THE EFFECT OF CONTINGENCY ON EXPECTATION
OF REWARD IN SELECTIVE LEARNING

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SCOPE AND CONTENTS:

The experiment was designed to study the effect of conditionality on the growth and decline of expectancy scores during acquisition and extinction. The results revealed that conditionality affects the growth of expectation during acquisition for both direct and vicarious tasks but has no effect on variation scores. Percentage of reinforcement is also effective, the expectancy scores for the 100% reward groups rising to a higher level in acquisition and dropping off more rapidly in extinction than for the 50% reward groups.

Problems arising from the differential effect of conditionality on expectancy scores and variation indices, and from differential expectancy levels at the end of acquisition were discussed.

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CHAPTER ONE

INTRODUCTION

A number of experiments have been carried out during the past few decades comparing the performance of both human and animal subjects under conditions of partial and continuous reinforcement. One of the more firmly established empirical generalizations in psychology stems from this research and is known as the partial reinforcement effect or PRE. This generalization states that "All other things equal, resistance to extinction after partial reinforcement is greater than after continuous reinforcement when behavior strength is measured in terms of single responses" (Jenkins and Stanley, 1950).

Among several theories proposed to explain the PRE is the expectancy theory of Humphreys (1939a). The theory describes expectancy as a hypothetical construct intervening between the training variables on the one hand, and some measure of the persistence of the response in extinction, on the other. The theory states that partial reinforcement develops a greater expectation that non-reinforcement will be followed by reinforcement than does regular reinforcement. Thus, when extinction begins after partially reinforced training, the expectation of reinforcement diminishes less rapidly than after regularly reinforced training. The difference in expectation is manifest in a difference in the persistence of responding in extinction. The theory has received wide criticism, partly because of the difficulty of rigorously defining and testing the proposed intervening state or variable in a way that could lead to a reasonably definitive test of the theory. As Lewis (1960) points out in his comprehensive review of the literature on partial reinforcement, "Perhaps every study . . . could be reinterpreted according to an expectancy notion, and that is the main weakness of such a point of view. There seems no way of disproving it." (p.23)

The present research is also concerned with expectancy under partial reinforcement. However, expectancy is here treated not as an intervening variable which might be used to explain the persistence of some other form of behavior, but rather as a dependent variable in its own right. The subjects in this experiment express verbally their expectation of reward while performing in a task which only sometimes yields rewards. The expectations are studied as a function of certain variables just as one might study the persistence of lever pulling or of some other non-verbal response.

The Problem:

The present thesis is concerned with the growth and decline in expectancy of reward during acquisition and extinction when only one of a set of alternative responses is rewarded. It is concerned with expectancy when subjects are confronted with a selective learning task rather than when their performance is in the context of a guessing game or a game of chance.

The experiment is designed to answer the following question: Is the growth of expectation of reward during acquisition, and its decline during extinction, affected by making rewards conditional upon correct responses, or is the expectation simply dependent upon the series of rewards and non-rewards however they are produced? Let us consider what is meant by conditionality in the present context.

Operant conditioning experiments may be carried out according to either a selective or a non-selective procedure. In the former case, subjects are required to learn a particular response and whether or not reward is obtained depends upon the occurrence of that response, and, of course, on the probability of reward given that the correct response has occurred. Rewards are in part controlled by the subject and are conditional or contingent on a correct response.[1] The overall probability of reward may be expressed as follows:

probability of reward = probability of the correct response x probability of reward given the correct response

or

$$P(+) = P(R_c) \cdot P(+)/R_c$$

It is evident that in any learning task in which the probability of a correct response, $P(R_c)$, is less than 1, the average probability of reward, $P(+)$, must be less than the conditional probability of reward given that the correct response has occurred, $P(+)/R_c$.

[1]The term conditionality is here used interchangeably with the term contingency.

In contrast to a selective learning situation, the subject in a non-selective situation responds in any manner he wishes and rewards are externally controlled by the experimenter, occurring at certain times regardless of what the subject is doing. Therefore, no conditional probabilities are involved since there will either be a single response alternative which the subject uses repeatedly, or the same probability of reward will attach to every one of the response alternatives. In such cases reward is said to be non-contingent[1].

The central question to be answered by the present research is whether the expectancy of reward in a selective learning task reflects the conditional structure of reward, or on the other hand, depends simply on the overall probability of reward.

In brief, the experiment is as follows. The expectancy scores of subjects performing in a selective learning task are to be compared with those who are performing in a non-selective task which differs only with respect to the absence of conditional or contingent probability of reward. If the expectation reflects the conditionality of reward, it will be higher in a selective than in a non-selective task.

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[1] There is a distinction between human and animal studies when one considers contingent and non-contingent reward presentations. Human subjects may be instructed to respond, for example, by pulling a lever or pushing a button. Since these responses are usually within the repertoire of all subjects before they come to the experimental room, the task may be described as one of performance, or at most, as one of simple learning. Within this framework a non-contingent procedure of reward presentation is employed. However, if the experiment is designed to allow for variations in the pattern of responding by introducing, for example, more than one lever or button, the rewards may be either contingent or non-contingent upon a particular response pattern. Even when a non-contingent procedure is used, the subject still makes a response which is peculiar to the task involved. In experiments with animal subjects, on the other hand, rewards presented on a non-contingent basis occur whether or not the animal makes a response of any form.

In a selective task in which the occurrence of reward depends on the performance of the correct response, one expects the frequency of reward to increase as learning proceeds. We would like to make the comparison of expectancy for contingent and non-contingent reward for the same pattern of reward and non-reward on successive trials. In order to do that, the series of outcomes generated by a subject in a selective learning task was recorded and then applied non-contingently to another subject. A design of this type is often referred to as a yoked control design.

The experiment provides data on the growth of expectancy when the probability of reward following a correct response is either 100% or 50% and, of course, on the growth of expectancy when the identical series of rewarded and non-rewarded trials is arranged non-contingently. The selective learning task consists of finding the correct response from a set of eight alternatives. Subjects in the non-contingent yoked control group have the same set of response alternatives available, but reward is not conditional upon which response is made on any trial.

What grounds are there for believing that the expectancy of reward will depend on contingency? When the subject learns to make the correct response he is presumably able to make the discrimination between the correct response and the incorrect responses that he has previously made. Thus unrewarded trials on which an incorrect response was made may be discounted so that they do not reduce the expectation of reinforcement given the correct response. The effect, of course, would be a higher expectancy of reward than in the non-contingent case.

In the above formulation, the distinction between the correct response and incorrect responses is thought of as providing a basis for discrimination in much the same way as would an external signal. It is as though the uniformly non-rewarded trials all occurred in the presence of a red light while trials on which reward was sometimes forthcoming (in the case of 50% reward) or always forthcoming (in the case of 100% reward) were accompanied by a green light.

If the principal function of responses were in fact to provide a discriminative signal, then one might expect to find that the expectancy scores of subjects who simply watched an indication of the responses made by someone else would develop in much the same way as the subjects who actually made the responses. In particular, a similar difference between expectancy scores with and without contingency should appear for the "watchers" as well as for the "players". Further, if responses make a difference only in so far as they improve the prediction of reward, then in the non-contingent procedure where responses do not in fact improve the prediction of reward, responses should be irrelevant to expectancy. Thus, in the absence of contingency, the expectation of reward in subjects who watch only the outcomes of the successive trials should not differ systematically from the expectation of reward for those subjects who watch or make responses as well as observing the outcomes. The present experiment includes several groups which provide comparisons relevant to these conjectures.

