MOTIVATIONAL PROPERTIES OF NONREWARD

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A) FRUSTRATION EFFECT AND CHANGE OF STIMULUS CONDITIONS.

B) RESPONSE DECREMENT AND CHANGE OF STIMULUS CONDITIONS.

By

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SCOPE AND CONTENTS: This study attempted to test: 1) an alternative interpretation of Amsel frustration effect and, 2) the possibility of extending Bindra's novelty theory.

Sixty-eight children were trained to pull two successive levers. During training two groups, 100:50 and 100:100, were always rewarded at the first goal box (G1) whereas two other groups, 0:50 and 0:0, were never rewarded at G1. During testing groups 100:50 and 0;50 were given 50% reward at G1 while groups 100:100 and 0:0 were respectively always rewarded and never rewarded at G1. All subjects were always rewarded at G2 both during training and testing.

The data did not yield the typical frustration effect which rendered the alternative interpretation untestable. The data offered supportive evidence for Bindra's novelty theory.

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CHAPTER ONE

HISTORICAL REVIEW AND INTRODUCTION

"Frustration" has been a widely employed concept in the science of behavior. Lewin (in Lawson and Marx, 1958) some time ago, warned that a "scientific" concept of frustration could not include all the phenomena covered by the popular meaning of the term. This unheeded caution is partially responsible for the literature on "frustration" presenting a rather confusing collection of material. Theories of emotion, as a whole have been notorious for their amorphous structure and ill-defined nature; a notoriety from which "frustration" has not escaped. Many reasons have been advanced to account for this; emotional phenomena are complex, manifold, evanescent, and difficult to measure. In Brown and Farber's (1951) opinion, however, the confusion is primarily the result of serious misconceptions about the nature of theory construction in psychology and the kind of procedures that must be followed if adequate theories of emotion are to be developed and integrated into more comprehensive systems of behavior.

Today the major trend in frustration theory is the emphasis on some form of two factor theory. Essentially, this view holds that frustration results in a) a momentary increase in motivation and/or b) the occurrence of stimuli that interfere with the response involved in a frustrating situation. A weakness in this position is that there is, as yet, no way to predict when one or the other will predominate. However, a strong point of these theories is the advance made toward the formulation of terms in a formal and operational manner with less emphasis on their clinical and emotional meanings. For example, such terms as physical barriers, the presence of an incompatible response tendency and omission or reduction of a customary reward, are all being utilized operationally as antecedent conditions that lead to some inferential state called "frustration." This does not mean that only the two factor theories are scientific. Other noteworthy attempts, by following the laws of theory construction, have been self destructive.

This survey proposes to review historically, the more important theories of frustration and exemplary research that has evolved from each one. The review will lead into a discussion of the two factor theories at which point special emphasis will be given to the theoretical position and the experimental work of Abram Amsel. This study purports to add an important control that has been omitted in the derivation of his theory.

The frustration-aggression theory of Dollard <u>et al</u> (1939), was the first major attempt to develop principles of frustration compatible with the larger body of behavior theory. The basic assumption was that aggression was an inevitable consequence of frustration, and that the existence of frustration always leads to some form of aggression (1939, p. 1). Frustration was defined as the interference with the occurrence of an instigated goal-response; aggression was defined as an act in which the goal was injury to an organism. It was held that the aggressive reaction need not always take the form of direct aggression against the instigator of the frustration but could be displaced toward other objects or could take the form of some substitute activity, such as day dreaming.

Sears, Hovland, and Miller (1940), in attempting to study aggressive behavior, subjected some college students to 24 hours sleep deprivation during which the subjects (Ss) were put into a frustrating situation. They were promised that there would be some games in the room with which they could play during the sleepless period, but there were none; they were promised that breakfast would be served at 5:00 A.M. but it never arrived; they were asked to refrain from smoking and to remain silent. On the other hand, the experimenters (Es) smoked and ate. Aggression was shown against Es, as predicted, and it took the form of accusatory questions asked in a hard, unfriendly tone. Also, the subjects' ratings of the Es and of the other Ss were more unfavorable during the session than during a subsequent control session.

Seashore and Bavelas (1942) required 15 children to draw a picture of a man. After drawing the picture, the children were instructed as follows, "Draw another man; this time draw a better one." This procedure was repeated 15 times and at no time was any approval given by E. It was argued that this experimental situation fitted in with the definition of frustration as interference with a goal response in the sense that the S comes to the task "goal minded," i.e. to retain the approval of the experimenter or even to enhance his relations with E. The observations were that Ss took progressively less time to draw each picture and that around trials 3-4 their resistive statements increased in time, finally reaching the stage at which 40% of their statements were classed as positive resistance to the task and to E.

The frustration-aggression hypothesis did not go unchallenged. Morlan (1949) and Levy (1941) argued, in general, that frustration is one of many factors that may influence behavior and that it rarely exists without the blending of other factors. Nor is aggressive behavior always the result of frustration. Davitz (1952) claimed that a person's reaction to frustration would be affected by his previous experience in situations similar to that in which frustration was encountered. He gave children either "constructive" or "aggressive" training in a playroom. The former consisted of a situation in which Ss were encouraged to play quiet games in an atmosphere of group cooperation; the latter, played highly competitive games and aggressive actions were encouraged. After Ss had been trained, they were taken to an adjoining room, given some candy, and a movie was begun. Suddenly, the movie was stopped at the most interesting point, the candy was taken away, and they were led back to the original room. Judgments of free play activity both before training and after the experimental treatment showed an increase in aggressiveness and in constructiveness in the post frustration situation for the groups trained accordingly. This study was a noteworthy attempt to evaluate the role of previous experience in reactions to frustration.

In response to these criticisms Miller et al, (1941) redefined their position. The assertion that aggression always presupposes frustration was deemed defensible and useful as a working hypothesis. However, the assertion that the existence of frustration always leads to some form of aggression was deemed unfortunate. They agreed with critics that such a statement suggests aggression to be the only consequence of frustration. In order to avoid this unfortunate implication, the statement was rephrased as follows: "Frustration produces instigation to a number of different types of response, one of which is an instigation to some form of aggression." Sears (1941) added that the next step was to find the total repertoire of frustration reactions available to an individual and to determine the antecedents that lead to one type of reaction and those that lead to another.

The frustration-aggression theory has merit in that it attempts to define the class of antecedent conditions leading to frustration; i.e. goal response interference. One flaw of the theory was the interpretation of a wide range of non-aggressive behavior as "substitute activity" for an aggressive act. If aggression did not occur as predicted it was explained as having been displaced toward some other activity. In other words, the theory was in such a position that it could "explain" all reactions to frustration but could not provide an adequate general theoretical framework in order to predict frustrative behavior.

The frustration-regression theory was originally proposed by Freud (1957). He believed that in the process of the development of the "libido," single portions of the libido could remain in an early stage of development, while other portions would reach their goal. These arrested impulses were said to be fixated. He believed further, that the portions which had completed their development could regress to the earlier stages in the face of frustration. By the term frustration, Freud referred to a state that results when reality prevents one from gratification of a "sexual" wish. Those who have since attempted to study regression experimentally have done so under one of two paradigms.

In one case the organism is successively trained on incompatible responses leading to one goal and then the most recently learned one is continuously punished. Typically, the organism reverts to the response learned earlier and, if successful, continues with that response. Mowrer (1940) performed a study of this phenomenon. He trained rats in a Skinner type box to push a bar in order to escape a mild electric shock to the feet. The experimental group had previously been trained to escape the shock by sitting on their hind legs, while the controls had received no such training. Finally the pedal itself, which had served to terminate the shock, was electrified, in addition to the grid floor. The results were that the experimental group regressed to the earlier habit of sitting on their hind legs while the controls continued to press the bar. In addition to electric shock, removal of food reward can be equally efficacious as the frustrating agent leading to regression (Hull, 1934).

The other paradigm for studying regression is included under the term primitivization, which refers to behavior that is characteristic of a less mature stage of development as opposed to a literal repetition of earlier learned behavior. Barker, Dembo, and Lewis (1941), in a now classic experiment, made observations of children's free play with a set of toys. A score was assigned to each child. The units of scoring were in months and therefore a child could be scored on a "play age" analogous to mental age. On the next day the children were brought over to the other side of the room and allowed to play with some toys that were much more attractive than the previous ones. Fifteen minutes later, the E, without warning or explanation, lead them back to the original location to play with the less attractive toys for half an hour. A wire-mesh net was lowered so that the more attractive toys were visible, but inaccessible. The results disclosed a decrement in the constructiveness of play in the post frustration period, which was generally typical of an earlier developmental stage.

