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THE REINFORCEMENT VARIABLE IN RESPONSE FIXATION

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THE REINFORCEMENT VARIABLE

IN RESPONSE FIXATION

RICHARD R. WAITE



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THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN PSYCHOLOGY

UNIVERSITY OF MASSACHUSETTS

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TABLE OF CONTENTS

																						Page
Introducti	lon	•	•	•	•	•	•	•	٠	•	٠	•	•	٠	٠	•	•	٠	•	•		1
Statement	of	t	he	P	ro	bl	em	•	•	•	•	•	•	•	•	•	•	•	•	•	•	13
Method	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	٠	•	•	•	18
Subje	ecti	5	•	•	٠	•	•	•	•	•	•	•	•	•	•	•	•	٠	•	•	•	18
Appar	atu	18	•	•	•	•	•	•	•		•	•	•	•	•	٠	•	•	•	•	•	18
Proce	du	re	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	18
	Pre	el:	im:	in	ar	y '	Tra	ai	ni	ng	•	•	•	•	•	•	•	•	•	•	•	18
	Pre	ef	er	en	ce	T:	ria	al	8	•	•	•	•	•	•	•	•	•	•	•	•	19
Insoluble Problem (Conflict Situation)													n)	•	•	20						
	Sol	lul	010	e]	Pro	ob.	len	n	•	•	•	•	•	•		•	•	•	•	•		21
Results .	•	•	•	•	•	•	•	•	٠	•	•	•	•	•	•	•	•	•	•	•	•	22
Discussion	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	27
Summary .	•	•	•	•	•	•	•	•	•	•	•	•	•	٠	•	•	•	•	•	•	•	36
References		•	•	•	•	•		•	•													37

INTRODUCTION

One of the laboratory phenomena which has posed problems for current learning theory is that of response fixation resulting from the exposure of a rat to an insoluble problem. Maier and his associates (15,17) have demonstrated that when the rat is confronted with an insoluble problem and is forced to respond, it develops a response which persists even when the problem is changed to an ordinary brightness discrimina-The usual feature of an insoluble problem is the subtion. jection of an animal to a series of trials in which the windows of a Lashley jumping stand are locked and unlocked in a set This insures that no consistent response is rerandom order. warded on more than one-half of the trials. Most of the rats soon refuse to jump, but are forced to respond by the experimenter by administering electric shock or air blast. The animals then develop stereotyped responses, usually to one of the two available positions, left or right. After the experimenter has changed the situation so that a response to one of the windows, the dark one, is rewarded on all trials and a response to the other one, the bright one, is punished on all trials, approximately 20 per cent of the animals solve the discrimination problem, but the rest persist in the stable position response previously developed, despite the availability of the more adaptive response. Maier has suggested that the rats thus form a bimodal distribution in terms of their ability to

- 1 -

adopt more adaptive responses, and this is characteristic of frustration-instigated behavior. There is evidence, however, that the animal does "learn" the discrimination as shown by continuous <u>reduction</u> in the resistance to jumping when the positive window appears on the preferred side, and <u>increased</u> resistance when the negative window appears on that side. The usual measure of resistance in this situation has been latency, measured from the time the animal is placed on the jumping platform to the time at which it jumps to one of the windows.

Maier has proposed that the conflict occurring during the insoluble problem phase of the procedure is responsible for the behavior stereotypy which results. A "frustration threshold" was postulated, which when exceeded led to response fixation. The mechanism through which such fixation came about was not explained, although Maier and Feldman (18) did ascertain that the probability of its occurrence increased with the number of conflict trials up to a limit of approximately 160 trials.

In reviewing Maier's book (15), Hilgard (13) correctly predicted that frustration theory as set forth therein would lead to controversy among psychological theorists. The advocates of learning theory, especially those interested in anxiety-reduction, argued without hesitation that the fixation phenomenon was amenable to a learning interpretation. Thus

- 2 -

Mowrer rejects Maier's notion of 'behavior without a goal', stating that "...we are dealing with fear as the dominant motive, and it requires for its reduction merely that the rat get off the jumping stand." (21, p. 347) Dollard and Miller took the same view when they asserted that "This reward (fear reduction) maintains the response... defined as incorrect." (20, p. 47)