Although it seems reasonable to believe that expectancy scores will reflect the conditionality of reward, there are some grounds for doubt.

First, it may be noted that incorrect responses will occur predominantly in the early part of the series of trials. Towards the end the correct response should be occurring on almost all trials. If the expectation of reward is heavily determined by recent outcomes, both groups toward the end of the series may, in fact, be discounting trials on which incorrect responses were made. That is so because, it will be recalled, a yoked control design is used which means that the same sequence of rewarded and non-rewarded trials occurs in the contingent and non-contingent cases.

Second, although it is clear to the experimenter that in the non-contingent groups response selections do not alter the probability of reward, it may not be clear to the subjects. We shall subsequently review some experiments which suggest that there are circumstances in which people, as well as animals, behave under non-contingent reward as though the reward depended upon their response. Let us suppose that in the present experiment, a subject in the non-contingent control group varies his responses until rewards become frequent at which point he settles down to the repetitive use of a single response alternative. Would he not then discount earlier non-rewards because of their association with a different response, and thus arrive at an expectation of reward very similar to the subject who generated this particular pattern of reward and non-reward under contingent reward? If these speculations were to prove correct one might expect to find no difference between expectation of reward in the contingent and non-contingent arrangements for either "players" or "watchers". However, those subjects who see only the trial outcomes, without any indication of the response, should presumably develop a lower expectation of reward than those that make or watch the response selections since only when the responses are available in some form is there an opportunity to discount non-rewards on the basis of their having occurred in conjunction with a different response.

We have discussed some possible outcomes of the present experiment in terms of the expectancy of reward during a series of acquisition trials. Following the last rewarded trial an extensive series of trials was given without further reward. The decline of expectancy during this phase is also of some interest. In particular, will the slower decline in expectancy after 50% reward than after 100% reward which has been found in non-selective tasks, also characterize the decline of expectancy in selective learning? Does the presence or absence of contingency during acquisition have any effect on the rate of decline of expectation?

Review of the Relevant Literature:

The experiments reviewed in this section will deal with the following independent variables either singly or in combination: (1) percentage of reinforcement, (2) contingency, and (3) task. The main emphasis will be on studies concerned with two dependent variables: (1) expectancy scores and (2) pattern of responding. However, several studies dealing with other response measures will be mentioned because of their concern with one or more of the independent variables included in the present study.

Since the major interest of this thesis is with expectancy scores, experiments employing human subjects will be emphasized although several animal studies will also be discussed because of their relevance to the problem of contingency.

1. Expectancy as a Function of Percentage of Reward:

The first experiment to utilize verbal expectancy scores under partial and continuous reinforcement was that of Humphreys (1939b). The seventy-eight subjects in this experiment were required to mark on a record sheet, before each trial, whether or not a light on the right would come on following one on the left. All subjects were run through two learning series. Series I consisted of twenty-four acquisition trials reinforced 100% of the time, followed by twelve extinction trials in which the right light never came on. Then series II began, consisting of twenty-four acquisition trials in which the right light followed the left light only 50% of the time in a random order, and twelve extinction trials in which again the right light never came on. The dependent measure was the percentage of verbal anticipations that the right light would come on. The results showed that with 100% reward subjects' expectations rose to a 98% level by the end of acquisition, while with 50% reward expectations did not exceed those of a "chance" series. During extinction the 50% series showed greater resistance to extinction than the 100% series, taking nine trials to reduce to a 10% level of responding in contrast to only three trials for the 100% series.

Detambel (1950) was puzzled by Humphreys' results concerning the rapid extinction of the 50% group to a below chance level and criticized Humphreys' experiment on the grounds that his instructions set the stage so that whenever the subjects' "yes" was followed by the second light the "yes" - response was strengthened, and whenever a "no" - response was followed by no light, this response was strengthened. "Thus in extinction the complete absence of the second light strengthened the "no" - response to such an extent that it reached a level near 100% frequency, while the competing response of "yes" was never reinforced and approached zero" (Jenkins and Stanley, 1950). In order to test his hypothesis Detambel ran four groups of subjects in a situation consisting of a pair of keys and one light. The task of the subjects in all groups was to press the key they thought would turn on the light. The conditions for the first two groups were similar to Humphreys' series I and II in the sense that a press on key A (which was correct during acquisition) paralleled a "yes" -response during acquisition and a press on key B (which was correct during extinction) paralleled a "no" - response during extinction. In other words during extinction trials there is a reversal instead of an elimination or extinction of the correct response. Under these conditions Detambel's and Humphreys' results were similar; - responding during extinction dropped to a 10% level in the first few trials. Detambel's groups III and IV were trained in the same way during acquisition. However, during extinction the light never came on. It is not surprising that under these conditions presses on neither key A nor key B came to be used exclusively during extinction. As Detambel predicted, extinction curves for both 50% and 100% reinforcement dropped only towards a chance level (50%) with a somewhat faster approach following 100% reinforcement. The structure of the present experiment is similar to that for Detambel's groups III and IV in that during extinction none of the eight alternative responses produces reward.

Humphreys' research gave impetus to further studies which included overt motor responding and a number of different percentages of reward. Three of these experiments were carried out by Lewis and Duncan (1957; 1958a; 1962). Their subjects were seated in front of an array of sixteen push buttons arranged in four columns of four buttons each. When a green signal light came on they were required to push one button in each column and then pull a lever. A disk dropped into a pay-off tray if that trial was to be rewarded.

The rewards occurred according to previously determined schedules and were independent of the manner in which subjects responded.

The subjects in each of the three experiments were also asked to state, after each trial, whether they expected to obtain a reward on the next trial. A continuum of numbers from 1 (indicating low expectation of success) through 6 (indicating high expectation of success) were used as a measure of level of expectation. The general results were as follows: (1) During acquisition the level of expectation increased differentially as a direct function of percentage of reward with the largest percentage showing the highest expectancy scores, and (2) During extinction the level of expectation decreased differentially as a function of percentage of reward, with the greatest extinction loss following the largest percentage of reward.

In one of these experiments (1957) an analysis of the button-pushing data was carried out to determine if stereotypy of response selection depended on the percentage of reward. Two response measures were used: (1) number of different buttons pressed during a block of trials, and (2) number of repetitions of buttons pressed during a block of trials. Neither response measure showed any changes as a function of the percentage variable.

It is important to note that all four experiments reported above employed a non-contingent procedure of reward presentation even though in the Lewis and Duncan studies the presence of many alternative responses may have led subjects to infer that conditionality was present.