Child and Waterhouse (1952), suggest that the term regression is not adequate for a general theory of frustration because although it is a frequent reaction to frustration, regression is not the only reaction to frustration. In some cases behavior after frustration may progress rather than regress. In its place is suggested the term "quality of performance." This would not only get away from the psychoanalytic implications but would serve for assessing behavior that improved rather than regressed.

Maier (1949) carried out a long series of studies on the development of behavior fixations and their subsequent elimination in rats and from these developed his theory of frustration. The rats were presented with an insoluble two choice jumping stand problem which required them to jump to one of two windows to receive a randomly located food reward. They were forced to continue responding to one of the two windows by use of an air blast or electric shock while on the jumping stand. Typically, the _Ss_ developed the response of always jumping to one side. This often became so fixated that when a solution later became possible, _Ss_ continued for 400 or more trials to respond to the one side only. _Ss_ which had performed the equivalent number of position responses for consistent food rewards, by comparison, quickly learned the alternative response when the problem was changed. Maier concluded from his studies that the enforced inability of an organism to develop an adaptive response pattern was the crucial factor in a frustrating situation, and that frustration-instigated behavior was qualitatively different from adaptive behavior and could _not_ be explained by learning principles.

Counterarguments against these theoretical conclusions were numerous, generally taking the view that his experimental data could be adequately interpreted and predicted by utilizing the concepts of learning theory and that there was no need of invoking a new theoretical sphere of especially motivated or non-motivated behavior. Some examples are presented.

Hilgard (1948, p. 473) claims that fixation need not be interpreted as a compulsion to which the learner is a slave. Instead the situation could be such that it is misinterpreted in the light of the learner's experience, and the sense of an alternative has been lost. Perhaps the animal has "chosen" to reject the second window as no better than the first, since its provisional tries toward a solution were frustrated as frequently at one place as at the other. A human parallel may be drawn. Suppose that experience has shown that the front and back doors of the laboratory had always been unlocked together. If one day a careless attendant forgot to unlock the front door, one may sit for a long time waiting for it to be opened, before trying the back door.

McClelland (1950), suggests that anxiety reduction is what has reinforced this stereotyped behavior and an experiment by Farber (1948) seems to give support to this notion. He argued that any response which removed anxiety would be reinforced and likewise, any response that reduced hunger would be reinforced. It follows that a response which both removes anxiety and reduces hunger, would be doubly reinforcing. Now if either the food reward or the anxiety provoking stimulus is removed there is no reason why the response should not continue, exactly as they did in the Maier situation. McClelland also claims that instead of making the assumption that the rats continued to respond to the insoluble problem because of frustration, it would be simpler to conclude that they responded because they were shocked, blasted, or shoved off the stand if they didn't jump. In this case primary drive reduction, escape from the noxious stimulus, would be the crucial determining factor.

Wilcoxon (1952), using the same apparatus as Maier, attempted to isolate the effects of partial reinforcement and nondifferential reinforcement in a situation similar to the one from which Maier had drawn his evidence for "abnormal fixations." Training for the three groups consisted of the following: Group 1 was given continuous reinforcement for making the correct response and continuous punishment for the incorrect response; Group 2 received partial reinforcement (50%) for making the correct R, and continuous punishment for the wrong one; Group 3 received the typical Maier unsolvable problem in which any position habit adopted resulted in reward on half of the trials and punishment on the other half. The latter group took longer to establish a consistent response, as might be expected, since nondifferential reinforcement increases variability. Likewise, group 2 took longer than group 1 to establish a consistent response. Also when the problem was changed so that it was solvable, the partial group was the one that took longest to extinguish. The interpretation was that partial reinforcement is of primary importance in the development of fixations.

In 1955 Maier affected a major innovation to his theory. The insolubility of a problem was no longer considered as the instigator to frustration, but the factor now considered to lead to frustration is the failure to confirm an expectancy. An organism, acquainted with its surroundings through learning, will be frustrated when its environment changes markedly in orderliness and conflicts with its expectation of events, no matter whether it is an expectancy of reward or punishment. The concept of "change" in experimental conditions as related to frustration will be discussed more fully later since it provides the basis for this study.

Within the last nine years three "two factor" theories of frustration have emerged. Lawson and Marx (1958) suggest this is an indication that this type of theorizing may dominate the field for some time. The theories of

Brown and Farber, Child and Waterhouse, and Amsel will be reviewed.

Brown and Farber (1951) use the term frustration to refer to a hypothetical condition or state of the organism. It is, therefore, dinstinguished from a frustrating event such as the blocking or nonreward of a response. They have carefully listed the antecedents to frustration as; 1) the introduction of partial or complete physical barriers; 2) the introduction of delay periods between the initiation and completion of a response sequence; 3) the omission or reduction of a customary reward on one or more trials; 4) variations in the organism's condition, environment, or training leading to the evocation of a response tendency that is incompatible with the ongoing one.

Although these antecedents differ widely with respect to their manifest topological features, the capacity they possess in common to thwart an ongoing response may be accounted for by assuming that each functions in some way to arouse a reaction tendency incompatible with that normally predominant in the situation. These competitive tendencies may be either positive excitatory tendencies to perform a conflicting response or inhibitory tendencies such as those resulting from the expenditure of effort. Therefore, the basic assumption is that frustration is the consequence of either; a) the simultaneous activation of two competing excitatory reaction tendencies, or b) the presence of a single excitatory tendency and an opposing inhibitory tendency. The amount of frustration that evolves from a particular situation is equal to the ratio between two incompatible reaction potentials.

As a determinant of behavior this frustration state may affect overt behavior in one of two manners: 1) frustration may increase the general level of motivation, or 2) frustration may produce, or be accompanied by, unique internal stimuli.

The possibility that frustration may produce a heightened drive level is coordinate with the notion that emotions have motivational properties, with current conceptions of the drive properties of fear and anxiety, and with numerous, though unsystematic observations of a clinical nature. The assumption of an increment in motivation can be incorporated into Hull's theory (1943) by assuming that frustration produced drive has the functional status of an irrelevant drive. According to Hull, irrelevant drives combine with primary drives to produce the effective drive (D) that energizes habits.

The second manner, according to Brown and Farber, in which an organism's behavior may be affected by frustration, is through the workings of unique, internal stimuli. Such stimuli may serve to provide the means whereby an organism could learn to discriminate between frustration and other states such as hunger. Also frustration produced stimuli might elicit specific overt responses or response patterns quite unlike those aroused under other antecedent conditions. Finally, frustration might provide a suitable explanation of the fact that so-called emotional responses often seem irrelevant and inappropriate to the immediate external situation in which they occur.

Brown and Farber, though they feel that an emotional theoretical schema will explain frustration in a more satisfactory manner, are not adverse to admit that some non-emotional interpretations can adequately handle much of the behavior following blocking of a goal response. Current learning theories do account for many of the response types that are typically listed as consequences of frustration. It is possible that increased vigor following thwarting may simply result from the fact that the organism has learned that more vigorous responses are likely to be successful under such circumstances. Marx (1956) reports a study of this phenomena. The purpose of the study was to provide an artificial environment in which decreased vigor in the face of frustration would for some Ss be reinforced as often and as quickly as increased vigor seems to be for others.

At two months of age, half of the rats were separated and maintained in individual cages for the next three months.

Frustration was kept at a minimum for these rats and none of their responses were consistently associated with frustration reduction. The remaining Ss had been living in overcrowded social cages equally long. The hypothesis was that individually raised rats, having had little opportunity to learn any particular response to frustration, could be taught with about equal ease to respond following frustration with either increased vigor (Strong Group) or with decreased vigor (Weak Group). The socially raised Ss were expected on the other hand, to have more difficulty learning the weak response, since they had lived in a competitive environment where forceful responding presumably was more frequently rewarded than weak responding. All Ss were trained to push a bar in order to gain a food reinforcement. After 4 days of 20 reinforcements per day frustration training was initiated and the first 5 bar presses each day were not rewarded. Thereafter, for the "weak" groups a response was rewarded only if it was of lesser intensity than the response just preceeding. The reverse condition was applied to the "strong group." The results showed that, individually raised Ss learned the weak response better than did socially raised Ss, while the reverse held true for the strong response. The results are quite consistent with the notion that increased vigor is, at least partially, a result of transfer from earlier situations in which stronger responses were learned.

