinction period.

Response Latency

The dependent variable, latency of response, was used primarily for explanatory purposes. If there were significant differences in original responses between experimental groups, then the length of time subjects took to respond might give some clue as to why these differences were obtained.

Plot Titles Test and Alternate Uses Test

Guilford (1967) in his factor analytic studies distilled four components of creativity: fluency, flexibility, elaboration, and originality. He measured fluency by asking an individual to produce a list of words sharing a particular characteristic. Flexibility was measured by requesting subjects to list as many possible uses for a particular object as, for instance, a nail. Elaboration was the degree of detail utilized in expressing a creative response. Originality was defined as a novel or a statistically infrequent response (identical with the definition employed in this paper).

The Plot Titles Test and the Alternate Uses Test measured certain factors Guilford had delineated, and these tests were employed in this experiment. (See Appendix A.) The Plot Titles Test measured the factors of originality and fluency (Guilford, 1967). The Alternate Uses Test measured the factors of flexibility and of originality (Guilford,

1967).

It was expected the training procedure used in the experiment would produce some generalization to scores on the Plot Titles Test and on the Alternate Uses Test. Therefore, it was predicted the rank order scores from highest to lowest on these tests would be: strong reward, weak reward, weak punishment, and strong punishment.

Self-Ratings of Confidence and Creativity

A history of punishment or of reward has an important effect upon personality. It is further possible that a single punishing or single rewarding situation can have at least short-term effects upon personality characteristics. Theories reviewed in the chapter on theoretical formulations indicate personality characteristics play crucial roles in the creative process.

One characteristic examined was self-confidence. It was predicted that subjects under a reward schedule would show greater self-confidence than those under a punishment schedule. The more intense the punishment, the lower the degree of self-confidence displayed. The more intense the reward, the greater was the degree of self-confidence. To measure self-confidence the subjects rated themselves on their feelings of self-confidence and on their capacities for creative abilities (Appendix A).

CHAPTER VII

HYPOTHESES

1. An increase in the intensity of punishment would produce: a decrease in the number of original responses, a decrease in the scores on the Plot Titles Test, a decrease in the scores on the Alternate Uses Test, a decrease in self-confidence ratings, a decrease in self-ratings of creative abilities, a decrease in the number of original responses occurring during the extinction period, and an increase in overall latency of responding.

2. An increase in the intensity of reward would produce an increase in: the number of original responses, the scores on the Plot Titles Test, the scores on the Alternate Uses Test, the scores on self-confidence ratings, the self-ratings of creative abilities, the number of original responses occurring during the extinction period, and a decrease in latency of responding.

3. Reward would produce: significantly more original responses than punishment, higher scores on the Plot Titles Test, higher scores on the Alternate Uses Test, higher self-confidence ratings, higher self-ratings of creative abilities, a greater number of original responses occurring during the extinction period, and a shorter overall latency

of response.

4. An interaction effect was predicted between type of reinforcement and intensity of reinforcement as measured by: the number of original responses, the number of original responses occurring in the extinction period, the Plot Titles Test scores, the Alternate Uses Test scores, self-ratings of creative abilities, self-confidence ratings, and latency of response. As intensity was increased for the reward groups, the dependent measures would increase. However, as intensity of punishment was increased, dependent measures would decrease.

5. The overall rank order for the four experimental groups, from highest to lowest scores on the dependent variable, would be: strong reward, weak reward, weak punishment, and strong punishment.

CHAPTER VIII

METHOD

Subjects

The subjects were 40 undergraduate students attending Oklahoma State University; of the 40 students there were 33 women and seven men. Each subject was randomly assigned using a table of random digits to one of four groups. There were 10 subjects in each group.

Experimental Apparatus and Materials

The experimental apparatus consisted of a table divided in half by a partition. On the subject's side of the partition was a counting mechanism which allowed him to keep track of his score. The experimenter controlled the counter mechanism from his side. A memory drum faced the subject, and the drum contained the stimulus words from the Connecticut Word Association Norms (1961). A tape recorder monitored conversation between the subject and the experimenter.

Examples of the Plot Titles Test, the Alternate Uses Test, self-ratings of confidence and of creativity are found in Appendix A.

Experimental Procedure

Before the experiment began, all subjects were told that the experiment would be recorded. Then, all subjects heard the following instructions before the first 10 trials were administered:

A single word will come up on the machine before you. I want you to respond with a single original response that you associate with the word on the machine. Do not use proper names. You have only 10 seconds. Respond as quickly as you can.

The subject was then given the first 10 trials without reinforcement. This procedure was done to establish a base rate.

The second set of instructions was then given to the subjects. These instructions differed for each of the four groups. The strong reward group's instructions read as follows:

When we start again, I want you to respond as before. Every time you give a correct response I will tell you. As an added incentive, I will pay you two cents for each correct response that you give. There will be a large number of trials, so the amount of money you earn can be as much as \$1.40. The counter mechanism will allow you to keep track of the number of correct responses you have made. Are you ready.

After the instructions were read, the person was given the first word, and his response and response time were recorded. Original responses were reinforced and common responses ignored. Each subject was given 70 trials.

The weak reward group was given the same instructions as the strong reward group. The only difference in the

instructions was the description of the reinforcement used and that the partition was raised. The instructions were as follows:

When we start again, I want you to respond as before. Every time you give a correct response the counter will indicate it. Are you ready.

Instructions to the strong punishment group were as follows:

When we start again, I want you to respond as before. Every time you give an incorrect response I will tell you so. As an added incentive, I will give you \$1.40. Each time that you give a wrong response you will lose two cents of that \$1.40. The counter mechanism will allow you to keep track of the number of wrong responses you have made. Are you ready.

The procedure for the weak punishment group was similar to that used by the weak reward group. The difference was in the description of the reinforcement used. The instructions were as follows:

When we start again, I want you to respond as before. Every time you give a wrong response this counter mechanism will indicate it. The counter mechanism will allow you to keep track of the number of wrong responses you have made. Are you ready.

The difference in procedure from the strong punishment group was the type of punishment used and that the partition was raised.

In the next phase of the experiment all subjects were given the Plot Titles Test and the Alternate Uses Test. Finally, the subjects were asked to rate themselves on creative potential and self-confidence. The dependent

variables were presented in random order.

The last phase of the experiment was the extinction schedule. Instructions prior to the extinction schedule had the first sentence as the lead statement for all four groups. The remaining instructions for each of the four groups were then read as follows:

In the following period you will again be given stimulus words to respond to. This time....

1. For the strong reward group - there will be no feedback information about your responses, nor will there be monetary reward.
2. For the weak reward group - there will be no feedback information about your responses.
3. For the strong punishment group - there will be no feedback information about your responses, nor will there be monetary loss.
4. For the weak punishment group - there will be no feedback information.

The procedure was the same as for the acquisition period except the subjects were not reinforced. The extinction schedule lasted for 50 trials. The partition was raised during the extinction schedule for all subjects to minimize reinforcement cues.

Experimental Design

Four analyses of covariance were employed. The first was a three factor (2x2x7) analysis of covariance. The original response frequency for the base period was used as the covariate. The three independent variables were: type of reinforcement, intensity of reinforcement, and trials by blocks of 10. The dependent variable was the number of

original responses. The second analysis of covariance was the same as the first except the dependent variable was response latency during the training period. The covariate was response latency during the base period.

The third analysis was a three factor ($2 \times 2 \times 4$) design. The independent variables were: type of reinforcement, intensity of reinforcement, and trials by blocks of 10 during extinction. The dependent variable was the number of original responses occurring during extinction. The original response frequency for the base period was the covariate. The fourth analysis of covariance was the same as the third during the extinction period except the dependent variable was response latency. The covariate was response latency for the base period.