A number of experimenters have pointed to the need for studying reinforcement schedules when a selective learning problem is involved, so that rewards would be contingent upon learning a correct response (Bilodeau and Bilodeau, 1961; Carment and Miles, 1962). One experiment which used a selective learning task is that by Taylor and Noble (1962). They designed an experiment requiring subjects to match, in a previously determined "correct" manner, each of four keys to each of four electrical circuit symbols presented on slides. Four schedules of reward were used: 100%, 75%, 50% and 25%, along with 15, 20, 30 and 60 acquisition trials respectively. All subjects had 15 specific reinforced trials available to them. Extinction consisted of 20 non-reinforced trials. The results were analyzed in several different ways. When correct responses were plotted in percentage terms as a function of the total number of acquisition trials the following results were obtained: (1) the rate of acquisition was faster the greater the relative frequency of reward; (2) all partial reinforcement groups reached a final level of about 80%, while the continuous group reached a 98% level of attainment, and (3) the intertrial variability of the partial groups was much greater than that of the continuous group. A 15 x 4 analysis of variance was carried out on percentage of reward over the fifteen available reinforcement trials during acquisition with percentage of correct responses as the dependent measure. Both the 'schedule' and 'trials' factors were significant. However, when the 100% group was removed, a 15 x 3 analysis showed the schedule effect to be non-significant. During extinction an 8 x 4 analysis of variance was carried out on the percentage of correct responses during the first 8 trials. Although the schedule of reinforcement factor was significant, again when the 100% group was removed the significant effect disappeared.

One of the problems which is not dealt with in the above procedure is that since the number of acquisition trials is constant for all subjects within a particular group, the number of "correct" responses made is likely to differ among subjects and therefore the number of rewards actually obtained, even though the same number of rewards are available to all subjects. Spence (1958, as cited in Pavlik and Born, 1962) points out that "This ... disparity in the relative frequencies of occurrences of the responses and of the experiences with their consequences suggests that unequivocal interpretations of subsequent choice behavior are difficult; both habit and reinforcement contingency effects are apt to be involved."

A second research program dealing with partial reinforcement in a selective learning task is that by van Fleet (1963). Van Fleet carried out two experiments, the first of which will be reported here. In this experiment four different percentages of reinforcement were factorially combined with 8, 16 and 32 correct acquisition trials. The number of reinforcements was allowed to vary. The subjects' task was to pull two levers in any manner they wished and to earn as many chips (reinforcements) as possible. The correct response was designated as one right-handed pull followed in succession by two left-handed pulls.

Subjects were allowed to quit the experiment whenever they wished, but were told that stopping before they had made as many chips as possible would count against them, as would continuing after they had earned all the chips they could.

The results showed that resistance to extinction increases as the percentage of reinforcement decreases. There was no effect due to the number of correct acquisition trials, the range of which included the variation involved in the present experiment.

Although the above experiments deal with a selective learning task, from the point of view of the present research they provide one with no comparison with a non-selective learning situation nor do they give expectancy score measures.

The Role of Contingency:

A comparison with the responses made by subjects in selective and non-selective learning tasks where rewards are contingent and non-contingent respectively on a particular response alternative has received little attention in the psychological literature up to the present. However, the distinction between contingent and non-contingent reward has been more clearly recognized in animal research. For example the important role that contingency plays in the development of behavior patterns has been of experimental interest ever since Skinner (1948) showed that pigeons could be made to respond in consistent patterns over long periods of time even though rewards occurred independently of what the pigeons were doing. In Skinner's words: "The bird behaves as if there were a causal relation between its behavior and the presentation of food, although such a relation is lacking." The social implications of this phenomenon as an explanation of superstitious behavior are readily apparent and that is what Skinner had in mind when he referred to the result as superstitious conditioning.

Bruner and Revusky (1961) referred to a similar type of performance in human subjects as collateral behavior. They required subjects to press a number of telegraph keys in order to obtain reward. Although all but one of the keys were non-functional in producing rewards, the subjects nevertheless pressed the non-functional keys in systematic patterns as though they were also required for reward. These results would support Wright's (1963) contention that "Human Ss in such situations usually believe that there is some means by which they can be right on every trial, that the solution is a complex one, and that they are more or less approximating that solution as a function of the relative frequency of reward selected in advance by E".

The above evidence would lead one to predict that the patterns of responding in selective and non-selective tasks might differ very little when human subjects are used. This suggests the possibility that expectancy scores might also show no differences for contingent and non-contingent arrangements.

Two animal studies which are concerned with the discrimination between, or preference for, contingent versus non-contingent reward conditions are relevant to the present research. Logan (1962) carried out a study on conditional-outcome choice behavior in which he allowed rats to choose between a contingent and a non-contingent situation for rewards. A two-alley apparatus was used. In one alley the rewards were contingently presented for a correct response at its end, while in the other alley rewards were non-contingently presented on the same number of trials as in the contingent alley. Several experiments are reported in which reward for the contingent alley was obtained by running slowly, choosing the correct brightness in a discrimination task, or turning in the correct direction at the end of the alley. Each of the experiments was run in blocks of four or six trials, the first trial in each block being a free choice one and the one on which the response measures were based. The remaining trials of the block were forced to ensure that subjects went equally often in each direction. Logan concluded that "Rats are indifferent between such an alternative and one in which the same frequency of reward was given regardless of performance." Logan's results are interesting, but need further investigation. For example only a small number of subjects was used in each experiment. In addition his final conclusion was based on the fact that although in some cases there was a preference for the conditional alley, when conditions were reversed only a small number of subjects actually reversed their preference. Logan himself also points out that "Other procedures, particularly ones in which the conditional aspect is very prominent, may be more likely to detect a preference, and other organisms, particularly primates, may be more likely to reveal one." Nevertheless his studies would indicate that rats are either unable to discriminate between a contingent and a non-contingent reward condition or, if they do discriminate, they have no preference between the two.

Appel and Hiss (1962) studied the distribution and rate of key pecking responses of pigeons under both contingent and non-contingent conditions. Two subjects were started on an FI 30 second schedule of reinforcement which alternated randomly between a contingent reward procedure in the presence of a white light and a non-contingent procedure in the presence of a red light. The interval was increased to one minute on Day 2, to two minutes on Day 3, and to four minutes on Day 4. Two other pigeons were scheduled in the same manner except that reward was delivered contingently in the presence of both lights until three days after the FI 4 schedule was introduced. Then non-contingent reward was used in the presence of the red light. On examining the average rates and the temporal distributions of responses during the two conditions of reward presentation the authors concluded that : "The pigeon can discriminate contingent from non-contingent reinforcements although this discrimination is not perfect. The distributions of responding during the non-contingent condition were similar to those obtained during fixed-interval reinforcement."

Comparable studies employing human subjects are not to be found in the literature. However, two experiments by Jenkins and Ward have been concerned with the judgments human subjects make about the degree of contingency between two events. In 1965 they carried out a study using a two-response, two-outcome situation. The subjects were required to judge the degree of control exerted by their responses over outcomes. Each subject worked on a set of two contingent and three non-contingent problems. The authors point out that the most valid assessment of contingency is arrived at by taking the difference between the conditional probabilities of the two events occurring under two different conditions. The conclusion was that "In all conditions the amount of contingency judged was correlated with the number of successful trials, but was entirely unrelated to the actual degree of contingency."

In a second study to determine the rules by which subjects make their judgments of contingency Ward and Jenkins (1965) altered the display of the information to the subjects so that one group received the presentation serially, another group in an organized summary, and a third group in both ways. A set of seven possible rules for judging contingency was formulated. However, only one of these, based on the difference in conditional probabilities, indicates an understanding of contingency. The results showed that "Only in the group which received the summary without the serial display were the judgments of a majority of subjects more consistent with an appropriate rule of judgment involving a comparison of probabilities than with one or another of several inappropriate rules involving the frequency of certain favourable events." In conclusion the authors state that generally speaking, statistically naive subjects lack an abstract concept of contingency.