Brown and Farber are to be commended for their attempt to integrate their frustration hypothesis into a more general theory of behavior, and also for the fact that even though they feel an emotional theory of frustration will be more adequate, they are prepared to consider nonemotional interpretations of their data.

Child and Waterhouse (1953) differ from the foregoing two factory theory to the degree that they view emotional interpretations and nonemotional interpretations, not as separate, but as two aspects which must be put together for the prediction of behavior in a frustrating situation. They apply the term frustration to an event, such as the blocking of a goal, rather than to an inferred state of the organism. As a dependent variable they measure quality of performance as it is affected by drive producing stimuli. These drive producing states have two properties: 1) they may operate to increase motivation supporting the goal oriented activity and thereby improve the quality of performance, or 2) they may influence other responses which are evoked by drive states, thus leading to a lower quality of performance. They stress that the most important consequence of a frustrating event is the arousal of interfering responses, which in turn lead to a poorer quality of performance. The similarity with the theory of Brown and Farber is evident.

The main difference is one of emphasis rather than of kind.

A recent publication of Amsel's (1958) is the most complete statement of his position in regard to frustration theory. He defines frustration as a hypothetical, implicit reaction elicited by nonreward after a number of prior rewards. This position is even more restricted than that of Brown and Farber. His theory is like the other two factor theories in that it is claimed that frustration leads to an increment in drive and that frustration provides some unique, drive stimuli. He differs, however, by adding the additional concept fractional anticipatory frustration ($r_F - s_F$), a classically conditioned form of frustration.

There have been many experiments prior to the Amsel studies which, directly or indirectly, seem to establish the motivational properties of nonreward, and they will be briefly presented. Miller and Stevenson (1936) reported an increase in agitated behavior of rats immediately following nonrewarded trials in a runway. This increased agitation was observed in the alley leading to the goal box where _Ss_ had 10 seconds previously been frustrated (nonreward following consistent reward). As time between a frustration occurrence and the next trial was increased, the agitated behavior became less apparent. Rohrer (1949) trained rats to bar press in order to acquire a food reward. They were then given extinction trials under one of two conditions, a

10 second (massed) intertrial interval or a 90 second (spaced) interval between trials. On the following day all rats were put on a second extinction with an intertrial interval of 50 seconds for both groups. The group that has experienced massed trials in the first extinction process showed a more rapid extinction in the second. The results were interpreted in terms of a greater intensity of frustration drive being evident in the former group. This is said to have produced more varied responses, some of which were antagonistic to the bar pressing response, in a manner analogous to the operation of retroactive inhibition in a rote learning situation.

Sheffield (1950) found that, during extinction, running time in a single alley was significantly faster with massed than with spaced trials, regardless whether training had been with massed or spaced trials. The explanation given was that nonreward leads to a drive increment. This increment has less chance to dissipate between trials, under massed conditions, hence leading to faster response times. She also found (1949), that, with massed training trials, partial reinforcement led to faster running times during extinction than did previous consistent reward. Spaced trials showed no consistent difference. The results were in agreement with her hypothesis which had predicted that the trace stimuli of nonreward would be conditioned to the response only if a rewarded response soon followed a non-rewarded one. Marzocco (1950) studied the effect of extinction on the force of bar pressing and found that the mean force of pressing increased from the first four extinction trials in relation to the second four.

Specifically related to the present study is the work of Amsel and his colleagues. This work was initiated as an attempt to delimit alternative interpretations that had been offered to explain increments in motivation. Amsel and Roussel (1952) utilized a two runway situation in which two instrumental (running) responses are elicited in series. Essentially, the apparatus consists of a start box (SB), a first runway (Runway 1), a first goal box (G1), a second runway (Runway 2), and a second goal box (G2). G1 serves as the SB for Runway 2. Guillotine doors confine S in the start box for the beginning of each trial. The major dependent variable is speed of running in Runway 2; the independent variables are manipulations of reward and nonreward in G1.

Amsel and Roussel trained 18 rats, that had been maintained on a 22 hunger deprivation schedule, to run down Runway 1 to G1 where they found food. About 30 seconds later they were released from G1 and ran down the second runway to G2 where they again were rewarded with a pellet of food. Once Runway 2 running time had stabilized, the design was such that on half of the following trials there was no food reward in G1, while the other half of the trials were rewarded as in training. G2 was always rewarded. The results indicated that on trials which were nonrewarded in G1, the Ss ran faster in Runway 2 as compared to running time after a rewarded trial. This increment in the vigor of performance has been termed the "frustration effect" (FE).

This led to the question of whether a continuous reward in G1 must necessarily precede the demonstration of FE, or whether FE would appear when, from the outset of training, a response was partially reinforced as in the test trials of the aforementioned experiment. Roussel (1952) utilizing the same apparatus, demonstrated the development of FE when the Runway 1 response was rewarded on a 50% basis from the beginning of training. The FE develops but only after some minimum number of rewards have occurred in the first goalbox.

To account for the frustration effect occurring only after a minimal number of rewards have occurred, frustration was conceptualized as being the result of "a factor" which had been developing during previous rewarded trials. This factor is the fractional anticipatory goal reaction ($r_g - s_g$). Amsel and Hancock (1957) set out to test this hypothesis. It was presumed that not rewarding a response will elicit frustration to the degree that earlier rewards of that response have led to the conditioning of r_g to the cues in an instrumental response sequence. If the goal box and the runway were similar, this would make conditions more favorable for building up r_g than if they were dissimilar. Since, in the "similar" situation the anticipatory response should be greater, it follows that if nonreward was introduced, the FE should be greater than it would be in the "dissimilar" situation. The apparatus resembled that employed by Amsel and Roussel, with a few modifications. The first runway could be either white with a hardware-cloth mesh floor to match the stimulus qualities of G1, or black with a smooth floor in order to create a dissimilarity between the first runway and G1. Two separate studies were conducted. The procedure of the first experiment followed that of the Amsel and Roussel study, except that one group ran into a goal box (G1) that had the same stimulus qualities as that of the runway while the other ran into a goal box (G1) distinctly different from the runway. The observed effects were that; a) both groups developed the FE, thus replicating the finding that nonreward in a previously rewarded situation leads to faster running times and, b) the group ran under "similar" conditions showed a greater FE, the difference being evident on the first block of trials (6 days X 3 trials per day). In the second experiment the same two groups were run with the exception that they were put on a 50% reinforcement schedule from the beginning of training. As predicted, the results revealed that FE developed in both groups but only after a minimum number of reinforcements had been received, and furthermore, that the FE was greater when the runway and the goal box were similar, i.e., when the conditions for r_g arousal were better.

Amsel, Erhart, and Galbrecht (in Amsel 1958) utilized a different technique in trying to maximize r_g arousal. They showed that a greater FE developed when Runway 1 was 8 feet long than when it was 1 foot long. The data was interpreted in the sense that the longer runway provides a longer period of time for the elicitation of anticipatory responses and as a result, there is a greater probability of its being present at sufficient strength when *S* runs into the frustrating situation. It was felt that this study and the one by Amsel and Hancock were important and successful attempts to link the construct $r_g - s_g$ to antecedent and consequent manipulable-observable events. The independent variables manipulated in order to establish different strength of r_g, were the length of Runway 1 and the similarity of Runway 1 with G1. The observed dependent variable was the point at which the FE developed, during the test trials.

One criticism of Amsel's "frustration" effect has been advanced by Seward *et al*. (1957). They hypothesized that the difference in Runway 2 running time was due to decreased drive on reinforced trials and <u>not</u> an increment in <u>D</u> on nonreinforced trials. An experiment in which they prefed rats before running them in an alley seemed to confirm this hypothesis. It might be argued against their position that even if prefeeding does lead to a response depression, this does not violate the possibility that nonreward leads to an increment in response rate. Furthermore, they used much larger food pellets than the Amsel studies, which is by itself an important enough factor to cause a discrepancy. Wagner (1959), in an attempt to control for response depression, replicated the Amsel-Roussel study and added a group that was never rewarded at G1. Predictions were made from both the frustration and the response depression hypotheses. The frustration hypothesis would predict that nonreinforcement at G1, for a group that had never been rewarded at G1, would not be frustrating and that consequently, this group would run more slowly on nonrewarded trials than would a group that had received reward at G1, and was nonrewarded. The response depression hypothesis would make two predictions. First, on nonrewarded trials at G1, it would be predicted that both groups would run at the same speed in Runway 2. Secondly, it would be predicted that the group never rewarded at G1 would run faster in Runway 2 on the trials comparable to those on which the second group had been rewarded at G1. Results were generally in favor of the frustration interpretation. Nonreward in a previously rewarded situation led to faster running times than did nonreward in a previously nonrewarded situation. Furthermore when trials were rewarded at G1 there was no depression in the speed of running Runway 2 when compared to comparable trials that had not been rewarded at G1.