There were three two-factor (2×2) analyses of variance. The independent variables were type of reinforcement and intensity of reinforcement. The dependent measures for each analysis were: Plot Titles Test scores (fluency factor), Plot Titles Test scores (originality factor), and Alternate Uses Test scores.

The Kruskal Wallace Test was employed for self-confidence ratings and self-ratings of creative abilities.

Post hoc analyses were employed where a more detailed analysis was necessary.

CHAPTER IX

RESULTS

Training Period - Original Responses

There was a significant interaction effect between intensity and type of reinforcement on the dependent variable which was the number of original responses during the training period (Table I). The interaction effect is illustrated in Figure 1. When reward was the reinforcer, the number of original responses seemed to increase as intensity increased.

Further analysis using T-tests indicated significant differences among all treatment combination comparisons (Table II). The rank order of the four experimental groups was: strong reward, weak punishment, strong punishment, and weak reward. These results are illustrated in Figure 2.

Trial blocks during the training period were also significant at the .01 level. Figure 3 indicates the number of original responses increased as trials progressed.

An interaction effect between intensity and trials occurred at the .05 level (Table I). The interaction effect is illustrated in Figure 4. The first block of training trials shows strong reinforcement was less potent than weak reinforcement in producing original responses. After the

TABLE I

ANALYSIS OF COVARIANCES OF FREQUENCY AND LATENCY SCORES FOR THE ACQUISITION AND EXTINCTION OF REMOTE ASSOCIATIONS

Acquisition						Extinction					
		Frequency		Latency				Frequency			Latency
Source	df	MS	F	MS	F	df	MS	F	MS	F	
<u>Between</u>											
A (Type)	1	3.68		1465.22	1	1	3.50		5402.02	2.07	
B (Intensity)	1	67.30	2.39	3437.80	1.11	1	52.05	4.07	18836.17	7.20	
A x B	1	231.22	7.70**	4118.87	1.32	1	122.51	9.59**	9313.49	3.50	
Ss within groups	36	30.02		3100.64		36	12.78		2609.58		
<u>Within</u>											
C (Trials)	6	19.71	10.56**	785.40	3.95**	4	11.02	3.20*	197.19	1	
AC	6	2.04	1.09	86.87	1	4	5.09	1.48	301.13	1.10	
BC	6	5.04	2.70*	309.56	1.56	4	5.48	1.59	198.05	1	
ABC	6	1.75	1	431.48	2.18*	4	8.40	2.44*	392.22	1.43	
C x Ss within groups	215	1.87		198.23		144	3.42		274.41		

p .05 * ; p .01 **

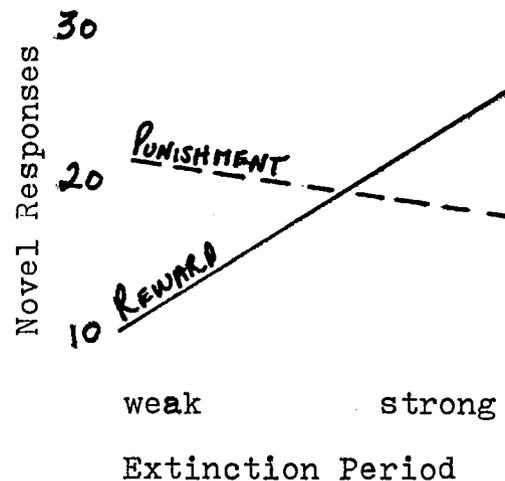
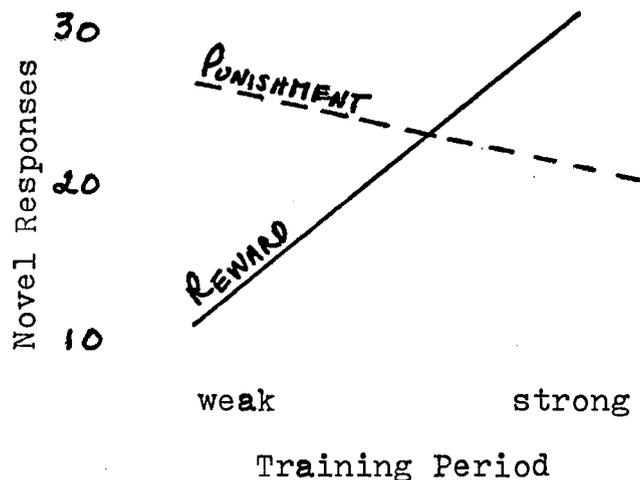


Figure 1a. Interaction Effect Between Type of Reinforcement and Intensity of Reinforcement With Mean Number of Novel Responses (Adjusted) as the Dependent Variable

Figure 1b. Interaction Effect Between Type of Reinforcement and Intensity of Reinforcement With Mean Number of Novel Responses (Adjusted) as the Response Variable

TABLE II

T-TEST SUMMARY TABLE OF COMPARISONS OF THE FOUR TREATMENT COMBINATIONS DURING TRAINING WITH NOVEL RESPONSES AS THE DEPENDENT VARIABLE

Source	df	T	P
Weak Reward Versus Strong Reward	36	8.15	.001
Weak Reward Versus Weak Punishment	36	5.97	.001
Weak Reward Versus Strong Punishment	36	3.41	.005
Strong Reward Versus Weak Punishment	36	2.18	.05
Strong Reward Versus Strong Punishment	36	4.73	.001
Strong Punishment Versus Weak Punishment	36	2.55	.05