Osgood (22) essentially follows the foregoing ideas in explaining the phenomenon. Citing evidence for the role of mediation processes in discrimination learning, he proposed that during the insoluble problem the rat was unable to connect differential mediators to the windows, and therefore did not attend to the window aspect of the situation. However, learning did take place in that the anxiety resulting from punishment and shock or air blast became associated with the entire situation. Any reaction that got the rat off the jumping stand eliminated these situational cues which aroused the anxiety. In this way anxiety was reduced and the response reinforced. Because the rat was not attending to the visual discrimination, the selection of the position response was more probable. When the animal entered the soluble problem stage of the procedure, the same situational cues were present leading to anxiety which mediated the stable position response. Since the anxiety mediator was dominant, and was continuously being reinforced through anxiety reduction, discovery of the

- 3 -

changed significance of the visual cues was prevented. Thus the animal persisted in the response which removed him from the situation. Unfortunately, this analysis overlooked the empirically demonstrated differential responses to positive and negative windows during the soluble problem which strongly indicated that the animal did recognize the changed significance of the visual cues.

Farber (6) conducted a study in which four groups of rats were given 100 trials in a single-unit T-maze, with food on the preferred side. During the last 60 trials, two groups (S, SF) were shocked immediately after the choice point, and two control groups (NS, NSF) were not shocked. Then the SF and NSF groups were fed at the locus of shock for two 10 minute periods. On the day following, the food reward was shifted to the non-preferred side and all groups run until their original response had been extinguished. The results showed that the S group's resistance to extinction was significantly greater than each of the other groups. Farber concluded from his study that the introduction of shock (and presumably air blast) is important in the development of fixations, stating that any response elicited by shock is likely to become fixated, no matter what the strength of the response is prior to the introduction of shock. Escape from shock was thought to result in exceptionally strong reinforcement, leading to habits of considerable strength. Thus his analysis included the con-

- 4 -

cept of habit strength supplemented by high reinforcement believed to be operant in the shock situation. Furthermore, he postulated that conditioned anxiety resulted from the shock and the reduction of this anxiety whenever the fixated response occurred enhanced the persistence of that response.

Maier and Ellen (17) made a detailed analysis of Farber's results and concluded that these results fit the expectations of frustration principles better than learning principles. They especially emphasized the fact that the extinction scores of Farber's S group formed a bimodal distribution not unlike that observed in Maier's studies. In discussing this point, they correctly pointed out that anxiety-reduction theory does not include postulates which are able to account for such a split in the distribution of scores. Frustration theory, on the other hand, tries to explain such results by using the concept of an individual "frustration threshold" for each animal.

It has been empirically demonstrated that other things being equal, partial reinforcement, (defined as reinforcement of a response less than 100 per cent of the time), results in heightened resistance to extinction. Although there is little agreement on the best explanatory vehicle for this phenomenon, nearly all studies dealing with it have confirmed the empirical expectation of the increased resistance (14). During the insoluble problem of Maier's experiment the set random order of

- 5 -

locked and unlocked doors results in 50 per cent reinforcement of any consistent response made by the animals. Acting upon this fact, Wilcoxon (29) conducted a study to investigate the possibility that fixations were the consequences of such partial reinforcement; i.e., that the fixated response was merely a learned response with a high resistance to extinction. He divided his animals into three groups, the first of which received 1.00 per cent reinforcement of one of the two position responses and no reinforcement for the other. The second group had one position response reinforced on 50 per cent of the trials, the other response receiving no reinforcement. The third group received 50 per cent reinforcement for any response, to positions or windows; i.e., this group followed the pattern of Maier's insoluble problem. Wilcoxon concluded that since the fewest number of fixations occurred in the first group, (38 per cent), and the most in the second group, (92 per cent), while the third group was intermediate with 58 per cent fixations, that partial reinforcement was the primary condition antecedant to the fixated response. He insisted that frustration was controlled in the second group which had the highest number of fixations.

However, this conclusion of Wilcoxon's appears to be unwarranted for several reasons. For one, the third group did not duplicate Maier's studies in either procedure or results, as was Wilcoxon's contention, since animals with stereotyped

- 6 -

window responses were required to learn to respond to a position during the soluble problem, instead of the opposite window response, and the percentage of fixations in this group was considerably lower than that of Maier's studies. If the usual percentage of fixations obtained using Maier's technique were substituted for Wilcoxon's third group, the significance of his differences would be questionable. Moreover, the design did not rule out the possibility that the rate were still being frustrated even though only one position was reinforced 50 per cent of the time, and it was this frustration, not the pertial reinforcement, that led to the fixations.