Amsel and Ward (1954) completed a series of 5 studies designed to show that frustration had directive (drive stimulus) properties. This line of investigation evolved from a quote by Brown and Farber (1951) "....frustration stimuli could provide the means whereby an organism might learn to discriminate between frustration and other states such as fear or hunger."

Amsel and Ward intended to set up a situation where the S was trained to make one response following frustration (nonreward) and another response following nonfrustration (reward). All Ss were trained in the two runway situation previously outlined. However, for the test trials the apparatus was a T maze and the experimental task was for the animals to learn to turn to the left following food reinforcement at the choice point, and to turn right following nonreinforcement. The results disclosed that the discrimination could be learned, but that, once learned, it was very unstable and transient. Also, later in training, a mild tendency arose for Ss to make a greater than chance number of responses to the side correct following frustration. This mild fixation was attributed to a double reinforcement on frustration trials: hunger reduction and frustration reduction. The results are interpreted as supporting the hypothesis that frustration produces drive stimulation that has directive properties.

Penney (1960) extended the study of FE to children, using an experimental situation analogous to the Amsel double runway. The apparatus consisted of two levers, corresponding to the two runways in the rat studies. The Ss, kindergarten children, pulled a lever at the onset of a stimulus light and a marble was ejected at goal box one. A second stimulus light initiated the pulling of the second lever and a marble was deposited at the second goal box. Penney was concerned with the number of previous reinforcements in training and the subsequent appearance of the frustration effect. During Phase I of training all Ss received four reinforced R1 - R2 trials. During Phase II of training the Ss received differential treatment. The Hi-habit group received 10 reinforced trials on R1 alone, whereas the Lo-habit group received 1 trial on R1, i.e. during Phase II neither group received any training on R2. In order to re-establish the R1 - R2 sequence of responding, two final R1 - R2 trials were administered to each group. During the testing situation the Hi and Lo-habit groups were further divided into experimental and control groups. The experimental groups (Hi and Lo) experienced nonreward at G1 on 12 of the 24 test trials, while the control groups (Hi and Lo) continued to receive a marble on every trial, as in training. The results revealed that the Hi-habit experimental group showed faster lever movement speed on nonreinforced trials relative to the reinforced trials. It was also shown that on the first, and on the last three non-reinforced test trials the Hi-habit experimental group was responding significantly faster than the Hi-habit control group. This latter group was run in order to control for any confounding between reward-nonreward and order of trials that may have led to a spurious within-group effect for the Hi-habit experimental group. The Lo-habit group did not show any frustration effect over the test series. Outside of the main finding that differential training led to a greater FE for the Hi-habit group, this study was a note-worthy attempt to extend the investigation of FE to the comparative level.

Penney and Ryan (1960) were interested in whether partial reward at G1 in training would lead to just as great an FE as continuous reward at G1 in training, when kindergarten children were used as subjects. The children were trained, on an apparatus similar to Penney's, to pull two levers in succession, for marble rewards. The three groups in this study were; 1) one group given 100% reward at G1 during training and 50% during the testing phase, 2) a group given 50% reinforcement at G1 both in training and in testing and, 3) a group given 100% reward at G1 in training and testing. The data revealed no within-group frustration effect for any of the groups. That is, there was no differential movement speed when nonreinforced test trials were compared with the reinforced test trials for any one group. However, when the movement speeds of rewarded and nonrewarded trials were pooled, groups 1 and 2 (i.e. the two groups on a 50% reward schedule at G1 during testing) did perform at a movement speed significantly faster than group 3. The authors argued that, although the data were not directly comparable to the Amsel frustration effect, a frustration interpretation could account for the data.

Summarizing, the results of many experiments have shown that nonreward in a previously rewarded situation (partial or continuous) leads to an increment in the speed of responding after nonrewarded trials as compared to adjacent rewarded trials. This effect has been observed and studied both in children and in rats. Amsel explains this phenomenon in terms of nonreward leading to a hypothetical, implicit reaction, called frustration. His position depends heavily on the fact, that frustration is a consequence of nonreward only after several rewarded trials have occurred and had permitted the development of r_g, and that before this, nonrewarded trials are not frustrating (1958, p. 107).

The case for the two factor theories though convincing in many respects, is certainly not without issue. Before deciding that positive results present conclusive evidence, they should also be examined in the light of alternative interpretations. Interpretations other than frustration should be examined to explain the increment in response strength following nonreward.

There is one fairly obvious possible alternative interpretation which can now be considered. These studies on FE have two things in common: a) nonreward is introduced into a situation where reward has come to be expected, and b) there is a change in the stimulus conditions. Without exception all "frustration effects" have been attributed to the former. It would be just as logical to argue that the change is what has produced the effect on behavior, due to some hypothetical, implicit reaction whose duty is to remain active in a situation that provides "variety," and become inactive, or less active in a situation that provides the "same old routine." This omission in the derivation of Amsel's theory demands experimental attention.

If a group that never received a reinforcement at

G1, was switched to 50% reinforcement, and if they increased in response speed on the early nonrewarded test trials in the same manner as do groups which receive nonreward in a previously rewarded situation, the results could not simply be explained as due to a building up of r_g. It would not, of course, alter the fact that nonreward leads to an increment in the rate of responding, but it would cast serious doubt on Amsel's interpretation in terms of fractional anticipatory frustration.

On the basis of theoretical and empirical grounds it would be predicted that nonreward in a previously rewarded situation will lead to an increment in the response speed of nonrewarded trials when compared to rewarded trials, while simultaneously, reward in a previously nonrewarded situation will not lead to any within-group effect. This finding would support Amsel's interpretation while offering the addition of an important control for change in stimulus conditions.

The proposed study has another interesting aspect. A recent theoretical exposition by Bindra (1959) advanced the central idea that any change in stimulus elements from the training to the test situation produces decrement in a trained response to the extent that the novelty provided by the altered stimulus elements evokes interfering novelty reactions. The effect of novelty is said to vary as a function of the following:

1) The greater the training, the greater will be the novelty offered when some of the stimulus elements are changed in the test situation. This will in turn lead to a greater number of competing responses and a corresponding greater response decrement.

2) Exposure of the animal to the test situation before training should weaken response decrement.

3) The greater the amount of change between testing and training situation, the greater will be the response decrement. For example, if 3 stimulus elements are changed in testing there will be more decrement than if only one element had been changed.

The decrement, of course, dissipates in time due to S adapting to the new situation.

Bindra's novelty theory seems incomplete when looked at on the basis of Penney's (1960) study of the frustration effect. Penney reported a frustration effect - fast responding on nonrewarding test trials - to occur on the very first test trial. This seems to contradict the notion that stimulus change always leads to an initial "response decrement", and suggests that "type" of stimulus change is also an important factor in response decrement. Penney's study suggests that a frustrative change would lead to an increment in movement speed on the very first test trial, whereas, a nonfrustrative change would not. Bindra's theory would predict a decrement from the training speeds to the test speeds if any change was introduced. The nature of the present design allows for a test of these two predictions.

CHAPTER TWO

METHOD

Subjects

The subjects were 68 kindergarten children obtained from an elementary school in Hamilton, Ontario. Seventeen children were randomly assigned to each of the four experimental conditions.

Apparatus

The experimental room was located in the basement of the school and measured 24 feet x 33 feet. All windows were boarded. The only source of illumination was supplied by a fluorescent light located about 6 feet from the apparatus.

The apparatus, picture in Figure 1 (presented on the following page), was located approximately in the center of the room. It consists of two sections: a) the double runway analogue, and b) the controls.

a) The double runway analogue. The main features of this section are two stimulus lights, S1 and S2, two levers, R1 and R2, and two goal boxes, G1 and G2.