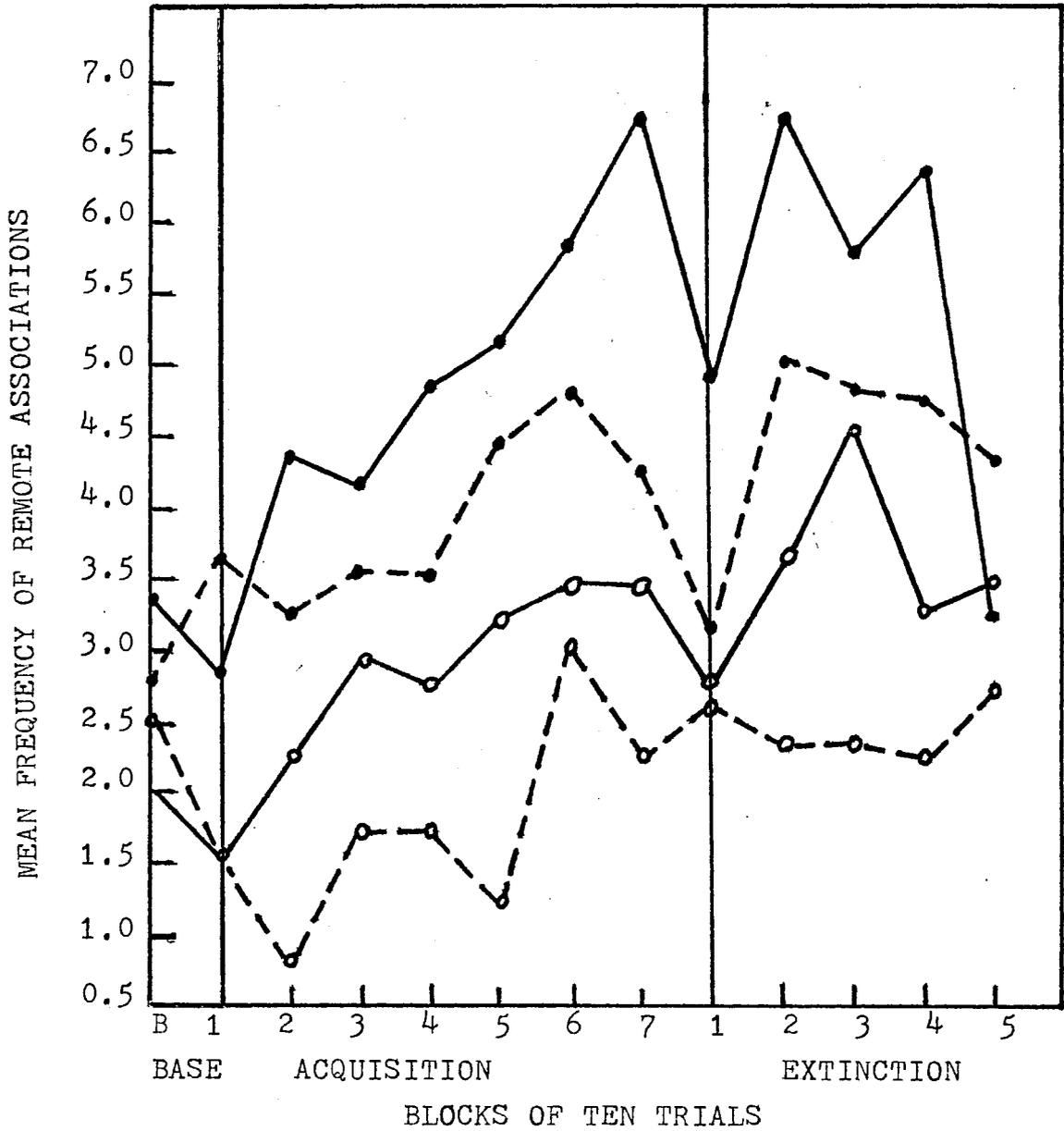
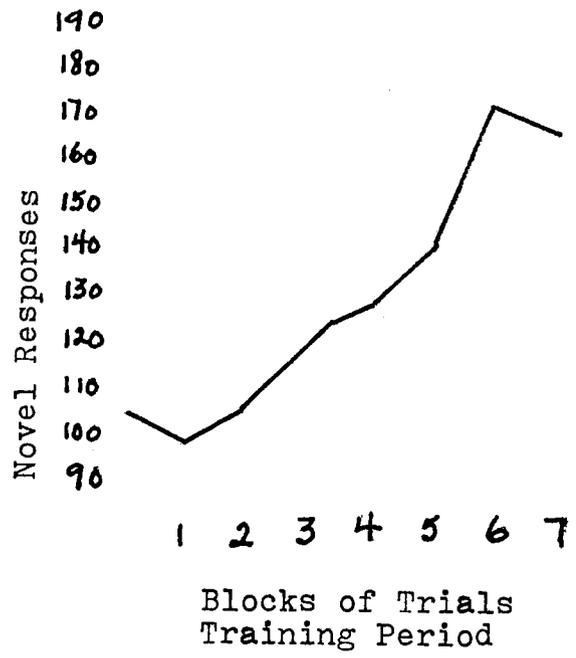


Figure 2. Mean Response Frequency of Remote Associations as a Function of Reinforcement Type (R vs. F) and Sign (+ vs. -)

- Positive Reward
- Negative Reward
- - -○ Positive Feedback
- - -● Negative Feedback



T
I
M
E
B
R
E
A
K

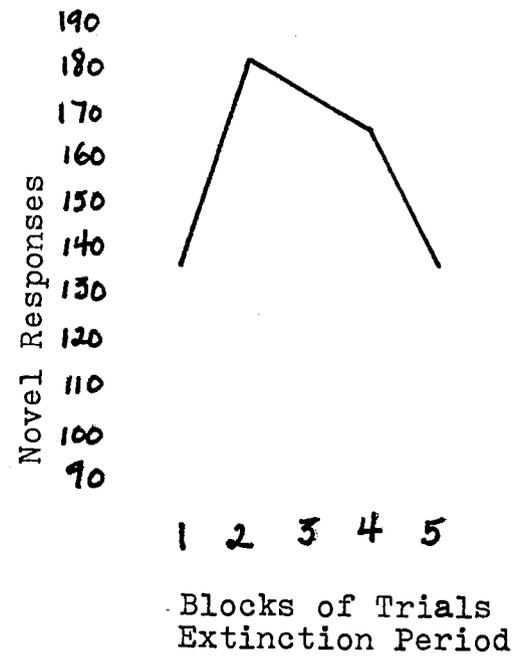
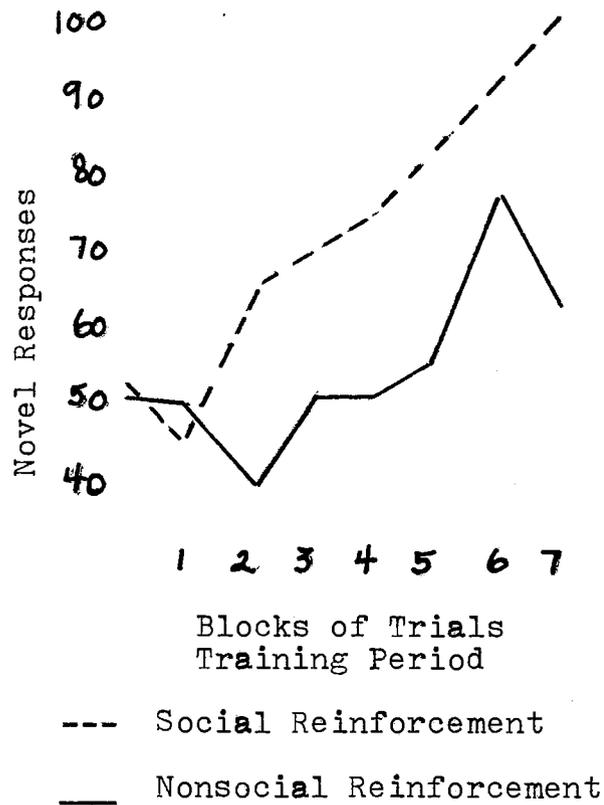


Figure 3. The Effects of Reinforcement on the Experimental Groups (Combined) Over Trials With Novel Responses as the Dependent Variable



T
-
E
M
B
E
R
A
K

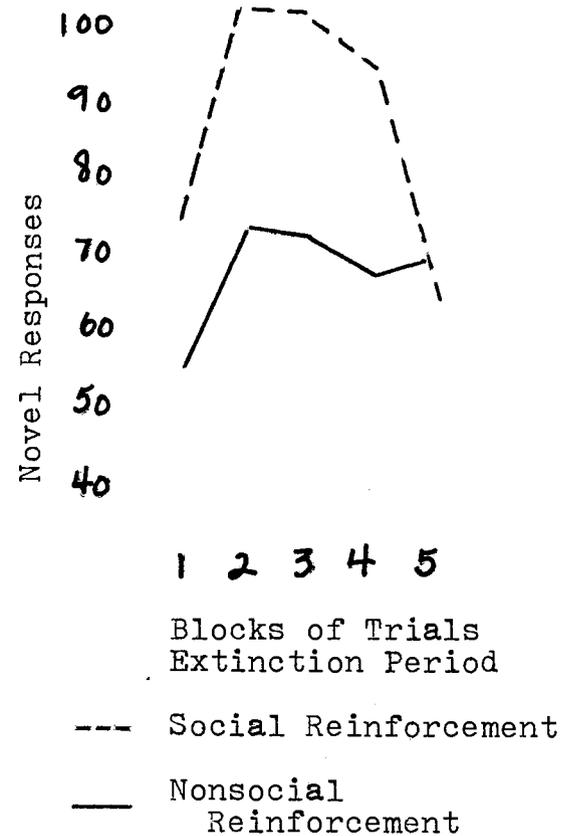


Figure 4. Social Versus Nonsocial Reinforcement Over Trials With Novel Responses as the Dependent Variable

first block of trials, the order was reversed. Strong reinforcement consistently produced more original responses for the remainder of the training trial blocks.