Feldman(8) conducted a study designed to control partial reinforcement as it pertains to response habituation and isolate the effects of random punishment <u>per se</u> on response fixation. During the insoluble problem on each day the rate were allowed to jump to either of the two windows on the first five trials, but were guided to make opposite responses on the last five trials. Only 33 per cent of these rate, instead of the usual 75 to 80 per cent, failed to master a subsequent soluble problem. This was interpreted as indicating that random punishment given 50 per cent of the time might be equivalent to a partial reinforcement situation and contribute to low extinction rates, thus explaining fixations, but one must also consider the possibility that frustration adds an increment to response strength not traceable to response reinforcement

- 7 -

since all responses (left to each window and right to each window), were made 25 per cent of the time and the rates of reinforcement were therefore the same. Also, it is conceivable that guidance on half of the trials interferes with the specific S-R connection undergoing development, and may not be equivalent to free trials. Therefore, an alternative explanation may simply be that the rats experienced conflict only during the eighty non-guided trials. This latter interpretation is supported by results from an experiment by Maier and Feldman (18) which demonstrated that rats subjected to an insoluble problem situation for only eighty trials developed responses that were significantly less rigid than when rats experienced conflict for 160 trials. In addition, a study recently completed by Feldman (9) demonstrated that if rats were guided to make a response on every trial with only 50 per cent reward, even though the responses were forced to the same position for 160 trials, no animal shows fixations during subsequent soluble discrimination problems. This suggests that guided trials are certainly not the equivalent of free trials when the consequences of the response are the same.

Another attempt to explain fixations in terms of learning principles was made by Gladin and Denny (12), who reported data which they believed supported the contention that a sequential cue was operant during both the insoluble and the soluble problems, and that this cue played a dominant role

... 8

in bringing about and maintaining the fixated response. This cue consisted of a learned expectation that successful trials would be more likely to follow unsuccessful trials. This was a cogent hypothesis since Maier's schedule actually did provide for the acquisition of such an expectation. Gladin and Denny's data did seem to support their hypothesis, but Feldman and Waite (11), in a more thorough analysis of typical data, found no such evidence. Moreover, they proposed alternative explanations for Gladin and Denny's results which contributed in no way to an explanation of fixations.

Wolpe (30) agreed with Maier that anxiety-reduction principles were inadequate for explaining the fixated response. Instead, he proposed a <u>primary</u> reinforcement interpretation, asserting that it was the escape from airblast (or shock) which was reinforcing. This explanation, therefore, is identical with that of the anxiety-reductionists except that Wolpe substituted primary reinforcement for the secondary reinforcement of anxiety reduction. Wolpe also stated that air blast acted as the cue to the response of jumping; apparently he pictured each trial as involving the administration of air blast or shock.

Although Wolpe was mistaken since shock or air blast is not necessary to get most animals to respond, it is possible that the primary reinforcement occurring on the trials in which such impetus is needed is the principal condition de-

- 9 -

termining the strength of the stereotyped response. Feldman (10) investigated this hypothesis, analyzing the data from two experiments, one using air blast and the other electric shock. In neither case did he find the necessary correlations between the number of trials involving air blast or shock and the strength of the fixations to support Wolpe's hypothesis. It is apparent, therefore, that the <u>role</u> of primary reinforcement is not a highly significant determinant in the development of the fixated response.

The work of Solomon and his colleagues (24,25) is also relevant to the fixation phenomenon. They placed dogs in a modified shuttlebox with an electric grid floor. Ten seconds after a decrease in illumination, the floor was energized at a just-subtetanizing level. The animals learned to jump into the other compartment before the onset of shock (US), apparently utilizing the decrease in illumination as a signal (CS) that the shock would occur. In attempting to explain the acquisition of such avoidance responses, Solomon hypothesized that anxiety was first classically conditioned to the illumination change, and then the avoidance response instrumentally conditioned, with the reduction of anxiety serving as reinforcement of the instrumental response.