An experiment which examines patterns of responding as a function of partial schedules of noncontingent reward was done by Wright (1962). He used a continuous responding situation in which subjects were instructed to push one button at a time in a circular array of sixteen buttons. Response sequences were recorded for each block of twenty-five button presses. Thirteen blocks of acquisition and two blocks of extinction trials were run. The schedules of reinforcement or probability of reward (π) were different for each of the five groups of subjects. The method of scoring took into consideration response repetition on a single button, constant interval rotation and other more complex patterns of responding used by subjects. The results of acquisition indicated that the repetition of any single button press was a positive linear function of the probability of reward. There was also a positive but curvilinear relation between probability of reward and orderliness of responding, with consistency being greatest at high probabilities of reward, intermediate at low probabilities and low at intermediate probabilities of reward. No significant differences were found between groups during extinction. Unfortunately this study provides no comparison of consistency of responding with a selective learning problem and contingent reinforcement.

Direct and Indirect Participation:

Up to now we have examined studies concerned with the development of expectancy scores in contingent and non-contingent learning situations when subjects are actively involved in generating response patterns. The problem of conditionality may also be studied by employing a second method which involves only indirect participation. Various names have been given to this process, among them imitation, copying and vicarious learning. The present research is not primarily interested in this variable for its own sake, but simply as a means of further studying contingent and non-contingent response-reward relationships. A number of experiments have been carried out comparing the degree of learning under direct and vicarious conditions and therefore a brief review of this literature seems pertinent.

Among the studies showing vicarious learning in infrahuman subjects are those by Miller and Dollard (1941), Darby and Riopelle (1959) and Hayes and Hayes (1952). Human subject experiments have been done by Lewis and Duncan (1958b), Berger (1961), Stary (1962), Kanfer and Marston (1963), van Wagenen and Travers (1963) and Barnwell and Sechrest (1965). Of this latter group only Lewis and Duncan and Stary have compared direct and vicarious learning under conditions of partial and continuous reinforcement.

Lewis and Duncan used a modified slot machine and two levels of reward, 100% and 25%. Subjects were required to place a metal disk in a slot at the top of a machine and pull a lever. Payoff disks were delivered non-contingently according to the predetermined schedule. On each play the subjects indicated their expectancy of success or failure by calling out a number on a scale from 1 to 6. Five pairs of groups took part in the experiment. Two groups played the machine and received reinforcement; two groups watched E play the acquisition series and were given rewards when E was rewarded; two groups watched E play the acquisition series but did not receive any reward; two groups had a hypothetical acquisition series explained to them and were given rewards every time the hypothetical player won; and two groups had hypothetical situations explained to them but did not receive rewards. The subjects were confronted with eight acquisition trials, after which they could quit any time they wished. The results showed that there were no overall differences between the four pairs of vicarious groups and the two groups which actually played the machine when the measure was either mean log plays to extinction or expectancy scores during extinction. Also the percentage of reward factor, in regard to both response measures, was significant only in the three pairs of groups in which subjects actually won rewards during the acquisition series. The effect was one of greater resistance to extinction following 25% reward than 100% reward.

Stary (1962) in an unpublished doctoral dissertation compared vicarious experience with actual play experience using preschool and grammer school children, and 0%, 33⅓%, and 100% reinforcement in a drawer-pulling task. The results of this experiment also showed no significant differences between the actual play and vicarious groups when responses were measured in number of plays to quitting. The PRE occurred in both types of experience.

In the study by Jenkins and Ward mentioned earlier, they also employed "spectators" who were paired with each of the active subjects. These spectators also made judgments concerning the degree of contingency in a series of trials. It was found that the degree of active involvement had no significant effect on the judgment.

Again it should be emphasized that in all three experiments just mentioned a non-selective learning problem was used. It remains to be seen whether the learning of a more complex problem with contingent reinforcement will be affected differentially by direct and vicarious procedures.

Summary of the Main Findings:

(1) Most of the experiments using human subjects and concerned with partial and continuous reinforcement found in the literature to date have employed a non-contingent procedure of

reward presentation. These studies, regardless of the dependent measures obtained, have generally supported the notion that resistance to extinction after partial reinforcement is greater than after continuous reinforcement. The only two experiments which used a selective task and different schedules of reward were those by Noble and Taylor and van Fleet. They obtained results which would also indicate that during extinction the partial groups are more resistant than continuous groups.

(2) Aside from a few animal studies no experiments were found which compared performance under contingent and non-contingent arrangements. However, when human subjects are asked to learn a simple task and are rewarded non-contingently, results indicate that they generally behave as though there were a contingent relationship between their responses and the outcomes. There is also evidence that human subjects are not good at discriminating between contingent and non-contingent relationships.

(3) Human subjects show no differences in terms of number of trials to quitting or expectancy scores during extinction when engaged directly or indirectly in a simple learning problem. In other words direct and vicarious learning are equally effective.

In conclusion it may be said that although a number of the variables and features of the experiment to be reported have been involved in other experiments, there is little in the previous literature that suggests an answer to the present question, i.e.:

does the expectancy of reward reflect the conditionality which exists between responses and rewards in human selective learning tasks?

CHAPTER TWO

METHOD

Subjects:

The subjects in this experiment were eighty male and female students enrolled in the introductory psychology course of a summer-school program at McMaster University. Each subject was assigned to one of ten treatment conditions as he came into the experimental room, making eight subjects in each group.

Apparatus:

The apparatus was a modified Gebrands-Lindsley operant conditioning panel which consisted of a 2' x 2' plastic-coated white board mounted at a 60° angle against a wall. Two red push buttons projected from the right and left of the panel. Directly above each button was a pilot-light. Each button press caused the pilot light above it to flash on momentarily. Distinctive trial-lights were also mounted on the panel in full view of the subjects. These trial-lights were automatically programmed to go on for five seconds and then off for five seconds continuously throughout the experiment. In the centre of the panel and below the push buttons was a receptacle into which the reinforcements were delivered. The reinforcement consisted of a small white plastic poker chip. Above the trial-lights and extending the width of the board was a 4" wide white card with the numbers 1 through 6 evenly spaced across it. The following descriptions were written above each number respectively: "very sure of not getting a chip", "mildly sure of not getting a chip", "slightly sure of not getting a chip", "slightly sure of getting a chip", "mildly sure of getting a chip", and "very sure of getting a chip". This terminology is an adaptation of that used by Lewis and Duncan (1957; 1958a; 1958b).

A counter which recorded the cumulative number of reinforcements received during the experiment was located above the card and in full view of the subject.

The conditioning panel was connected to Grason-Stadler automatic programming and timing units in an adjoining room. Rewards could be made to occur automatically according to a pre-programmed schedule for a correct response, or could also be released manually on specific trials. The response patterns were recorded trial by trial on a Phillips two-channel tape recorder. This tape was later used to activate the pilot lights associated with each push button so that this sequence of responses could be indicated to another subject. Response patterns were also recorded on a Hunter paper event recorder for the purpose of analysis.

Experimental Design:

The design of the experiment is summarized in Table 1 overleaf.

TABLE 1

Experimental design of the present research.

Each entry in the table represents a group of 8 subjects.

	Play and Win		Watch and Win		Win Only
	Contingent	Non-contingent	Contingent	Non-contingent	----------------
100%	Group I (P&W,100%,C)	Group II (P&W,100%,NC)	Group III (W&W,100%,C)	Group IV (W&W,100%,NC)	Group V (WO,100%)
50%	Group VI (P&W,50%,C)	Group VII (P&W,50%,NC)	Group VIII (W&W,50%,C)	Group IX (W&W,50%,NC)	Group X (WO,50%)

Group I - Subjects generate responses and outcomes. The series of outcomes over trials generated by this group is used for all other groups under 100% reinforcement.