The Newman Keuls Test was applied to the seven trial block means in the strong reward group for the training period. The results in Table III indicate there was a consistently significant increase in the number of original responses over training trials for the strong reward group.

For the weak reward group the Newman Keuls Test was applied to the seven trial block means in the training period (Table IV). Only the comparison between trial blocks two and six was significant.

For the weak punishment group trial blocks five and six generally produced a significantly larger number of original responses when compared with the trial blocks preceding them (Table V).

For the strong punishment group the data in Table VI indicate trial blocks three through seven were generally producing a larger number of original responses than the first, and to some extent, the second trial blocks. However it should be noted that the base rate was higher than both trial blocks one and two (Figure 2). The difference between the base rate of original responses and the final three trial blocks was not large. This casts doubt on how effective strong punishment is in facilitating original responses.

An analysis of variance ($2 \times 2 \times 2$) of the means of each

TABLE III

NEWMAN KEULS SUMMARY TABLE COMPARING TRIAL BLOCK MEANS OF
THE STRONG REWARD GROUP DURING THE TRAINING PERIOD
WITH NOVEL RESPONSES AS THE DEPENDENT VARIABLE

Means	2.8	4.1	4.3	4.9	5.1	5.8	6.7
	c ₁	c ₃	c ₂	c ₄	c ₅	c ₆	c ₇
c ₁		.05	.01	.01	.05	.01	.01
c ₃			NS	.05	.01	.01	.01
c ₄					NS	.01	.01
c ₅						.05	.01
c ₆							.05

NS means not significant

.05 and .01 represent the degree of probability

TABLE IV

NEWMAN KEULS SUMMARY TABLE COMPARING TRIAL BLOCK MEANS
OF THE WEAK REWARD GROUP DURING THE TRAINING PERIOD
WITH NOVEL RESPONSES AS THE DEPENDENT VARIABLE

Trial Block Means (C)	.8	1.2	1.5	1.7	1.7	2.2	2.9
	c ₂	c ₅	c ₁	c ₃	c ₄	c ₇	c ₆
c ₂		NS	NS	NS	NS	NS	.01
c ₅			NS	NS	NS	NS	NS
c ₁				NS	NS	NS	NS
c ₃					NS	NS	NS
c ₄						NS	NS
c ₇							NS

NS means not significant

.05 and .01 represent the degree of probability

TABLE V

NEWMAN KEULS SUMMARY TABLE COMPARING TRIAL BLOCK MEANS
OF THE WEAK PUNISHMENT GROUP DURING THE TRAINING
PERIOD WITH NOVEL RESPONSES AS THE
DEPENDENT VARIABLE

Trial Block Means (C)	3.2 C ₂	3.5 C ₃	3.5 C ₄	3.6 C ₁	4.1 C ₇	4.4 C ₅	4.8 C ₆
C ₂		NS	NS	NS	.05	.01	.01
C ₃			NS	NS	NS	.05	.01
C ₄				NS	NS	.05	.01
C ₁					NS	.05	.05
C ₇						NS	NS
C ₅							NS

NS means not significant

TABLE VI

NEWMAN KEULS SUMMARY TABLE COMPARING TRIAL BLOCK MEANS OF
THE STRONG PUNISHMENT GROUP DURING THE TRAINING PERIOD
WITH NOVEL RESPONSES AS THE DEPENDENT VARIABLE

Trial Block Means (C)	1.5 C ₁	2.2 C ₂	2.7 C ₄	2.9 C ₃	3.2 C ₅	3.4 C ₆	3.4 C ₇
C ₁		NS	.01	.01	.01	.01	.01
C ₂			NS	NS	.01	.01	.01
C ₄				NS	NS	NS	NS
C ₃					NS	NS	NS
C ₅						NS	NS
C ₆							NS

NS means not significant

experimental group for the base rate and trial block one was utilized. The results are found in Table VII.

The Newman Keuls Test was used to compare the four base rate means and the four means of trial block one for the experimental group (Table VIII); the results indicate the weak punishment group was significantly higher than the strong punishment group in both the base period (.05 level) and trial block one (.01 level). For the weak punishment group, significant increases occurred in the original response number (.01 level) when the base rate was compared to trial block one. However, for the strong punishment group, there was no such increase; original responses decreased when the base rate mean was compared to the trial block mean. An analysis of variance ($2 \times 2 \times 5$) of the means of each experimental group for the last three trial blocks of the training period and the first two trial blocks of the extinction period was conducted. The results are found in Table IX.

The Newman Keuls was used to compare the means of the final three trial blocks of the acquisition period and the first three trial block means of the extinction period for the strong punishment group (Table X). The most important finding was that trial block three of the extinction period was significantly higher in the number of original responses than any of the trial block means in the acquisition period.

Extinction Period - Original Responses

When the number of original responses during the

TABLE VII

ANALYSIS OF VARIANCE OF THE FOUR EXPERIMENTAL GROUPS FOR
THE FOUR MEANS OF THE BASE RATE AND THE FOUR MEANS
OF TRIAL BLOCK ONE IN THE TRAINING PERIOD

AOV					
Source	SS	df	MS	F	P
<u>Total</u>	242.9873	79			
Between	176.4875	39			
A (Type)	.0125	1	.0215		
B (Intensity)	.6124	1	.6124		
A x B	30.7275	1	30.7275	7.6	<.01
Error (b)	145.778	36	4.04		
Within	66.5	40	1.66		
Trials	1.5124	1	1.5124		
Trials x A	4.6216	1	4.6216	3.029	<.1
Trials x B	1.0217	1	1.0217		
Trials x A x B	4.9292	1	4.4292	2.9	<.1
Error (w)	54.92	36	1.5256		

TABLE VIII

NEWMAN KEULS FOR THE ORIGINAL RESPONSE MEANS OF THE FOUR
EXPERIMENTAL GROUPS DURING THE BASE RATE PERIOD AND
TRIAL BLOCK ONE OF THE ACQUISITION PERIOD

	1.5 +TB	1.5 --TB	2.0 --B	2.5 +B	2.7 -B	2.8 ++TB	3.3 ++B	3.6 -TB
+TB		NS	NS	.01	.01	.01	.01	.01
--TB			NS	.01	.01	.01	.01	.01
--B				NS	.05	.05	.01	.01
+B					NS	NS	.05	.01
-B						NS	NS	.01
++TB							NS	.05
++B								NS

NS means not significant

TABLE IX

ANALYSIS OF VARIANCE OF THE MEAN NUMBER OF ORIGINAL
RESPONSES OF THE FOUR EXPERIMENTAL GROUPS FOR
THE LAST TWO TRIAL BLOCKS OF THE
ACQUISITION PERIOD AND THE
FIRST THREE TRIAL BLOCKS
OF THE EXTINCTION
PERIOD