The lights served as stimuli and elicited the lever pulling responses. S1, a green light, was the signal to

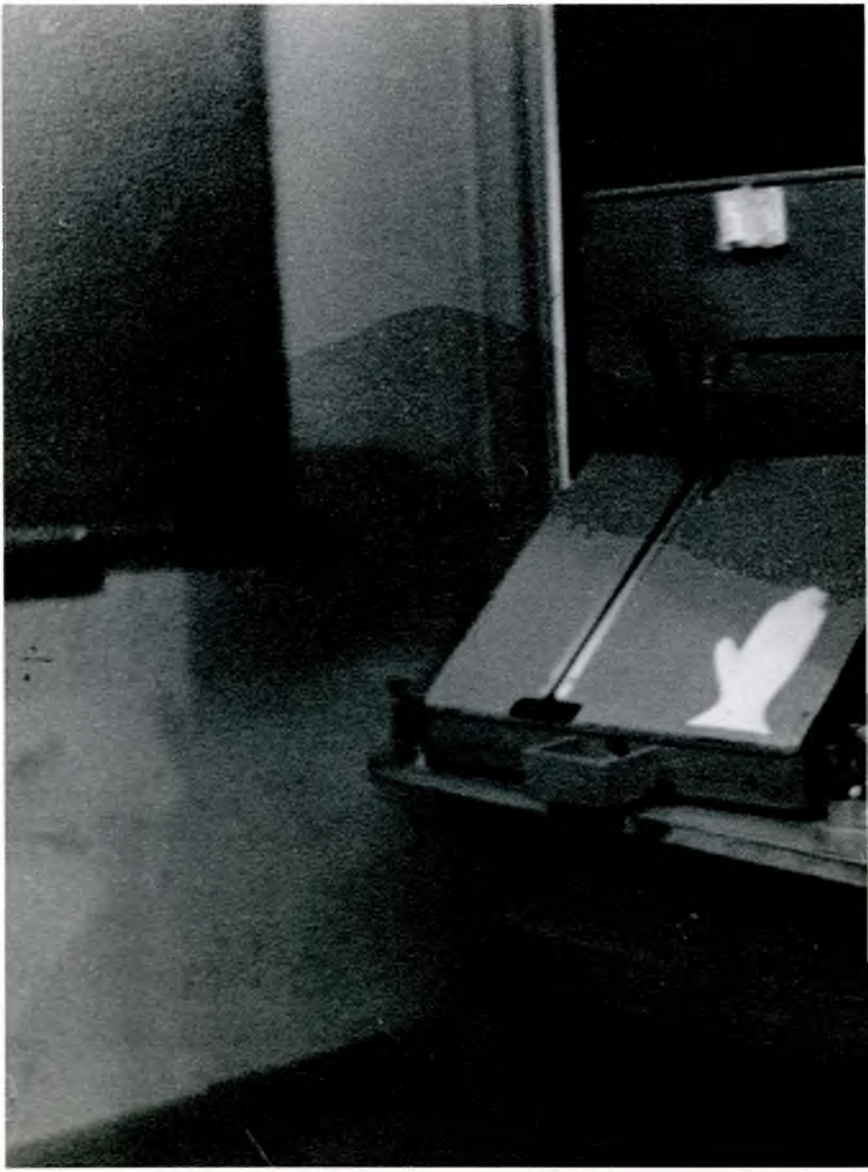
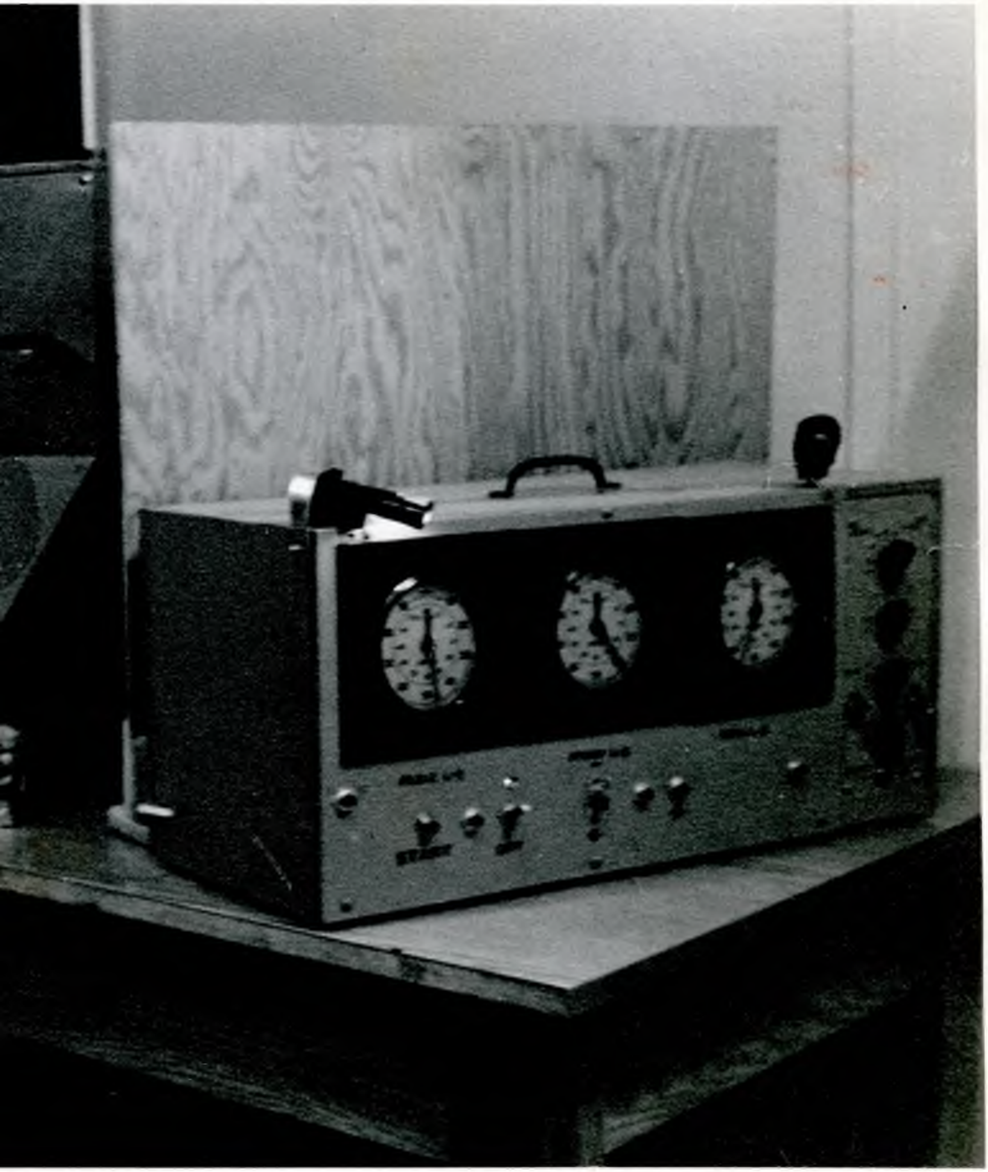


FIGURE 1

A - THE DOUBLE RUNWAY ANOLOGUE



- THE APPARATUS

B- THE CONTROLS

pull R1. S2, a white light, was the signal to pull R2. The stimulus lights were located $\frac{1}{2}$" from their respective levers.

R1 moved, to the left of S, through an excursion of $8\frac{1}{2}$". At the completion of R1, one of two events occurred. If the experimental conditions specified that a trial be rewarded, the R1 response led to the sound of a door chime and a marble was dispensed at G1. On nonrewarded trials, the marble and door chime were not presented at the completion of R1's excursion.

R2 moved toward S, through an excursion of 12". At the completion of R2 a marble was ejected into G2. It is to be noted that G2 was always rewarded and that reference to nonrewarded trials pertains only to G1.

G1 was located about 1" from the terminal point of R1. G2 was located about 2" from the terminal point of R2.

A small plastic cup was located at the side of the apparatus into which S deposited the marbles. Prior to each stimulus presentation S placed his hand on a hand pattern located at the bottom right hand corner of the apparatus. A clear plastic container was centered at the top of the apparatus above the first goal box.

b) The controls. The controls were situated approximately 6 feet behind the subject, slightly to one side. This arrangement permitted a clear view of the child during the experimental session, yet it minimized any experimenter cues that might be given in a face to face situation. The main features of the controls are a start button, a reward button, three Standard Precision Timers, a series of microswitches, and a stop watch.

Each trial was initiated by pushing the start button. This illuminated S1 and _S_ pushed R1 through its excursion. Moving R1 from its resting point operated a microswitch which terminated S1 and started the first timer. At the completion of R1, a second microswitch was closed which served to stop the timer and either released a marble and activated the door chime, or did not do so, depending upon the prior arrangement of the reward button.