Like the fixated response, these avoidance responses were extremely resistant to extinction. Like Maier, Solomon was unable to explain this resistance employing only the familiar learning theory framework. He found it necessary to introduce two new principles, anxiety conservation and the partial irreversibility of classical conditioning. By anxiety conservation he meant that during extinction trials the dogs at first responded with latencies shorter than those required for the elicitation of anxiety, and no anxiety reduction could occur. The result was a decrement in the avoidance habit factor and a consequent increase in latencies, until the latencies were long enough to allow the elicitation of anxiety. Then, since anxiety reduction was once again possible, an increase in habit was brought about. Since reduction of the anxiety occurred only on intermittent trials, anxiety is 'conserved' as a relatively inert potential, theoretically speaking.

The principle of partial irreversibility hypothesized that in the case of intense anxiety, established on the basis of an intense pain, the conditioned anxiety response is incapable of complete extinction. If verified, this principle would add to and substantiate the anxiety-reduction interpretation of Maier's experiments. However, Brush (4) has reported that he has been unable to find any relationship between different shock intensities and the resistance to extinction of an avoidance response. Moreover, the applicability of these two principles is apparently limited since the first depends upon the establishment of exceptionally short latencies and the second involves the use of electric shock of extremely

- 11 -

- 12 -

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high intensities. Neither of these two conditions is operant to any major extent in the ordinary fixation procedure.

STATEMENT OF THE PROBLEM

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The foregoing discussion has illustrated the failure to clearly isolate mechanisms that can account for behavior fixation. It is recognized that the frustration hypothesis is not explicit enough for both precise explanation and prediction, and in the case of the various hypotheses proposed within the learning theory framework, they remain hypotheses at best, since sufficient empirical substantiation has not been found. Maier (16) has said that in its development, psychological theory has not attained the level where one set of postulates, such as that of learning theory, can be utilized in explaining all response phenomena. Although he has specifically separated the fixated response from the learned response, hypotheses using the concepts of learning theory have been advanced concerning fixations, and it is felt that they should be put to empirical test. Brown (2), in dealing with some of the difficulties encountered in applying the drivereduction point of view, implied that it was the learning theorist's responsibility to analyze phenomena such as fixated behavior, and devise methods to empirically validate the application of learning explanations. The logical step, consequently, is to attempt to isolate experimentally verifiable learning mechanisms within the conflict or frustration situation.

The strategic question at this point might be that if the fixated response is a learned response, is it possible to

- 13 -

empirically relate the strength of the fixated response to something in addition to its own persistence? This would avoid the circularity of explaining fixations in terms of a response-defined habit strength, or to a not too vigorously defined anxiety which is presumably reduced by the response.

The design of Maier's experiments consists of a visual discrimination problem (the soluble problem), in which the subjects have had previous experience of a special sort; 1.e., the insoluble problem. The learning theorists maintain that during this previous experience the animals learn a habit whose strength is great enough to interfere with the subsequent mastery of the visual discrimination. In most instances, this strong habit is one of position. A principle basic to the learning explanation is contained in the theoretical framework postulated for discrimination learning by Spence (26,27,28). Briefly, Spence stated that following reinforcement, an S-R connection undergoes an increment, while failure or lack of reward causes a decrement in the strength of this connection. The strength of a stimulus complex was seen as the sum of the strengths of its component stimuli, and given two antagonistic connections, the one having the greatest strength will prevail. From these postulates he concluded that in a discrimination situation such as that afforded by the Lashley jumping stand, a greater difference between the strengths of the positive and negative stimuli (windows) would

be required for learning if there is an initial difference in the strengths of the two position stimuli than if no such difference exists.

These postulates of Spence have been questioned by Lashley, Kreshevsky, and others, leading to the well-known continuity versus non-continuity argument. Bitterman and Coate (1) reviewed the controversy and devised an experimental method to test Spence's theory. They trained animals to learn a brightness discrimination on the Lashley jumping stand, and then required the subjects to give up the brightness discrimination responses and learn a position response. During brightness discrimination the positive stimulus appeared eighty per cent of the time on the side which was to be correct during the subsequent position learning for group A, and twenty per cent of the time on the to-be-correct side for group B. It was found that position learning was significantly slower for the latter group. The results indicated that although the position stimuli were non-relevant during the brightness discrimination, the strength of the connections between the response and each of the positions varied directly with the number of repetitions of those connections. Thus, animals in group A, whose responses during brightness discrimination were made eighty per cent of the time to the position which was to be correct in the next stage of the experiment, entered position learning with a greater strength for the positive position

- 15 -

than for the negative position. The relative strengths of these connections were apparently reversed for animals of group B. Bitterman and Coate concluded that these results supported the continuity postulates of Spence.