AOV					
Source	SS	df	MS	F	P
<u>Total</u>	1476.55	199			
Between Subjects	1125.15	39	28.85		
A (R x P)	3.12	1	3.12	.140	NS
B (Intensity)	91.12	1	91.12	4.10	<.01
A x B	231.13	1	231.13	10.403	<.005
Error (b)	799.78	36	22.216		
Within Subjects	351.4	160	2.196		
Trials	31.521	4	7.88	4.28	<.005
Trials x A	13.859	4	3.464	1.88	<.2
Trials x B	8.259	4	2.0647	1.123	NS
Trials x A x B	14.641	4	3.66	1.99	<.1
Error (w)	283.12	154	1.838		

NS means not significant

TABLE X

NEWMAN KEULS ANALYSIS APPLIED TO THE ORIGINAL RESPONSE
 MEANS OF THE LAST TWO TRIAL BLOCKS OF THE
 ACQUISITION PERIOD AND THE FIRST THREE
 TRIAL BLOCKS OF THE EXTINCTION
 PERIOD FOR THE STRONG
 PUNISHMENT GROUP

	2.7 E ₁	3.4 A ₆	3.4 A ₇	3.8 E ₂	4.5 E ₃
E ₁		.05	NS	.01	.01
A ₆			NS	NS	.01
A ₇				NS	.01
E ₂					.05

NS means not significant

extinction period was used as the dependent variable, the interaction effect between reinforcement and intensity was significant at the .01 level (Table I). This is also illustrated graphically in Figure 2.

When reward was the reinforcer, the number of original responses increased as intensity increased. When punishment was the reinforcer, the number of original responses decreased as intensity decreased.

When further analysis was employed using T-tests, significant differences were indicated among all treatment combinations either at the .05 or at the .01 levels of significance (Table XI). The rank order of the four experimental groups was the same as in the training period: strong reward, weak punishment, strong punishment, and weak reward.

The number of original responses as a function of trials was significant at the .05 level (Table I). There was also a triple interaction effect between intensity, type of reinforcement, and trial blocks at the .05 level (Table I).

The Newman Keuls Test was applied to the five trial block means in the strong reward group in the extinction period (Table XII). Trial block five was significantly lower than any of the other four trial blocks. There was also an initial significant upsurge in responding between trial blocks one and two at the .01 level.

For the weak reward group no significant differences

TABLE XI

T-TEST SUMMARY TABLE OF COMPARISONS OF THE FOUR TREATMENT
COMBINATIONS DURING EXTINCTION WITH NOVEL RESPONSES
AS THE DEPENDENT VARIABLE

Source	df	T	P
Strong Reward Versus Weak Reward	36	8.27	.01
Strong Reward Versus Weak Punishment	36	2.39	.05
Strong Reward Versus Strong Punishment	36	4.599	.01
Weak Punishment Versus Strong Reward	36	2.209	.05
Weak Punishment Versus Weak Reward	36	5.88	.01
Strong Punishment Versus Weak Reward	36	3.67	.01

TABLE XII
 NEWMAN KEULS STRONG REWARD
 (EXTINCTION)

	C ₅ 3.2 C ₅	C ₁ 4.9 C ₁	C ₃ 5.3 C ₃	C ₄ 6.3 C ₄	C ₂ 6.7 C ₂
C ₅		.01	.01	.01	.01
C ₁			NS	.01	.01
C ₃				.01	.01
C ₄					NS

NS means not significant

were found among the trial block means (Table XIII).

In the strong punishment group there was initially a significant surge in the number of original responses (Table XIV). The peak was reached in trial block three. Trial block three was found to be significantly higher in original responses (.01 level) than the asymptotic means of the acquisition period (Table XIV). Following the peak at trial block three, there was a significant decrease in original responses in trial block four (.01 level) and trial block five (.05 level). It should be noted, however, that both four and five trial block levels contain nearly the same number of original responses as does the maximum trial blocks found in the training period.

With the weak punishment group as with the strong reward and the strong punishment groups, there appeared an initial increment in the number of original responses between trial blocks one and two at the .01 level. (See Table XV.) Trial block two contained as many original responses as the maximum trial block mean in the training period. Following trial block two, there was a rank order decrease in the number of original responses obtained. These differences do not, however, achieve significance at the .05 level of confidence.

Training Period - Time

When time was used as a dependent variable during the training period, there was a triple interaction effect at

TABLE XIII
 NEWMAN KEULS WEAK REWARD
 (EXTINCTION)

	C ₄ 2.2 C ₄	C ₃ 2.3 C ₃	C ₂ 2.3 C ₂	C ₁ 2.6 C ₁	C ₅ 2.7 C ₅
C ₄		NS	NS	NS	NS
C ₃			NS	NS	NS
C ₂				NS	NS
C ₁					NS

NS means not significant

TABLE XIV
 NEWMAN KEULS STRONG PUNISHMENT
 (EXTINCTION)

	2.7 C ₁	3.2 C ₄	3.4 C ₅	3.8 C ₂	4.5 C ₃
C ₁		NS	NS	.05	.01
C ₄			NS	NS	.01
C ₅				NS	.05
C ₂					NS

NS means not significant

TABLE XV
 NEWMAN KEULS WEAK PUNISHMENT
 (EXTINCTION)

	3.1 C ₁	4.3 C ₅	4.7 C ₄	4.8 C ₃	5.0 C ₂
C ₁		.05	.01	.01	.01
C ₅			NS	NS	NS
C ₄				NS	NS
C ₃					NS

NS means not significant

the .05 level (Table I). Trial blocks was the only significant single factor at the .01 level. Figure 5 illustrates the reaction time patterns for the four treatment combinations over trial blocks.

Extinction Period - Time

Intensity of reinforcement was the only factor to reach significance (.05 level) during the extinction period with time as the dependent variable (Table I).

Alternate Uses Test

When scores from the Alternate Uses Test were used as a dependent variable, there were no significant differences among the four experimental groups.

Plot Titles Test

When the fluency factor of the Plot Titles Test was used as a dependent variable, no significant differences were found among groups. However, when the originality factor of the Plot Titles Test was the dependent variable, a significant interaction effect emerged between the independent variables of reinforcement type and intensity (Table XVI). Further analysis using Tukey's Test indicated no significant differences between any two experimental groups. However, Scheffe's Test showed weak reward to be significantly less effective than the average of the other three treatment combinations in maximizing the originality