Group II - Subjects generate responses but outcomes occur on the same trials as in Group I.

Group III - Subjects watch responses and outcomes generated by Group I.

Group IV - Subjects watch responses generated by Group II and outcomes which occur on the same trials as in Group II (and hence in Group I also).

Group V - Subjects watch outcomes only, which occur on the same trials as in Group I.

Group VI-X - Responses and rewards are generated in the same way as they are in Group I - V.

The structure incorporates an incomplete 2 x 2 x 3 factorial design with the elmination of two groups under the third variable (see Table 1). The independent variables are percentage of reinforcement, divided into schedules of 50% and 100%, contingency, defined by contingent and non-contingent relationships, and a task variable, described as Play and Win, Watch and Win and Win Only. This latter terminology is the one used by Lewis and Duncan (1958b).

Subjects in the Play and Win groups played the acquisition and extinction series themselves and received rewards directly. Three discrete button presses were to be made on the two push buttons on each trial. Therefore, any one of eight possible alternative patterns could be produced on any trial. The conditions of the two Play and Win contingent groups required that subjects learn a correct response, which was arbitrarily designated as one right-button press followed in succession by two left-button presses (RLL). The 100% reward group was required to make sixteen correct responses in acquisition, the 50% reward group to make thirty-two. Thus, the 100% and 50% reward groups each received sixteen reinforcements. Eight different schedules of 50% reward were assigned to the eight subjects of that group. These schedules were random except for the following restrictions: (1) the first and thirty-second correct responses were reinforced, and (2) the first and last sixteen correct responses each received eight reinforcements.

Subjects in the two Play and Win non-contingent groups were matched with the contingent subjects in the manner of a yoked control design. They were also required to generate their own response patterns directly and were instructed to learn the correct response although in fact there was none. Rewards were controlled by the experimenter and were made to occur on the same trials as they did for each matched subject in the contingent groups.

Each subject in the Watch and Win groups was matched with a subject in each of the four Play and Win groups. Their task was to observe the response patterns and rewards generated by their matched subject, by regarding the sequences of pilot-light flashes which were reproduced for them from a tape.

Subjects in the Win Only groups were required to observe the trial lights going on and off at five second intervals throughout the experiment and the occurrence of rewards from time to time. These rewards were made to fall on the same trials as they did in the Play and Win (and Watch and Win) groups. Since no responses were made by the subjects in the Win Only groups, the distinction between contingent and non-contingent reward does not apply.

It is evident from the design that the number of acquisition trials will vary from subject to subject, but that the limits will be set by subjects in the Play and Win contingent groups, so that all remaining groups will have the same number of trials as their matched subjects in these two groups.

All subjects were required to state, for each trial, immediately after the trial-lights went off, a number from 1 to 6 indicating their expectancy that a chip could occur for that trial. These expectancy numbers, along with the response patterns, where obtained, were recorded by the experimenter who sat in the adjoining room.

For the subjects in the contingent groups rewards were released automatically according to a prearranged schedule of reinforcement on the correct response four seconds after the trial-lights went off. For non-contingent reward presentations the experimenter closed an electrical circuit manually on the specific trials in which rewards were to occur. These rewards were then automatically released four seconds after the trial-lights went off.

Procedure:

When a subject entered the experimental room he was asked to make himself comfortable in the chair in front of the panel. Then one of three sets of instructions was read to him. The Play and Win instructions were as follows:

> This experiment is designed to compare the ability of people to learn. By pressing these buttons in a certain way you can make poker chips drop into this receptacle. This is how to operate the buttons. Just press them in and a spring will pull them back by themselves.

You may begin pressing when these trial-lights come on. These lights will remain on for five seconds during which time you may make three, and only three presses. Then the trial-lights will go off. In other words when the lights are on, you may make three presses in any manner you wish, as long as you press only one button at a time. But remember, do not press when the trial-lights are off.

Your task is to make as many chips fall down as possible. This counter will record the number of chips that drop into the receptacle so that you can keep track of the number you have earned. In other words you can judge your progress by the counter and the number of chips that fall. There is something else I want you to do. In front of you is a scale of numbers from 1 to 6. Corresponding to these numbers are the descriptions: "very sure of not getting a chip", "mildly sure of not getting a chip", "slightly sure of not getting a chip", "slightly sure of getting a chip", "mildly sure of getting a chip" and "very sure of getting a chip". At the end of the three button presses I want you to indicate whether you think a chip will drop for these three presses. For example, if you are not very sure that a chip will fall, you might call out number 1 or 2; if you are very sure that a chip will fall, you might call out number 6. Be sure to call out a number right after you have made the three button presses. Then the trial-lights will go off and you will find out if you have obtained a chip or not. Then the trial-lights will come on again and you will make three more presses.

The reason you are calling out the numbers is to tell us how confident you are that a chip will fall. It has nothing to do with what actually happens. It is the way you press that counts.

In other words when the lights are on for five seconds, you will make three presses and call out a number indicating how confident you are that a chip will fall. Then the same lights will go off and you will find out if you have obtained a chip or not. Are there any questions?

Before we start the experiment, I am going to let you practice on a few trials. Remember to call out a number right after you have made the three button presses. .... That's fine. The practice session is over. Now we will begin the experiment. Try to make as many chips as you can. Continue pressing until I tell you to stop.

The Watch and Win instructions were as follows:

This experiment is designed to compare the ability of people to learn. Notice these trial-lights and pilot-lights in front of you.

When the trial-lights come on this is the beginning of a trial. They will stay on for five seconds. Then there is a five second time between trials when the lights are off. The series of five second trials, separated by five second off periods, continues throughtout the experiment.

During the trials you will see that the pilot-lights will flash on three times in some sequence. Sometimes, but not always, after the trial-lights go off, a poker chip will drop into this receptacle and this counter will record it for you. See if you can discover a relation between the sequence of pilot-light flashes and whether or not a chip falls.

In front of you is a scale of numbers from 1 to 6. Corresponding to these numbers are the descriptions; "very sure of not getting a chip", "mildly sure of not getting a chip", "slightly sure of not getting a chip", "slightly sure of getting a chip", "mildly sure of getting a chip", and "very sure of getting a chip". At the end of the three pilot-light flashes I want you to indicate whether you think a chip will drop for this sequence of flashes. For example, if you are not very sure of getting a chip, you might call out number 1 or 2; if you are very sure of getting a chip, you might call out number 6.

Be sure to call out a number right after you have observed the three pilot-light flashes. Then the trial-lights will go off and you will find out if you have obtained a chip or not. Then the trial-lights will come on again and you will observe three more pilot-light flashes.

The reason you are calling out the numbers is to tell us how confident you are that a chip will fall. It has nothing to do with what actually happens. It is the sequence of pilot-light flashes that counts.

In other words when the lights are on for five seconds you will observe the pilot-lights flash and call out a number indicating how confident you are that a chip will fall. Then the trial-lights will go off and you will find out if you have obtained a chip or not. Are there any questions?

Before we start the experiment, I am going to let you practice on a few trials. Remember to call out a number right after you have observed the three pilot-light flashes. ......That's fine. The practice session is over. Now we will begin the experiment. Continue until I tell you to stop.