The onset of S2 was controlled by a delay tube which was activated 10 seconds after the completion of R1. This interstimulus interval gave _S_ enough time to deposit the marble into the cup and to place his hand on the hand pattern before the next stimulus light (S2) appeared.

The initial movement of R2 functioned to release two microswitches that started the second and third timers. The second timer was stopped when R2 closed a microswitch midway through the excursion. The final timer stopped when R2 closed a microswitch located at the end of the excursion. At the completion of the R2 response, a marble was dispensed at G2.

The Standard Precision Timers measured movement time to the nearest hundredths of a second. Timer 1 measured the movement time of R1; timer 2 measured the time it took to pull R2 through the first half of its excursion; timer 3 measured the complete movement time of R2.

Procedure

E was introduced to the children as a group and told them about a "game" that they were invited to play. Later, each willing S was individually accompanied by E from the classroom to the experimental room and seated in front of the apparatus. The following instructions were given:

> "Do you like candy? Well in this game you can win two candies. Which two would you like to win? (E displayed 3 candies. S demonstrated his preference and 2 candies were placed into the plastic container above the first goal box). You can win these candies if you get many marbles into this cup. I'll show you how to win the marbles, okay?
>
> Here's what you do. Put your hand on this white hand, and put your other hand under your leg and sit on it. Don't use that hand to pull the stick. If this light (S1) comes on, pull this stick (lever 1) all the

way over to here. If this light (S2) comes on, pull this stick (lever 2) all the way down to this black line. Always pull the stick with the hand that's on the white hand.

Do you understand how to play the game? Remember, you have to get many marbles into the cup so that you can win the candy. Okay, let's start to play the game now."

The first time that a marble appeared in a goal box, S was instructed to put it into the cup.

Training: The Ss were divided into 4 groups and were given 12 training trials. A trial consisted of the R1 - R2 sequence. The intertrial interval was 20-25 seconds. This is not to be confused with the 10 second inter-response interval, which was the interim between termination of R1 and the onset of S2. Groups 100:100 and 100:50 received 12 rewarded trials at G1, while groups 0:0 and 0:50 were given 12 nonrewarded trials at G1. All Ss were always rewarded at G2.

Testing: During the testing phase group 100:100 received an additional 24 rewarded trials at G1, whereas group 100:50 was given 12 nonrewarded and 12 rewarded trials at G1. Similarily, group 0:0 was given 24 additional non-rewarded trials at G1, while group 0:50 received 12 rewarded and 12 nonrewarded trials at G1. It is emphasized that all

Ss were always rewarded at G2 for an R2 response, and non-reward pertains only to G1. The procedure is summarized in Table I.

TABLE I

Summary of the Experimental Treatment

Groups	Training	Test Trials 1-4	Test Trials 5-24
100:100	12 rewarded trials at G1	4 rewarded trials at G1	20 rewarded trials at G1
100:50	12 rewarded trials at G1	4 nonrewarded trials at G1	12 rewarded and 8 nonrewarded trials at G1
0:0	12 nonrewarded trials at G1	4 nonrewarded trials at G1	20 nonrewarded trials at G1
0:50	12 nonrewarded trials at G1	4 rewarded trials at G1	12 nonrewarded and 8 rewarded trials at G1

For group 100:50, the first 5 trials during testing and trials 7, 8, 12, 14, 15, 18, 23, and 24 were nonrewarded. The remaining 12 trials were rewarded. For group 0:50, the first 4 trials during testing and trials 7, 8, 12, 14, 15, 18, 23, and 24 were rewarded. The remaining 12 trials were nonrewarded.

The design allowed for two separate analyses. One analyses relevant to frustration theory, focuses exclusively on test trials 1-24. The obvious question is whether, during these trials, movement speed on nonrewarded trials is faster than on rewarded trials. The usual frustration theory would expect this to be the case, but for group 100:50 only. These <u>Ss</u> alone experience nonreward in a situation in which reward has previously regularly been given.

The other analysis, relevant to change theory, focuses exclusively on test trials 1-4. The obvious question is whether, on the <u>first</u> test trials, a <u>decrement</u> in movement speed is observed. Bindra's change-theory would predict such a decrement for the 100:50 and 0:50 groups, since a change in stimulation occurs for both these groups. Support for Bindra's theory would also demand that the decrements observed for these two groups be at least greater than any possible decrement observed in the remaining two groups, for whom stimulus conditions do not change. It will be of further interest to observe whether a decrement obtained with the 100:50 procedure is different in magnitude from a decrement obtained with the 0:50 procedure. Such a finding would indicate that Bindra's theory ought to be modified to include "direction," or "type" of change as an important variable.

In addition to measuring response duration with the Precision Timers, <u>E</u> recorded the verbalizations and any "out-of-the-ordinary" locomotor gestures that the <u>Ss</u> made during the experiment.

CHAPTER THREE

RESULTS

All data for the three response measures were transformed into reciprocals ($1000 \frac{1}{n}$). The mean reciprocal movement times were computed for each trial. The three measures revealed similar curves and consequently the subsequent analyses were performed on only one measure. Hence in the remainder of this thesis, the term movement speed pertains only to the time taken to pull R2 through its entire excursion.

In order to detect any possible variation in movement speed prior to introduction of the test conditions, an analysis of variance (Lindquist 1953 Type I) was performed over three blocks of training trials. The main effects were training conditions and trials. The summary, in Appendix A, Table I, discloses that only the effect of trials was significant.

The difference scores between reinforced and nonreinforced test trials were calculated for each group by subtracting the R2 movement speed of nonrewarded trials from that of rewarded trials. The data from test trials 1-4 were excluded from this calculation. The remaining 20 trials yielded 17 mean difference scores for each group. It is to be noted that for group 100:100, which was never nonrewarded, the speeds utilized in the calculation were those of the trials that would have been nonrewarded, had this group received the same conditions as group 100:50. Likewise, for group 0:0 which was never rewarded at G1, the scores used were those of the corresponding test trials that would have been rewarded had this group received the same experimental treatment as group 0:50. A Wilcoxon matched-pairs signed-ranks test (in Siegel 1956), was performed over the difference scores for each group. No differences were found in R2 movement speed when rewarded trials were compared with nonrewarded trials within each group.

The second aspect of this study has to do with response decrement as a function of a change in stimulus conditions. Table II (on the following page) presents the mean movement speeds and the mean difference scores of the last 4 training trials and the first 4 test trials for each group. A previous analysis (Appendix A, Table I) has shown that there was no significant difference between groups in R2 speed during training. A Wilcoxon matched-pairs signed-ranks test (in Siegel 1956) was performed on the difference scores of the last four training and first four test trials for each group. Using a two tailed test, because of the nature of the prediction, group 100:100

shows a significant increment between training and test scores. That is, their movement speeds during the first four test trials were faster than during the last four training trials. This might be due to the fact that this group had not yet reached asymptote at the termination of training. With a two tailed test no significant differences between training and testing scores are revealed for any other group. It is to be noted, however, that Bindra would have predicted decrement for both groups 100:50 and 0:50. It seems worthy of notice that, had Bindra applied a one-tailed test, he would have concluded that both groups that experienced a change in stimulus conditions, showed a significant decrement. The decrement shown by the two change groups did not differ significantly.

TABLE II

Mean Movement Speeds of the Last Four Training and First Four Test Trials

Groups	Training Trials 9-12	Test Trials 1-4	Mean Diff.
100:100	18.36	20.43	+2.07
100:50	17.35	16.54	-0.81
0:0	18.67	18.41	-0.26
0:50	19.68	18.63	-1.05

The notes taken by E during each experimental session suggest one further type of analysis which tends to support Bindra's notion. None of the children in groups 0:0 and 100:100 attempted to speak to E, or displayed any unusual motor behavior during test trials. For groups 100:50 and 0:50 the situation was quite different. For instance, immediately after introduction of a reward in a previously nonrewarded situation, group 0:50 had 4 children who made comments[1] and 3 who made novel gestures. That is, 7 out of 17 children in this group manifested a behavioral change coincident with the stimulus change. For group 100:50, immediately after the introduction of nonreward in a previously rewarded situation, 8 children made comments to E and 8 made novel locomotor movements. That is, 16 out of 17 children demonstrated novel behavior coincident with a change in stimulus conditions. A chi square ($\chi^2_{3\ df}$) comparing these "novelty reactions" for all 4 groups was significant at much less than the .001 level. Also, a chi square pooling the two "change" groups against the two "no change" groups yields a significant $\chi^2_{1\ df}$, $p < .001$. It is interesting to note that group 100:50 displayed more of these "novelty reactions" than group 50:100. A chi square ($\chi^2_{1\ df}$) is significant at beyond the .01 level. It is emphasized that these data on novelty reactions were subjectively acquired by E and therefore apt to be less precise than the accompanying lever movement measures.