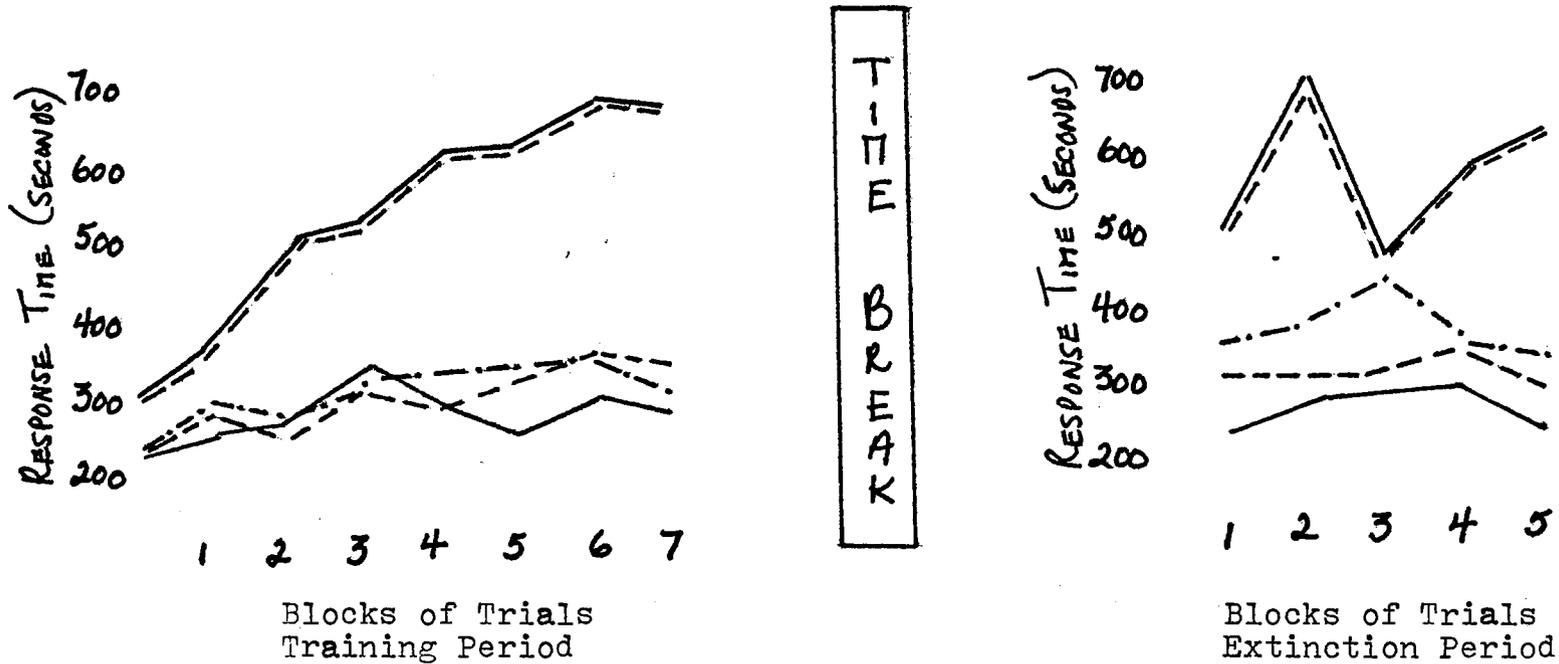


Figure 5. The Effects of Reinforcement on the Four Experimental Groups Over Trials With Response Time as the Dependent Variable

- === strong positive reinforcement
- weak positive reinforcement
- strong negative reinforcement
- . weak negative reinforcement

TABLE XVI
PLOT TITLES TEST
(ORIGINALITY)

AOV					
Source	SS	df	MS	F	P
<u>Total</u>		39			
A	9.025	1	9.025	3.11	NS
B	7.225	1	7.225	2.49	NS
A x B	18.275	1	18.275	6.31	.05
Error	104.25	36	2.8958		

NS means not significant

factor of the Plot Titles Test (Table XVII).

Self-Ratings

When subjects rated themselves on creative abilities, the dependent variable, no significant differences were found among the four experimental groups. However, when the dependent variable, ratings of self-confidence, was examined, significant differences were found (Table XVIII). The rank order of ratings of self-confidence for the four groups is found in Table XIX. The strong punishment group, the weak punishment group, and the weak reward group were highest in self-confidence. The strong reward group was lowest in self-confidence.

TABLE XVII
 PLOT TITLES TEST (ORIGINALITY)
 SCHEFFE'S TEST

13.53	16.47	(The difference is significant between nonsocial reward and the average of the other three groups.)
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TABLE XVIII
 SELF-CONFIDENCE RATINGS
 KRUSKAL WALLACE TEST

T = 820
 H = 1575.03
 C = .8992
 H' = 8.1687, P .05

TABLE XIX
 SELF-CONFIDENCE RANK ORDER

Strong Punishment	43
Weak Punishment	42
Weak Reward	41
Strong Reward	37

CHAPTER X

DISCUSSION

Training Period

Weak Versus Strong Punishment -

Original Responses

The hypothesis that strong punishment produces a decrease in the number of original responses as compared with weak punishment is confirmed. All of the previously discussed theories predicted these results.

Psychoanalytic theory states strong punishment will produce more repression and consequently, less originality. Birney's, Burdick's, and Teevan's theory explained the results in terms of the intervening variable or fear of failure. The strong punishment group is motivated by a stronger fear of failure than the weak punishment group; thus, the strong punishment group is less willing to take risks than the others. Willingness to take risks is the central trait of a creative person according to their theory.

The extension of Mednick's theory, which explained the results by means of flatter associative gradients for the weak punishment group, is also upheld. Marx's theory, based

on the conditioned emotional response inhibiting all responding, predicts that punishment produces more intense inhibition of responses. Because the initial probability of an original response occurring is low, the inhibitory effect has a greater impact on novel responses than common responses.

Crutchfield's theory does run into difficulty. This theory correctly predicts the results, but Crutchfield's explanation holds that subjects under intense punishment have decrements in self-confidence. However, when subjected to self-ratings, the subjects demonstrated no significant differences between the weak and the strong punishment groups. These results do not support Crutchfield's theory. The problem can, however, lie very well with the measuring instrument with its lack of sensitivity in detecting differences.

Another explanation for the superiority of weak punishment is that subjects can produce greater numbers of original responses in the strong punishment group, but can refuse to do so because of the situation's aversiveness. Unfortunately, this hypothesis does not explain experiments in which intense punishment is more effective than weak punishment in simple problem solving situations. Surely, the same factor was active in these experiments.

From several points of view, it seems that a more punitive feedback mechanism is thought to suppress novel responses. No explanation gives a clear idea as to how the

mechanism operates, but the evidence does support the contention that more aversive stimuli suppress novel responses.

The suppression effect seems to have a maximum impact very early in the training period. The weak punishment group shows a significant increase in responding in trial block one as compared with the base rate. The impact of strong punishment on original responding does not produce a similar increase in responding. There is even a decrease in responding, though this decrease is not significant. The absolute differences between the two groups are greater for trial block one than for any other trial block.

The implications of these results should be explored. It may be that if one wants to encourage novel ideas, then the threat of punishment should be reduced. While social censure and the threat of the loss of material incentives may work well in motivating people to perform their jobs, the above findings at the same time suggest that any tendencies toward originality will be stifled. Negative feedback does not have to be eliminated as results demonstrate that weak negative feedback is very effective in facilitating novel responses. However, results point to the conclusion that an increase in punishment, even relatively mild social punishment, has adverse effects. In this experiment the experimenter had no prior contact with the subjects and would never see them again. What impact he had upon them would be relatively innocuous as compared with an employer or an instructor.

Strong Versus Weak Reward - Original
Responses

The hypothesis that social reward produces a greater number of original responses than weak reward was confirmed. These results are in accordance with experiments cited previously which demonstrate that strong reward has more effect than weak reward.

Crutchfield's explanation involved the application of the intervening variable of self-confidence. An increase in the magnitude of reward increased self-confidence, and this in turn facilitated the use of original responses. Such an explanation adequately explained the results found not only with reward but also with punishment. However, the finding that the strong reward group viewed themselves as significantly lower in self-confidence than the weak reward group does some damage to Crutchfield's formulations.

Birney's and Teevan's explanation was that the subjects under rewarding conditions were more likely to be motivated by hope for success and were more willing to take risks, i.e., choose novel responses. The stronger the reward, the more intense the motivation, and the more apt is the person to willingly use original responses. This theory does seem to explain the results using both reward and punishment.

In utilizing psychoanalytic theory it is possible to explain the results by assuming that an increase in the magnitude of reward produces a decrease in the arousal of the defense mechanisms, which are said to impair creativity.