The present study was intended to ascertain whether or not the principle of reinforcement is applicable in explaining the rigid response developed during the insoluble problem. Specifically, when a rat responds in an insoluble problem situation does a stimulus which is non-relevant undergo a change in excitatory strength according to Spence's theory, as occurs in ordinary discrimination learning? The main hypothesis which stems from this question is:

> If the conflict-induced response acquires its strength due to the operation of some reinforcement mechanism, then the non-relevant cue will increase in excitatory strength. If this cue should subsequently become relevant, the learning of a response to that cue will be facilitated.

Two corollary hypotheses are:

1. If the cue in question gains in excitatory strength, then the factors contributing to stereotypy may more likely be overcome.

- 16 -

2. If the cue gains in excitatory strength, the rate of learning a subsequent discrimination, as shown by latency measures, will be faster. METHOD

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Subjects

Thirty-four male albino rats of the Wistar strain from the University of Massachusetts food technology breeding colony were used. Age of the animals approximated one hundred days at the beginning of the experiment. They were fed thirty grame of moist Purina Fox Chow, seasoned with canned soup, once per day during and immediately following trials. They were allowed free access to water in their individual cages.

Apparatus

The apparatus used was a semi-automatically controlled modified Lashley jumping stand similar to that described by Feldman (7). This stand consisted essentially of a small electric grid platform from which the rat jumped toward one of a pair of windows. One window was dark and the other bright. A response through an unlocked window led to food reward, while a response to a locked window led to a bump and a fall to a net 39 inches below. Response latency in seconds was measured by starting an electric timer when the rat was placed on the jumping platform and stopping it when the rat responded by jumping.

Procedure

Preliminary Training: The animals were trained to jump

following the procedure developed by Maier (15). At first the rats were placed on the feeding platform with their daily food ration. After three days they had become familiar with the apparatus and were eating well. Next, individual training trials were begun in which the jumping platform was placed close to the windows, and the rats were required to step through open windows to the feeding station. In order to prevent pre-experimental acquisition of strong preference habits, each subject was manually guided on even-numbered trials to the window opposite the one it had chosen on the preceding All animals underwent ten trials per day, five jumps trial. to each window. Every day the jumping platform was moved back about one inch from the windows until the rats were jumping eight and one-half inches. Then, gradually, the windows were closed by plexiglas sheets. At first the subjects had to brush past them, but eventually they had to push them open to reach the feeding platform. One of the windows was illuminated, thus presenting a bright-dark stimulus pattern. The bright and dark windows were interchanged after every evennumbered trial.

Preference Trials: After the rats were jumping readily through the windows, they were given a series of forty trials, ten trials per day. Each window, bright and dark, appeared on each side in a set random order, and neither was locked. The set random order used was the same as that employed during

- 19 -

the soluble problem. During these trials the animals were given thirty seconds in which to make a response. If a rat did not respond within this period, the electric grid on the jumping platform was charged with two shocks per second until a response was made. If a subject responded to the same position or to the same window three times in succession, it was guided manually to the opposite side or window on the following trial.

The data from the preference trials were then examined, and all rats who responded regularly to either window were eliminated from the experiment. The remaining rats were divided into two groups, equated for position preference and latencies to each window.

Insoluble Problem (Conflict Situation): During the insoluble problem, rate of Group I were placed in a situation where the windows were locked in a set random order so that the animals could be successful in getting to the feeding station only fifty per cent of the time no matter what side they chose. The entire conflict situation lasted for sixteen days, ten trials per day. During the trials the dark window appeared on the animals' preferred sides eight out of every ten trials. As during preference trials, the grid was charged after thirty seconds if the rat did not respond and the latency of each response was recorded for each trial.

Subjects in Group II received treatment identical with

- 20 -

that employed for Group I except that the <u>bright</u> window was presented on the preferred side on eighty per cent of the trials.