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1. Appendix C contains examples of Ss comments and locomotor behavior.

However, a decrement in movement speed (cf. Table II) would be an obviously expected consequence of descriptive "novelty reactions."

The movement speed of the reinforced and nonreinforced test trials were then combined into 6 blocks of 4 trials for each group. It is to be emphasized that the reinforced and nonreinforced test trials were now being pooled. The measures are presented in Table III. Examination of the table reveals that groups 100:50 and 0:50 appear to be

TABLE III

Means of the Combined Reinforced and Nonreinforced Test Trials in Blocks of 4 Trials

	Blocks of Trials					
Groups	1	2	3	4	5	6
100:100	20.43	18.94	18.92	19.69	18.69	18.04
100:50	16.54	19.38	20.23	21.30	20.43	22.99
0:0	18.41	17.80	17.90	17.59	17.90	17.83
0:50	18.63	20.40	21.47	21.12	20.81	21.06

increasing their speed with trials while 100:100 and 0:0 do not. An analysis of variance (Lindquist 1953 Type I) was performed over the 6 blocks of 4 trials for all groups. As indicated in Table IV (presented on the following page) there was a significant trials x testing interaction. This means that the forms of the curves of movement speed as a function of test trials for the four groups are not the same.

TABLE IV

Summary of the Analysis of Variance (Lindquist Type III) Over 6 Blocks of 4 Trials in Testing

Source	df	ms	F	P
Between Ss	67			
Groups	3	144.92	—	
error (b)	64	280.18		
Within Ss	340			
Trials	5	21.12	3.20	<.01
Trials x Groups	15	29.40	4.45	<.001
error (w)	320	6.60		
Total	407			

A trend analysis of the linear and quadratic components was then performed over the four curves, (in Edwards 1960). The analysis is summarized in Table V (presented on the following page). None of the quadratic components were significant. The linear analysis revealed a significant trials x groups interaction. This indicates that the linear trend for the different groups is not the same. An analysis was then performed between 100:50 + 50:100 pooled and 100:100 + 0:0 pooled, which disclosed that the trend for the two groups for which stimulus conditions were changed differs significantly from that for the two groups for whom stimulus conditions remained constant. An analysis was then performed between 100:50 and 0:50 and showed that the trend of these two lines did not differ significantly from each other.

TABLE V

Analysis of Variance Showing the Linear and Quadratic Components For All Groups

Source	df	ms	F	P
Linear Components				
Groups	1	76.53	11.60	$< .001$
Groups x Trials	3	106.29	16.10	$< .001$
(100:50 + 0:50) vs. (0:0 + 100:100)	1	244.10	36.98	$< .001$
Quadratic Components				
Groups	1	13.18	2.00	——
Groups x Trials	3	12.93	1.96	——
error	320	6.60		
100:50 vs. 0:50	1	66.59	3.06	——
error	32	21.74		

CHAPTER FOUR

DISCUSSION

The results of the experiment may be summarized as follows: 1) there was no difference in the movement speeds on reinforced and nonreinforced trials for any group, not even for group 100:50, the typical Amsel "frustration group;" 2) the two "change" groups, 100:50 and 0:50 offer suggestive support of movement speed decrements during the first four test trials relative to their speeds at the termination of training, while such decrements were not displayed by the two "no change" groups, 100:100 and 0:0; 3) pooling reinforced and nonreinforced test trials reveals that both the 100:50 and 0:50 groups were increasing their speed over test trials, and that this is not the case for the 0:0 and 100:100 groups.

Failure to demonstrate the frustration effect on nonrewarded trials is not in agreement with previous studies of this variable by Amsel and Roussel (1952) and Penney (1960). This renders pointless any further comparisons of the magnitudes of within-group effects <u>across</u> groups. In other words, evidence for an alternative interpretation of Amsel's "frustration effect" can not be provided if one is unable to reproduce the effect in the first place. It is interesting, however, to speculate as to why there was a failure to reproduce the effect. Penney's (1960) previous reproduction of the effect using children as subjects and an apparatus quite similar to that employed in the present study suggests that the difference in species is not the major factor. It is possible that the present procedure failed, during training trials, to bring performance sufficiently close to asymptotic level in order to demonstrate the effect during testing. Another possibility is that Penney's demonstration of the effect depended on the fact that, during training, he gave his _Ss_ repeated practice on R1 _alone_, rather than on the complete R1—R2 sequence. Whatever the cause, the fact remains that the original hope of discounting an alternative interpretation of the empirically observed Amsel "frustration effect" must fall by the wayside.

The second interest of this study concerned a proposition to be tested on the first bank of four test trials only. Bindra's (1959) stimulus change theory predicts a response decrement whenever the stimulus conditions in which learned behavior occurs are suddenly changed. The decrement is said to be due to the elicitation of "novelty reactions" which compete with the learned response. As _S_ adapts to the changed situation the decrement disappears.

From this point of view one would expect that both the 100:50 and 0:50 groups would perform at slower movement speeds on test trials 1-4 than on training trials 9-12, and that any such decrements would be greater in magnitude than possible decrements observed in the 100:100 and the 0:0 groups.

On empirical grounds, there was reason to expect that Bindra's prediction would not be upheld with respect to the 100:50 group. Penney had previously reported faster movement speed on the first nonreinforced trial following a training period of regular reinforcement. Actually, a two-factor frustration theory makes no clear cut predictions regarding the very early nonreinforced test trials elicit some competing responses which reduce movement speed even though, in theory, motivation is heightened. In this respect it is interesting to note that Amsel characteristically omits from his analyses the first block of trials following introduction of nonreward. In a recent artical, Amsel and Prouty (1959) state that it is not uncommon for FE to fail to appear on the earliest test trials, although this does not always happen. It is stressed that, in theory, the prediction from Bindra's theory could have been upheld at the same time as that from Amsel's theory. In other words it would be possible for group 100:50 to show a decrement in movement speed during the first block of four nonreinforced test trials relative to their speed at the end of training and at the same time, for this group to show faster movement speeds on nonreinforced than on reinforced test trials over the entire block of twenty-four testing trials.

The data on response decrement tend to support Bindra's theorizing. The two "change groups" did show decrements during the first four test trials relative to their speeds at the termination of training. Such decrements for each of the change groups was approximately equal and it thus seems reasonable to believe that a change in the conditions of reinforcement falls within the bounds of Bindra's theory. However, the children switched from reward to nonreward were observed to make significantly more novel verbalizations and gestures than the children switched from nonreward to reward. This less precise data on novelty reactions gives some support to the idea of making a distinction between the "type" of stimulus change that is made.

Finally, consideration will be given to the trends in movement speeds for all four groups during test trials. By pooling the reinforced and the nonreinforced trials, it is revealed that both the 100:50 and 0:50 groups were increasing their speed over trials, while the 0:0 and 100:100 groups were not. It is difficult to assess the theoretical significance of this fact. Groups 100:50 and 0:50 have in common, both the fact that they have experienced a change in reinforcement frequency, and the fact that, during the test trials they are receiving 50% reinforcement in G1. Either change of reinforcement conditions or the 50% reward schedule, or both, could logically be responsible for the results. At present, however, these data do not adequately fit within any theoretical schema. It seems possible that a continued experimental attack on the problems posed by the finding might contribute toward any commination of change theory, partial reinforcement theory, and frustration theory.

SUMMARY

This experiment attempted to discount any alternative interpretation of the Amsel "frustration effect," that could explain the observed motivational increment as being simply due to a change in the stimulus conditions. A second purpose of this study was to examine the possibility of extending Bindra's novelty theory so that it would include "direction" or "type" of change in stimulus conditions.

Sixty-eight children were trained to pull two successive levers. During training two groups, 100:50 and 100:100, were always rewarded at the first goal box (G1), whereas two other groups, 0:50 and 0:0, were never rewarded at G1. During testing, groups 100:50 and 0:50 were given 50% reward at G1, while groups 100:100 and 0:0 were respectively always rewarded and never rewarded at G1. Both, during training and testing all groups were always rewarded at goal box two (G2).