The Win Only instructions were as follows:

This experiment is designed to compare the ability of people to learn. Notice these trial-lights in front of you. When they come on this is the beginning of a trial. They will stay on for five seconds. Then there is a five second time between trials when the lights are off. The series of five second trials, separated by five second off periods, continue throughout the experiment. Sometimes, but not always, after the trial-lights go off, a poker chip will drop into this receptacle and this counter will record it for you. Your task is to see if you can figure out on what trials the chips will fall.

In front of you is a scale of numbers from 1 to 6. Corresponding to these numbers are the descriptions: "very sure of not getting a chip", "mildly sure of not getting a chip", "slightly sure of not getting a chip", "slightly sure of getting a chip", mildly sure of getting a chip", and "very sure of getting a chip". During the time that the trial-lights are on I want you to indicate whether you think a chip will fall on this trial. For example, if you are not very sure of getting a chip, you might call out number 1 or 2; if you are very sure of getting a chip you might call out number 6. Be sure to call out a number before the trial-lights go off.

The reason you are calling out the numbers is to tell us how confident you are that a chip will fall. It has nothing to do with what actually happens.

In other words when the trial-lights come on for five seconds I want you to call out a number indicating whether you think you will get a chip on this trial. Then the trial-lights will go off and you will find out if you have obtained a chip or not. Are there any questions?

Before we start the experiment, I am going to let you practice on a few trials. Remember to call out a number during the trial. However, no chips will fall during this practice run. .... That's fine. The practice session is over. Now we will begin the experiment. Cohtinue until I tell you to stop.

All subjects received one hundred extinction trials. Questions were answered by re-reading the relevant part of the instructions. Then the experimenter left the subject alone and the experiment began.

After the experiment was over all subjects were asked to complete the following questionnaire: (1) In this experiment what do you think made the chips fall down? Please explain in detail. (2) What did you think was happening when you did not get any more chips?

CHAPTER THREE

RESULTS

The principal focus of the present thesis is on the effect of conditionality of reward on the expectation of reward, and all groups yield data on expectancy. However, in the Play and Win groups certain additional measures of interest are available. Under contingent reward in the Play and Win condition, the acquisition and extinction of the correct response can be examined as a function of percentage of reward. Although there are, of course, no data on the correct response when reward is non-contingent, it is possible to examine the degree to which subjects converge toward some response pattern in the course of acquisition, and, perhaps, diverge again in extinction. For this purpose, a measure of overall response variation has been devised and applied to both contingent and non-contingent groups in the Play and Win condition.

We turn first to these ancillary measures which are available only in the Play and Win groups. The order of presentation for each measure is acquisition, extinction and finally a closer look at the transition from the end of acquisition to the initial trials in extinction.

Performance of the Correct Response:

All subjects in the Play and Win groups were required to obtain 16 reinforcements in order to complete acquisition. If a subject did not attain this level of performance within 150 trials he was discarded and randomly replaced. One subject in the 100% group and 4 subjects in the 50% group fell into this category. The number of trials to complete acquisition by the final groups is listed in Table VII of the Appendix.

It should be remembered that the schedules of reinforcement used in the present experiment refer to the percent of correct responses to be rewarded. The actual overall probability of reward for acquisition is determined by dividing the 16 obtained reinforcements by the total number of trials required to reach acquisition. These values are included in Table VII of the Appendix. They also represent the probability of reward values for all of the remaining 100% and 50% groups in the experiment.

A measure which permits a sensible comparison between the 100% and 50% reward groups for the rate of acquisition of the correct response is based on the number of incorrect responses that occur between each successive correct response. Mean values for this measure are plotted for the Play and Win contingent groups for 100% and 50% reward in Figure 1. A t test, computed between the total

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Figure 1 about here

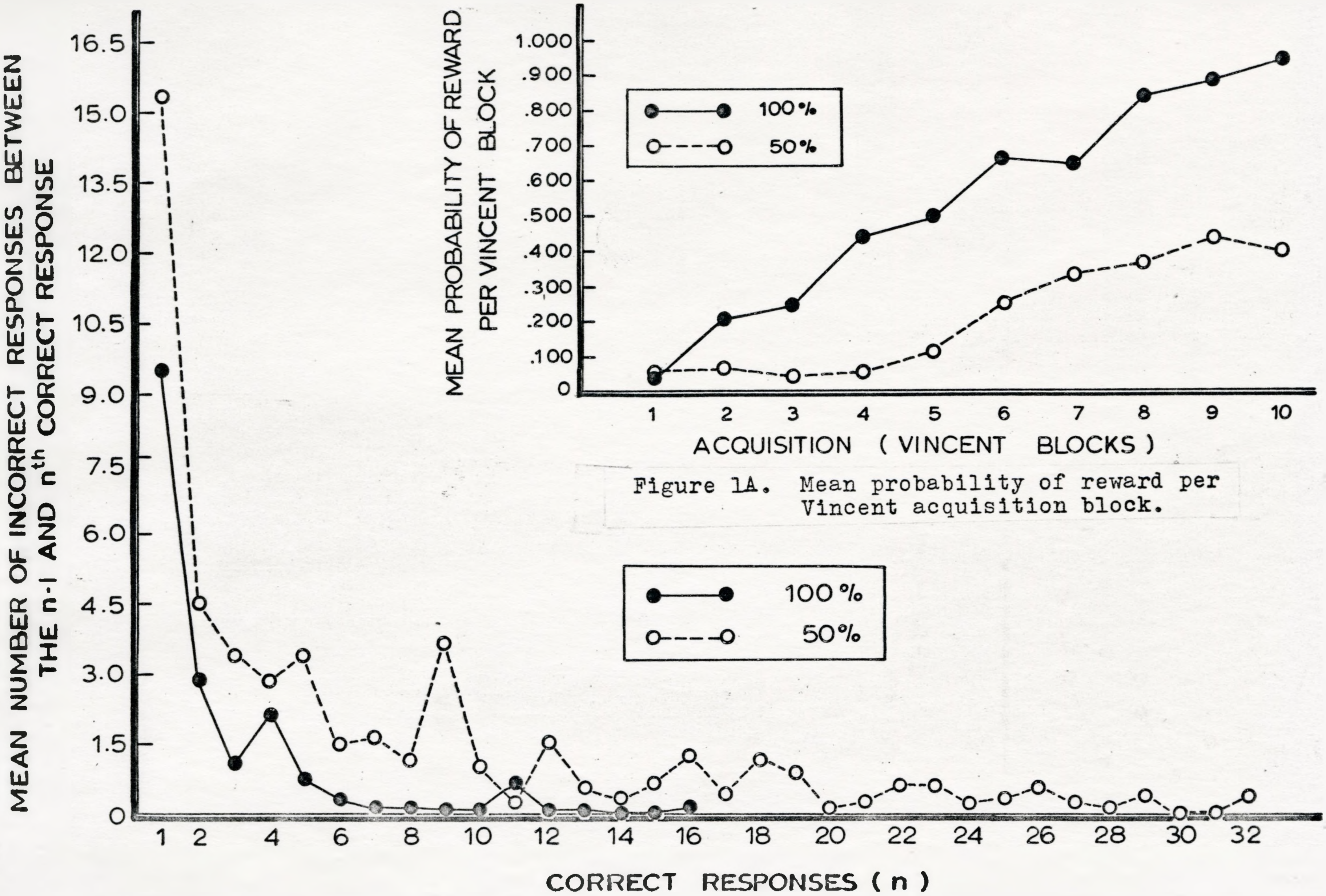

Figure 1A. Mean probability of reward per Vincent acquisition block.