<u>Soluble Problem</u>: Both groups were then subjected to a situation wherein each window appeared on each side fifty per cent of the time in a set random order, the dark window being unlocked on all trials, the bright window locked on all trials. Ten trials per day were given for twenty days, giving a total of two hundred trials. Response latencies were recorded and the grid was charged after a hesitation by any rat on any trial of thirty seconds. The criterion established for mastery of the soluble problem was three consecutive days with not more than one error. RESULTS

First, it seems necessary to detail the disposition of the animals during the various stages of the experiment. ATT thirty-four rats which began the study completed preference trials, but eight of these were eliminated prior to conflict trials because they had demonstrated a preference for the bright window. The remaining subjects were divided into two groups of thirteen, equated for latencies to each window and for position preferences. During the course of conflict trials, one animal from Group I and two animals from Group II suffered from a respiratory ailment and died, and two animals of Group II changed their preference from a position to the bright window and were necessarily eliminated from the experiment. Thus, at the beginning of the soluble problem Group I contained twelve animals while Group II consisted of nine animals. A11 of these remaining twenty-one rats completed the two hundred soluble problem trials.

Since it was conceivable that the loss of five animals after the matching of the two groups might have disrupted their equality, a <u>t</u>-test was applied to the preference trial data of the twenty-one animals that finished the experiment to determine if there was an initial difference between the groups in terms of latencies to the dark and bright windows. No such difference was found, indicating that any such difference appearing later in the experiment would not be due to

- 22 -

original group inequality.

Inspection of the data from the conflict trials showed that Group I animals responded slightly faster to the dark window, while Group II animals responded slightly faster to the bright window. In other words, each group tended to respond quicker to the window that appeared on the preferred side eighty per cent of the time. These differences in latencies were consistent for each group on every day of the insoluble problem. An analysis of variance of the data demonstrated that although the inter-group differences on each day were slight, the over-all difference was significant at below the .001 level. The difference did not increase or decrease significantly over the sixteen days, however, since the analysis also indicated that the curves of group means were parallel.

Although it was hypothesized that more rats in Group I would master the soluble problem than the twenty to twentyfive per cent found in prior studies, the results are that no animal in either group managed to abandon his stereotyped response and reach the learning criterion. While the animals persisted in their position responses throughout the soluble problem, they did respond faster when the dark window (the correct window), appeared on their preferred side than when the bright window appeared on that side. At the beginning of the problem, this difference in latencies was minimal, but gradually increased to a maximum of between 12 and 14 seconds.

- 23 -

Figure 1 shows this development of the differential latencies to the positive and negative windows. The median latencies to each of the windows was computed for each rat on each day, and the differential latency obtained by subtracting the latency for the positive window from that of the negative win-Group means were then computed for each day. The graph dow. indicates that the difference between latencies increased for Group I faster than it did for Group II. It is also apparent that Group I reached its asymptote after nine days of the soluble problem, while Group II did not reach this level until approximately the fifteenth day. These graphic indications are supported by a statistical analysis of the data which rejected the null hypotheses of no over-all difference over the twenty days, no over-all difference between the two groups, and a parallelism of the group curves, all at the .001 level of confidence. It also ascertained that differences between Group I means on days nine through twenty were insignificant, supporting the interpretation that this group had reached its asymptote.

Figure II shows graphically the effect that each of the windows, dark and bright, had on response latencies during the soluble problem. The data represented in this graph covers both groups of animals. It can be seen that latencies of responses to the unlocked (dark) window fell to & lower level, while latencies of responses to the locked (bright)

- 24 -



- 25 -

window rose to a higher level. Furthermore, it is noted that the increase in latencies of responses to the bright window is greater than the decrease in latencies associated with the dark window.

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With regard to the consistency of the animals' responses, it was found that during the insoluble problem only five rats made any responses other than their preferred position responses. The soluble problem data shows that no animal, on any trial throughout the twenty days, jumped to its non-preferred side. DISCUSSION

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It was hypothesized that if a rat, in responding to a position during the insoluble problem, also responded eighty per cent of the time to the dark window, the subsequent learning to jump to the dark window would be facilitated. While none of the animals in either of the two groups were able to completely master the soluble problem, it was apparent that those in Group I learned to discriminate between positive and negative windows faster than those in Group II. Figure I indicated that Group I reached an asymptote in differential latencies at least sixty trials before Group II. Therefore, we might say that the hypothesis was at least partially confirmed. Moreover, the results agree with the predictions made from Spence's postulates; viz., the more an animal responded to the dark window during the conflict trials, the higher became the dark window's excitability. In other words, animals of Group I entered the soluble problem with a stronger S-R connection concerning the dark window than animals of Group II.