In utilizing reward to facilitate original responses the evidence indicates that the intensity of reward, defined in terms of verbal praise and monetary gain, is important to the production of original responses. In this experiment strong reward is much more effective than simple nonsocial positive feedback. The blanket generalization that social reward is always more effective than nonsocial reward, of course, cannot be made. There are too many parameters that must be explored. For instance, the characteristics of the person dispensing rewards may interact with intensity. The subject may perceive the praise as being genuine rather than a gushy reward. This alone may have an impact on responding which could alter the results.

A slight change in the verbal wording of the reward from "good" to "excellent" to "that is exactly what we are looking for" could have had an impact on different subjects which could have significantly altered the results.

The intensity of reward may also greatly interact with the type of problem situation. The type of reward most effective in this experiment may be the least effective reward in a different situation.

Reward Versus Punishment - Original Responses

The hypothesis that reward produces a significantly greater number of original responses than punishment was not confirmed. The explanation for this lay primarily in the

poor showing of the weak reward group. This point becomes clearer when one examines the next hypothesis.

Type of Reinforcement Versus Intensity -
Original Responses

The hypothesis that there is a significant interaction effect between type of reinforcement and intensity during the training period was confirmed. Strong reward was the most effective method to facilitate novel responses; simple positive feedback (weak reward) was clearly less effective. The reverse was discovered for punishment; weak punishment was more effective than strong punishment.

The four experimental groups in order from most to least effective are: strong reward, weak punishment, strong punishment, and weak reward. Reward is not necessarily more potent than punishment in facilitating novel responses. It is surprising that weak reward was so clearly the least effective of the four groups. One suspects that weak reward is nearly as effective as its counterpart, weak punishment; however, this is not the case. This result led to a modification of the position that reward was more effective than punishment in facilitating novel responses from the person. The stand must be taken that some varieties of reward are more effective than punishment. It is important that the parameters of the reinforcement be taken into account. For instance, the parameter defined as intensity in this experiment is critical in this situation. Certain high

intensities of reward seem to be more potent than punishment but low intensities of reward are less potent than any type of punishment.

The explanation for the poor showing of the weak reward group is explained by using two factors: the weak reward group received a lower level incentive as compared to the strong reward group, and simultaneously, the information gained was minimal for this group as compared to the punishment groups. The punishment groups received feedback for every incorrect response as common responses are more frequent than original ones.

Spence's theory was unconfirmed because it did not explain the interaction effect. His theory implies that high motivation produced either by reward or punishment hinders original responding; however, the theory is supported only for punishment.

As explained earlier, Crutchfield's theory, Birney and Teevan's theory, and psychoanalytic theory assume that reward and punishment affect original responses in different ways as intensity varies. These theories predict that an increase in intensity for reward produces an increase in original response, but an increase in intensity for punishment produces a decrease in original responding. The significant interaction effect supports this viewpoint.

Trials x Intensity - Original Responses

The hypothesis that rate of production of original

responses during the training period is a function of intensity was confirmed (Table I); Figure 4 illustrates the effects of intensity over trials. At first, high intensity interfered with the production of novel responses; however, after the first 10 training trials high intensity reinforcement became more effective.

Examining Figure 2, the initial superiority of weak intensity results from: the decrease in original responses for the two high intensity groups in the first 10 trials and an actual increase in the number of original responses for the weak punishment group during the first 10 trials as compared with the covariate.

The reasons for the larger number of original responses occurring with the high intensity reinforcement group later in the training period are verified in Figure 2. Differences result from: strong reward being the most effective of the four groups in producing novel responses and weak reward being the least effective of the four.

To encourage originality, one might initially avoid high intensity reward and substitute weak punishment. With experience, the person could then go to a high intensity reward contingency. Since not enough evidence is available to support this conclusion, further research is needed.

Trials - Original Responses

The hypothesis that the number of original responses varied over trials was confirmed. When the responses for

all groups were combined, it was obvious that the number of original responses increased as trials progressed. The training procedure facilitated responding.

The obvious interpretation is that the subjects were learning how to respond in an original style. Another possible explanation is that the subjects already learned the responses, and the results indicate only an increase in performances, not learning. This explanation is a plausible one; however, it is not possible to tell which interpretation is correct. Regardless which of the two explanations is correct, there still is a considerable increase in original responses.

The large number of significant differences between trial block means for the social reward group indicates that the number of original responses does increase over trials for this group. It is possible to interpret this condition to mean that social reward facilitated learning how to give original responses.

The differences between trial block means for the weak reward group provide almost no evidence of a performance curve. It is reasonably safe to say that almost no learning took place for subjects in this group.

For the weak punishment group there is a significant trend toward an increase in the number of original responses as trials progressed. There are grounds to support the fact that learning to produce original responses occurred with this group.

For the strong punishment group there is a trend toward an increase in the number of original responses during the training period, but this trend is misleading. When the pre-reinforcement base rate is examined, one can see that most of the training performance increase is accounted for by a decrement in responding in trial blocks one and two. Consequently, the increase in original responses over trials is small when the covariate is used as the standard of comparison. Very little learning took place for this group.

In conclusion one can assume that a real increase in performance over trials occurred for strong reward and weak punishment. There is some evidence for such a performance curve for the strong punishment group. There is little evidence for an increase in performance over trials for the weak reward group.

Extinction Period

Trials - Original Responses

It should be noted that there was a significant change in the number of original responses produced over blocks of trials. When this is viewed graphically (Figure 3), there is a decrement in responding, in comparison to the training period, followed by an increase which again is followed by a response decrement. This final response decrement is characterized by a continuous decrease in responding from trial blocks two through five. The results seem to reflect an extinction curve. This evidence provides support for the

proposition that once an individual acquires the ability to produce novel responses he does not forever keep that trait; instead, this ability is subject to the same principles of extinction that other responses are. Because the behavior in question seems to conform to this principle of learning and because the response seems to be dependent on the consequences (nonreinforcement) that follow, it is possible that the behavior can be considered an operant.

Type of Reinforcement Versus Intensity of
Reinforcement Versus Trials - Original
Responses

The interaction effect between type of reinforcement and intensity, also found in the training period, is carried over to the extinction period. Whatever produced the significant differences, it initially continued to have an impact in the extinction period. The four experimental groups maintained their significant rank order differences. However, the impact decreased as trials progressed. This can be seen in the convergence of the four experimental groups over trials. This trend toward convergence can be taken for evidence of extinction.

For the strong reward group there is some evidence for an extinction curve. The claim lies primarily with the very sharp drop in responding which occurred in trial block five. An extension of the extinction schedule provides a more definite answer to whether there is a genuine decrement in

responding.

For the weak reward group there is no evidence of an extinction curve. This is not surprising since there is little evidence of a performance increase during the training period. In other words, there is very little to extinguish.

For the weak punishment group there is a trend toward a decrement in responding, but this trend is not significant. Again, an extension of the extinction schedule is necessary before it can be concluded that extinction took place.

For the strong punishment group there is a decrement in responding occurring for trial blocks four and five. However, when this decrement is compared to the maximum in the training period, it is easy to see that extinction did not take place because there is very little evidence for a performance curve during the training period.

In conclusion, there is some evidence for extinction taking place for strong reward and for weak punishment, but the evidence is not conclusive, possibly because there are not enough extinction trials. The strong punishment and the weak reward groups show little evidence for extinction. Part of the explanation is that there is little increase in performance for these two groups.