Figure 1. Mean number of incorrect responses between the n - 1 and the nth correct response as a function of successive correct responses (n) with 100% and 50% reinforcement as the parameters.

number of incorrect responses for the third to the sixteenth correct responses indicates that the 100% and 50% groups do not differ significantly.[1] However, an examination of Figure 1 shows the trend to be in the predicted direction; i.e. the 50% groups took consistently more trials (incorrect responses) to learn the correct response than did the 100% group.

If the number of trials taken to reach acquisition by the Play and Win groups are Vincentized into tenths the actual probability of reward for each Vincent block can be calculated. These values are listed in Table VIII of the Appendix and are graphed in Figure 1A. It is clear from Figure 1A that although both groups start with the same low probability of reward in the first block, by the tenth block the probability of reward approximates the probability of reward for the correct response; i.e. 1.00 and .50 for the two groups respectively.

In order to examine the persistence of the correct response in extinction the 100 extinction trials were divided into 10 blocks of 10 trials each. The mean number of correct responses in each successive block was then calculated for the 50% and 100% Play and Win contingent groups. These values are plotted in Figure 2.

Figure 2 about here

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[1] The incorrect responses prior to the first two correct responses are left out of this test because all groups are treated alike up to that point. The obtained difference prior to the first correct response appears disconcertingly large in Figure 1. It was not, however, a significant difference.

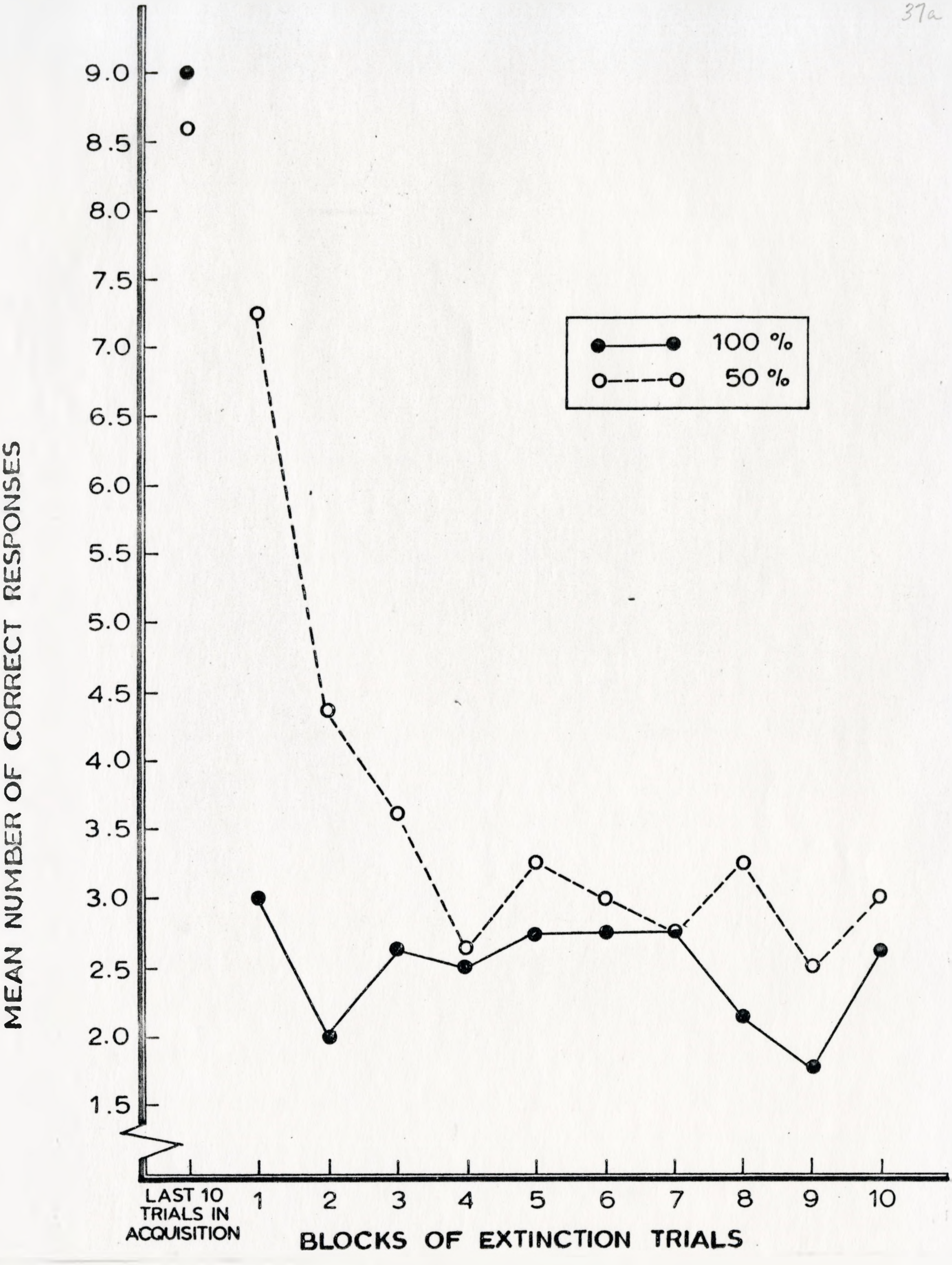

Figure 2. Mean number of correct responses for the Play and Win contingent groups for the last ten trials in acquisition and for blocks of extinction, with 100% and 50% reinforcement as the parameters.

Figure 2 also shows the mean number of correct responses for the two groups for the last 10 trials of acquisition. A *t* test indicates that these values at the end of acquisition do not differ significantly.

A simple 2 x 10 analysis of variance was carried out for the extinction data of Figure 2. The results are summarized in Table 2. Both the blocks effect and the % reward X blocks interaction effect are significant.

Table 2 about here

The significant interaction reflects the fact that in the 100% group the mean number of correct responses dropped to a low level even within the first block of 10 extinction trials and remained at approximately that level throughout extinction, whereas it took the 50% group about four blocks to reach as low a level.

The failure of the analysis of variance to yield a significant main effect is apparently due to the atypical performance of one subject in the 100% group (see subject No. 8 in Table X of the Appendix) who continued to make the correct response on all trials beyond the 20th. In order to minimize the effect of this subject's behavior, a Mann-Whitney U Test was computed on the total number of correct responses made during extinction by the two groups. The result was a significant percentage effect, the 50% group making

TABLE 2

Summary of analysis of variance of mean number of correct responses made over the ten blocks of extinction trials

Play and Win contingent groups

Source	DF	SS	MS	F	P
Between subjects	15				
% reward (A)	1	46.23	46.23	1.02	ns.
error	14	634.67	45.33		
Within subjects	144				
blocks (B)	9	91.65	10.18	4.69	<.001
A X B	9	61.77	6.86	3.16	<.01
error	126	273.58	2.17		
Total	159	1107.90			

significantly more correct responses during extinction than the 100% group. (P = .028).