Another aspect of the results is the high degree of behavior stability during the insoluble problem. Since the procedure here differed from that customarily employed only in the position biases assigned the windows during conflict trials, the question is raised as to the effect of these biases upon the responses during conflict trials. In an analysis by Robins (23) of some unpublished data by Neet and Feldman it was

- 27 -

indicated that the number of fixations which develop is inversely related to the variability of responses during the insoluble problem. Robins' criterion of variability was the number of days during the conflict trials on which an animal made at least one response that was different from his typical conflictinduced response. For example, a rat may have jumped to the left on 156 trials; on the first day it jumped twice to the right and on the third and fourth days it jumped to the right once. This animal's variability score would be three. In his analysis, Robins found that the animals able to solve the subsequent soluble problem after sixteen days of conflict trials had a mean variability score of twelve, while those unable to solve the problem had a mean variability score of eight. These differences were significant at the .05 level of confidence. Inspection of the insoluble problem data of the present study shows that out of the twenty-one animals, four had variability scores of one and one had a variability score of two, while the remaining sixteen animals had scores of zero. We might conclude, then, that the exposure of the same window on the same side for eight out of ten conflict trials greatly reduced the variability of responses during the insoluble problem. This decrease in variability would, according to learning principles, result in exceptionally strong position responses to the preferred side and conversely, the strength of a response to the other side would be minimal.

- 28 -

The above analysis has suggested that reinforcement was operant during the insoluble problem, but what can we determine as to the source or nature of the reinforcement? Reconsideration of the conflict situation may be helpful at this point in answering this question. The rats responded with high consistency to the same position over a period of sixteen days, ten trials per day. In every ten-trial-block, Group I animals responded eight times to the dark window. Four of these responses resulted in punishment from hitting a locked window, and the other four resulted in entry to the feeding platform through an unlocked window. On two of the ten trials each day the animal, in making his position response, jumped towards a bright window and received punishment once and reward once. It is obvious, therefore, that any differential reinforcement or enhancing of the excitatory values of the two window cues cannot be attributable to the punishing or rewarding characteristics of the windows per se, since reward and punishment were administered in equal amounts. One might argue, on the other hand, that the absolute magnitudes of increments due to reward, and decrements due to punishment are not equal. Indeed, McLelland (19) advanced the hypothesis that the effects of avoidance motivation have greater strength than those of approach motivation. Figure II shows the changes in latencies for the two groups combined during the soluble problem. It is noticed that the increase in latencies of responses to a locked

- 29 -

window, (the bright one), is greater than the decrease in latencies of responses to an unlocked window (the dark one). Although this suggests that the effects of punishment are of greater magnitude than the effects of reward, the results of the insoluble problem suggest the opposite conclusion. During the insoluble problem we would expect that if punishment raises latencies more than reward lowers them, that the latencies to the window appearing on the preferred side eighty per cent of the time would be higher than those of responses to the twenty per cent window. The analysis of the insoluble problem data showed the opposite to be the case. Therefore, the hypothesis that punishment results in greater excitatory change than does reward finds no support. The question remains, then, if one adheres to Spence's theory, what can be offered as the reinforcing agent? The most salient factor in the situation which could be employed is that of reinforcement resulting from the animal merely getting off the jumping stand. In other words, something associated with making the response has a possible reinforcing effect. Since there is good reason, derived from the use of shock as well as the existence of conflict, for supposing that the animal is in a state of anxiety prior to making a response, the postulation of anxiety reduction as the major source of reinforcement may have some substance.

But, granted some reinforcement mechanism, even anxiety reduction, the problem of why the position response is stronger



than the competing "dark response" still must be faced. During the insoluble problem, the rats might have been reinforced by jumping to the left, but the animals in Group I were also responding to the dark window most of the time. If one assumes a strong habit strength for the left response being established at this time, there is ample reason to believe that almost equivalent strength is associated with the dark window, but apparently this is not the case. If one suggests that position responses are inherently stronger than discrimination responses, one must be reminded that Maier's conflict technique frequently produces window (bright and dark) stereotypes and that these are <u>less</u> likely to be abandoned during subsequent soluble problems than are position stereotypes.