The results have some significance for Maltzman's (1960) theory of originality. He postulates that original responses are intrinsically reinforcing. The results of his experiment indicate that the concept of intrinsic rein-

forcement, while it may exist, is certainly not sufficient to explain the differences in the acquisition curves of the four groups. Furthermore, the evidence that extinction took place again indicates that intrinsic reinforcement is not a sufficient explanation for the maintenance of original responding.

Part of the explanation for why the strong reward group extinguishes more quickly than the other groups is that there is obviously more to extinguish for the strong reward group. However, another part of the explanation as to why the two punishment groups do not extinguish as quickly as the strong reward group can lie with the cognitive dissonance theory. Both punishment groups are receiving negative feedback concerning the task. To reduce the dissonance aroused by the negative feedback received and to continue this task, the subjects in the punishment groups could form new cognitions concerning the value of the tasks. These new cognitions concerning the task are part of the reason for the relative lack of extinction for the punishment groups. No such cognitions are formed for the strong reward group; hence, extinction is expected to rapidly occur for this group.

One phenomenon that needs explaining is why there are substantial increases from trial block one to trial block two for all groups except weak reward. One should notice that the level of responding for trial block one in the extinction period is lower than the final training block

for all three of the groups concerned. Some factor, possibly a disorientation factor, can explain this happening.

However, a disorientation factor cannot explain all of the increases in original responding taking place. When the asymptotic level of the strong punishment group in the training period is compared with trial block three in the extinction period, one finds a significant increase in original responding. One explanation is to postulate that learning which took place in the training period was suppressed by the punishment schedule. When the aversive stimulation is removed, then the latent learning becomes evident in the performance curve.

There seems to be three lines of evidence indicating a suppression effect due to strong aversive stimulation. The first is the general superiority of weak punishment over strong punishment. The second is the differences found between the two groups in the base period and trial block one of the training period. Finally, the fact of the asymptotic level of performance occurring in extinction rather than acquisition for the strong punishment group provides the third piece of evidence for a suppression effect produced by strong punishment.

Response Time

The most striking aspect of Figure 5 is the very large difference in response time between the strong reward group

and the other three groups. The strong reward groups have a much higher latency of response, which is the opposite of what is expected. Previous experiments indicate an increase in the magnitude of reward reduces response latency.

One possible explanation lies with the type of task involved. In a relatively simple task where extra time is of little value in producing the correct response, then response latency is expected to be shorter. However, when extra time is critical in producing the correct response, then response latency increases as the magnitude of reward increases. In the present experiment it is possible that the extra time played an important part in the production of an original response. This makes sense when it is considered that the group with the longest latency period also produced the largest number of original responses.

Plot Titles Test

Originality Factor

The hypothesis that the effects of type of reinforcement are dependent upon the intensity of reinforcement are validated at the .05 level. When analyzed for individual differences between specific means, no significant differences are found. However, significant differences are found between the weak reward group and the average of the other three groups.

It should be noted that the same trend as was found in the training period is observed here. The strong reward

group and the two punishment groups all produce a greater number of original responses as compared with the weak reward group. Apparently, something was learned by the subjects in the three higher performance groups that was of value in doing well on the Plot Titles Test (originality factor).

It was pointed out earlier that the originality factor of the Plot Titles Test was found to be related to the instructor's ratings of psychology graduate students for creativity.

Whether or not the training procedure was really affected, the underlying factor responsible for what was generally considered creativity cannot be ascertained here. It is possible that the experimental procedure simply affected an indicator (score on the Plot Titles Test) of creativity and not the underlying factor itself.

Fluency Factor

There was not a generalization effect as measured by the fluency factor in the Plot Titles Test. Again, this result is not surprising when certain factors are considered. In the training situation a single original response is being reinforced. The fluency factor of the Plot Titles Test is defined in terms of the total number of responses without regard to originality. Though ideational fluency is considered to be an essential factor in Wallach's view of creativity, it is not the factor which was manipulated in

this experiment; instead, response originality was reinforced.

Alternate Uses Test

The independent variables had no effects upon the scores of the Alternate Uses Test. This result is consistent with Wallach's (1971) review of the literature on creativity. The primary factor which the Alternate Uses Test measured was flexibility. Wallach concluded that flexibility contributed more to general intelligence than to creativity.

Perception of Self-Confidence

The hypothesis that the independent variables would significantly affect the subject's perception of his self-confidence was confirmed. The rank order of the results was unusual as the subjects under strong reward perceived themselves as having less self-confidence than the other groups. These findings do not support Crutchfield's theory that has self-confidence as the critical element in the creative individual.

The results can be explained in terms of cognitive dissonance theory. The punishment groups received continuous negative feedback; yet, they persisted in the task. It is possible that this would arouse some dissonance in these subjects. Such dissonance can be lowered by forming such cognitions as: "I can perform in spite of adverse

conditioning; therefore, this makes me a better person than those who have it easier than I."

Irrelevant Responses

One problem this experimenter thought would arise was that of the completely irrelevant response, which is a response that in no conceivable way is related to the stimulus word. Such instances did not occur. Even for highly original responses the relationship could very quickly be seen. In the very rare instance when no relation could be perceived, the subject, when questioned after the experiment, would have a rational explanation for the relationship.

Implications for Developmental Psychology

The acquisition period for the experiment usually lasted about 15 minutes. During this period, reinforcements were dispensed from an experimenter, a complete stranger to the subject. Since a brief and a relatively inconsequential experimental situation does have a significant impact on a person, it is worth pondering how great the impact would be over a training period lasting for years where the people giving reinforcements are important to the person. For example, a parent has the potential to give powerful reinforcements to his child over many years. The potency of this situation is enhanced when taking into account that the response patterns learned at an early age are much more like

those patterns that endure than responses learned later in life. Perhaps, a large part of the response variance we attribute to the trait of creativity may be explained in terms of reinforcement contingencies the person is exposed to during his life.

CHAPTER XI

SUMMARY

The production of original responses is influenced by reinforcement. This ability to produce novel responses increases over trials. Various kinds of reinforcers have differential effects upon the ability of a person to give original responses. The order for the reinforcer's effectiveness in this experiment from most to least successful is: strong reward, weak punishment, strong punishment, and weak reward. The ability to produce original responses, acquired during the training period, generalizes to the originality factor of the Plot Titles Test. When reinforcement is removed, there is evidence of extinction of original responses. Maltzman's concept of the intrinsic reinforcing property of original responses is not sufficient to account for extinction. The results indicate that strong punishment of common responses also produces an inhibition of original responses. Because the ability to produce original responses seems to follow the laws of conditioning, one can profitably think of this behavior as being an operant. Implications for developmental psychology were also discussed.

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VITA

Dennis Edward Mercadal

Candidate for the Degree of
Master of Science

Thesis: THE EFFECTS OF REINFORCEMENT AND INTENSITY ON
ORIGINALITY AND CREATIVITY

Major Field: Psychology

Biographical:

Personal Data: Born in New Orleans, Louisiana,
June 18, 1943, the son of Mr. and Mrs. Sidney
E. Mercadal.

Education: Graduated from Chalmette High School,
Chalmette, Louisiana in May, 1961; received the
Bachelor of Arts degree from Louisiana State
University (New Orleans) in 1965 with a major in
psychology; completed requirements for Master of
Science degree from Oklahoma State University in
July, 1974.

Professional Experience: Psychology teaching
assistant, 1970 to 1971; practicum trainee, Payne
County Guidance Clinic, 1971 to 1972; psychology
trainee, Veterans Administration Hospital, 1971
to 1973; psychology teaching assistant, 1972;
practicum trainee, University Counseling Service,
1972; intern, University of Oklahoma Medical
School, 1973 to 1974.