The data were not even capable of demonstrating the typical frustration effect which rendered the alternative interpretation contestable. Support was offered for response decrement that would have been predicted from Bindra's novelty theory. There was some slight evidence that the "type" of stimulus change may also be important.

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APPENDICES

APPENDIX A

Table I

Summary of the Analysis of Variance (Lindquist Type I)

Over 3 Blocks of 4 Training Trials

Source	df	ms	F	P
Between Ss	67			
Groups	3	96.06	—	
error (b)	64	97.66		
Within Ss	136			
Trials	2	415.59	20.08	$<.001$
Trials x Groups	2	22.88	1.11	
error (w)	132	20.70		
Total	203			

APPENDIX B

Raw Data for 3 Blocks of 4 Trials in Training and for

6 Blocks for 4 Trials in Testing

Training

	RR			RN			NN			NR		
	Blocks of Trials											
S	1	2	3	1	2	3	1	2	3	1	2	3
1	12.13	17.61	12.71	5.37	8.26	8.27	12.56	19.10	20.52	9.18	12.41	14.81
2	17.38	22.30	27.08	28.53	25.73	26.35	14.50	19.05	17.83	8.23	13.59	13.71
3	13.05	16.34	20.10	7.33	13.44	14.20	11.59	15.66	14.54	33.32	39.60	40.87
4	8.95	10.33	11.48	7.16	13.23	20.53	6.48	5.30	7.78	15.26	23.18	21.59
5	8.53	9.33	8.33	15.68	18.74	22.17	9.74	15.15	21.31	10.17	16.47	16.92
6	9.62	17.49	18.12	4.98	10.68	11.08	14.48	21.04	21.80	7.64	8.63	6.58
7	12.93	20.65	21.65	12.06	22.50	19.57	17.62	26.94	27.01	18.66	26.43	23.80
8	15.75	22.51	26.52	11.92	16.89	13.96	32.01	25.69	26.56	14.82	18.57	17.78
9	13.49	18.73	18.42	12.71	19.59	22.39	20.09	25.82	34.26	9.56	11.28	9.51
10	15.29	14.26	15.92	12.23	16.63	18.95	20.60	27.16	15.77	11.97	15.19	19.78
11	12.24	13.50	27.65	10.34	14.23	16.15	18.37	17.57	21.55	18.59	28.74	23.52
12	11.65	12.91	13.79	11.16	12.08	17.72	16.63	20.18	19.66	11.86	13.84	19.10
13	7.56	9.43	13.67	9.09	10.43	13.56	8.95	10.96	9.75	10.31	17.41	21.34
14	14.74	18.19	21.17	20.38	38.31	24.57	9.96	14.77	12.33	7.38	9.59	12.41
15	10.23	15.85	17.00	8.77	15.10	16.37	11.70	17.62	20.20	18.40	22.36	24.17
16	16.33	23.22	25.09	6.66	14.54	17.41	9.31	15.55	18.46	16.47	19.64	18.38
17	8.88	13.24	13.35	13.49	12.95	11.69	54.30	6.03	8.06	21.65	28.45	30.34

Testing

	RR						RN					
	Blocks of Trials						Blocks of Trials					
S	1	2	3	4	5	6	1	2	3	4	5	6
1	21.51	17.24	22.80	19.24	19.44	18.51	11.30	11.19	11.45	11.69	13.37	16.58
2	35.87	39.31	35.19	36.61	36.11	35.26	22.75	23.00	26.94	26.60	25.60	25.63
3	19.68	18.11	17.99	16.98	14.80	17.16	15.85	18.53	14.48	12.64	13.29	17.09
4	12.84	11.31	11.03	11.67	12.30	12.92	19.78	26.50	30.82	29.67	24.94	33.37
5	10.74	10.92	10.51	12.80	8.97	10.78	21.58	23.69	19.98	28.77	22.69	26.85
6	23.30	22.75	24.74	23.83	23.65	20.23	7.57	12.43	13.63	14.38	13.22	17.45
7	25.54	20.32	16.97	14.82	18.57	14.42	18.63	18.42	21.25	23.05	22.34	20.34
8	26.60	22.79	25.22	27.01	28.91	23.89	15.42	14.74	14.73	17.24	13.34	16.29
9	20.95	14.28	16.80	14.17	15.48	19.11	22.17	25.88	30.59	30.03	29.29	25.16
10	16.50	24.56	18.89	14.73	17.33	17.49	16.31	21.27	17.81	23.97	24.53	27.29
11	22.27	24.56	22.05	30.05	27.52	18.07	17.55	19.53	21.57	23.50	25.05	28.33
12	16.11	15.50	17.92	18.19	16.31	17.42	16.51	18.29	16.14	17.83	18.01	18.09
13	14.11	14.80	17.18	20.07	12.99	17.94	10.26	10.79	16.12	18.34	17.91	18.04
14	24.97	11.35	17.91	21.19	18.66	21.20	22.99	33.73	38.72	42.65	42.22	47.54
15	16.79	16.83	12.72	16.49	15.46	9.64	15.92	21.66	21.42	16.21	20.41	24.21
16	24.31	20.89	20.54	21.55	15.17	19.65	15.64	18.02	15.40	12.02	9.12	10.05
17	15.26	14.74	13.22	15.33	16.07	13.03	10.92	11.88	12.87	13.54	11.62	18.46

Testing

	NN						NR					
	Blocks of Trials						Blocks of Trials					
S	1	2	3	4	5	6	1	2	3	4	5	6
1	15.60	24.08	22.96	20.54	19.30	18.25	13.68	13.86	10.29	15.01	11.31	12.66
2	17.95	21.07	18.23	16.78	21.52	20.11	13.45	18.24	18.31	13.58	13.42	13.03
3	14.56	15.84	14.93	15.39	13.88	13.92	40.96	39.06	38.37	35.92	38.62	37.88
4	4.79	6.37	5.65	8.08	6.48	8.72	15.37	23.75	25.24	21.04	24.70	24.42
5	25.49	21.35	20.18	22.69	25.97	17.08	15.89	18.27	18.91	16.71	15.39	16.63
6	27.27	28.24	23.33	22.40	25.79	27.20	8.26	10.38	10.91	10.12	16.48	16.98
7	30.57	18.14	23.41	20.58	19.92	20.82	30.00	28.94	32.31	36.75	39.72	25.40
8	21.87	22.89	19.17	19.52	20.09	19.41	14.10	20.54	22.14	21.89	20.87	21.42
9	27.78	25.53	32.43	27.62	15.66	17.64	6.99	6.91	8.47	5.69	6.73	5.85
10	16.18	15.44	17.79	16.95	17.86	13.45	18.15	21.14	21.58	25.02	23.08	22.67
11	22.78	19.55	20.30	22.76	24.91	25.55	34.27	33.08	31.25	34.65	29.32	32.15
12	19.20	20.86	20.84	16.46	18.22	21.44	16.40	17.24	22.78	19.96	17.54	22.93
13	12.55	8.75	11.07	12.27	11.83	15.11	19.00	22.10	23.72	27.13	20.94	26.00
14	11.22	13.03	14.24	15.09	15.94	15.96	8.43	9.20	9.06	12.01	13.06	13.19
15	19.09	16.71	16.48	17.47	22.38	22.69	19.12	19.04	21.75	20.25	12.29	14.26
16	18.50	18.30	16.85	16.79	16.36	17.43	15.55	15.87	17.27	15.91	16.18	18.01
17	7.57	6.49	6.36	7.68	8.27	8.71	27.11	29.14	32.58	27.38	34.14	34.38

APPENDIX C

Examples of Ss Verbalizations and Locomotor Behavior After the Introduction of a Change in Stimulus Conditions

Comments - Group RN

"No marble comes out".
"There's no marble here".
"The thing didn't come out".
"Hmmm".
"Mister, this one doesn't work".
"Didn't work".

Group NR

"Should I take that one?"
"What do you know, a marble."

Locomotor Behavior

Group RN

- pulling R2 with the wrong hand, even though they had been performing the response for 12 times with the proper hand.
- turn around and look at E, as if asking for an explanation of what had happened.
- hand on chin.
- hand on head.
- scratch head.
- hand left extended in air after pulling R1.

Group NR

- pulling R2 with wrong hand, even though they had performed the response properly for 12 times.
- turn around and look at E, with a beaming smile.