Perhaps the explanation suggested by Bruner, Matter and Papanek (3) in their concept "breadth of learning" may contribute something. They stated that the range of cues to which an organism will attend is a function of determinate processes and is therefore a dependent variable. High motivation and intensive practice were cited as two independent variables in this sub-system which tend to reduce this range of cues. Certainly in the present experiment both of these antecedent conditions were present both pefore and during the time the animals were required to attend to the dark window as the consistently positive stimulus. Using Bruner's concept, it could be hypothesized that after the intensive practice of

- 32 -

the insoluble problem, and under the high motivation resulting from hunger, occasional shock, and perhaps anxiety, the range of cues to which the subjects attended was restricted. In other words, when the dark window appeared on the side of their strong position responses, it was of minor significance in the stimulus complex. An interesting implication of their data cited by Bruner et al was the possibility that under high motivation the predictions from continuity theory may not be substantiated. In a sense, they believed that the reduction in the range of cues to which an animal attends reduces, in turn, the possibility of a rise in the excitatory values of non-relevant cues. One might tentatively conclude that the applicability of the continuity hypothesis is perhaps limited to situations in which the motivational variables are of relatively low intensity. It might be, then, that because of the high motivation existing in the present study the blased presentation of window cues during the insoluble problem could not raise the excitability value of the dark window high enough to overcome the strength of the ongoing position response during the soluble problem. Explanations such as this which proceed from the Bruner, Matter and Papanek paper must remain tentative, however, since Church (5) has reported that he has been unable to duplicate their experimental results, casting doubt upon

- 33 -

the validity of the "breadth of learning" concept.

It has been previously stated that the interpretation of the fixation phenomenon within the framework provided by learning theory was at least partially supported by the results of the present study. But, it is the inability of any animal to master the soluble problem which continues to demand the isolation of additional variables. Feldman (9) has found that when rats were guided with a transparent screen to the same side or window on every trial throughout the insoluble problem all animals were able to readily solve a subsequent discrimination problem. He has hypothesized that the principle ingredient within a conflict situation contributing to the development of fixations is the extinction of the mediational processes concerned with the consideration of alternatives. In other words, the early elements in the instrumental chains leading to jumps to alternate cues are associated with the internal effects of conflict, (acting as a negative reinforcer), and eliminated. In guiding animals to the same side or window on every trial, Feldman presumably prevented the occurrence of these early elements and they consequently were not eliminated lack of due to their association with a negative reinforcer. Thus, these elements were present when the soluble problem trials began, allowing the instrumental chain connected with the "correct" cue to develop. In the present study one might consider that the number of alternatives was increased by the

presentation of the window cues with a position bias. This can be explained in the following way. Whereas in the ordinary insoluble problem situation the window cues are presented randomly as to position, hence, are non-relevant and consequently offer no strong alternatives for the animals with an initial position preference. But, in this study, they were associated with positions by their biased presentation and were included within each of the two position alternatives. In other words, since the windows were presented in association with position, they, too, became a significant aspect of the situation. We might expect, therefore, that the early elements of the instrumental chains to a <u>greater</u> number of alternatives were extinguished, resulting in greater rigidity of behavior.

Perhaps the next step in the investigation of fixated behavior is an empirical test of Feldman's hypothesis. One way in which this could be done is to train animals under the usual procedure and then subject them to an insoluble problem in which both windows are grey. In this situation the animals would have only the choice of position responses, and it would be expected that in extinguishing the consideration of alternatives the window cues would be unaffected since they would be absent. Exposure of the rats to a subsequent discrimination problem wherein one of the windows was unlocked on every trial and the other window locked should result in a relatively low number of fixations, according to Feldman's proposal.

- 35 -

SUMMARY

Twenty-one rats exhibiting a position preference in responding on a Lashley jumping stand were subjected to an insoluble problem in a manner developed by Maier (15), and later subjected to an ordinary brightness discrimination During the insoluble problem twelve animals were problem. presented with the to-be-correct stimulus on their preferred side 80 per cent of the time, while the other nine animals were presented the to-be-incorrect stimulus on their preferred side 80 per cent of the time. The results indicated that the rats with the positive position bias developed differential latencies to the correct and incorrect windows during the discrimination problem faster than the other group, but the acquired associative strength was insufficient to cause any animal to abandon his stereotyped response and solve the problem.

The applicability of learning theory in explaining the results was found to be only partial. It was hypothesized that another explanatory mechanism might be that fixations are the consequences of conflict-induced extinction of the "consideration of alternative responses".

- 36 -

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