The change in number of correct responses between the last 10 trials of acquisition and the first 10 trials of extinction is shown in Figure 3.[1] The amount of change for the values in Figure 3 was

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Figure 3 about here

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calculated and a t test computed comparing these difference scores. The results indicate that the 100% group made a significantly greater change than did the 50% group. (P<.01) Since a t test on the terminal acquisition levels (as redefined in the footnote to this page) also shows no difference for the two groups, we can interpret the above analysis by saying that the 100% group decreases to a significantly lower level of correct responding during the first 10 trials of extinction than does the 50% group.

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[1] Generally the experimenter in learning studies arbitrarily designates a cut-off point where extinction is to begin. However, what is called the first trial of extinction in fact should be the last trial in acquisition since the subject has no way of discriminating that something different (i.e. non-reinforcement) is occurring. This distinction is rarely made in learning experiments. However, since we are taking a small group of trials and looking carefully at the changes which occur from the end of acquisition to the first of extinction, it appears appropriate to make this distinction. Therefore, in the following analysis and discussion what are referred to as the last 10 trials of acquisition will actually be the last 9 trials in acquisition and the first trial in extinction. What are referred to as the first ten trials in extinction will actually be the second to eleventh trial in extinction. A very slight difference will be noted between the points representing the last 10 trials of acquisition in Figure 3 and those representing the same values in Figure 2. This discrepancy is due to the changes noted above.

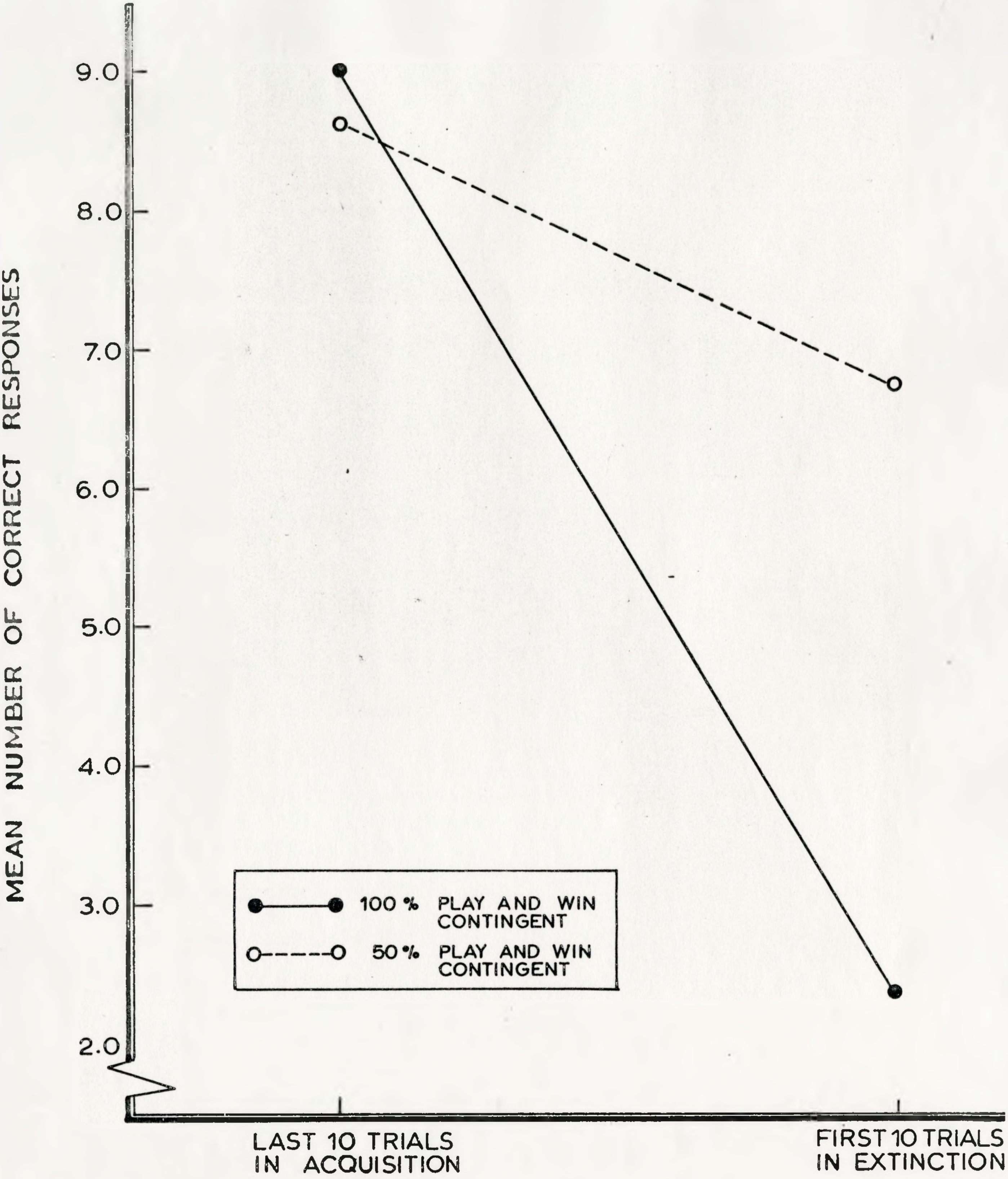

Figure 3. Mean number of correct responses in the last ten trials in acquisition and the first ten trials in extinction for the 100% and 50% Play and Win contingent groups

Variation in Response Patterns:

A measure of the degree to which subjects in each of the four Play and Win groups converged on any set of response patterns during acquisition and extinction was calculated in the following manner: For each subject the eight alternative response patterns were ranked according to their frequency of use during a block of trials; the rank was then multiplied by the frequency of occurrence and these values were added together and divided by the number of trials in the block. The resulting value will be called the response-pattern variation index for that block. The lower the index the less the subject tends to vary the response patterns which he uses. A higher index would indicate relatively greater variability in the use of different response patterns.

In order to determine the change in response-pattern variation during acquisition the index was calculated for each subject in the Play and Win groups for the first half and second half of his acquisition trials. The means of these indices are presented in Table 3.

Table 3 about here

A 2 x 2 x 2 analysis of variance was carried out on the group data. The results, as summarized in Table 4, indicate significant main

TABLE 3

Mean response-pattern variation

indices for the first and second half of acquisition

Play and Win Groups

	Contingent		Non-contingent	
	1st half	2nd half	1st half	2nd half
100%	2.72	1.46	2.45	1.39
50%	3.15	1.82	3.33	2.24

effects of both the % reward variable and the "halves" variable. However, neither the contingency variable nor any interaction effects were significant. An examination of Table 3 shows that subjects

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Table 4 about here

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reinforced on a 100% schedule converge on a smaller set of response patterns during acquisition than do subjects on a 50% schedule. Also all four groups show a significant decrease in the amount of response-pattern variation from the first to the second half of acquisition.

It should be noted that although response-pattern variation indices are not affected by contingency, in the non-contingent groups the 50% subjects obtained reinfordements for an average of 3.88 different response patterns during acquisition and the 100% subjects obtained reinforcements for an average of 2.75 different patterns. In the contingent groups, on the other hand, all reinforcements were of course received for the single response pattern which was designated as the correct one.

During extinction the response-pattern data for the Play and Win groups were analyzed as in acquisition, except that response-pattern variation indices were calculated for each of the ten blocks of trials. Since any possible effect of either % reward or contingency on variation indices may dissipate in time, a 2 x 2 x 4 analysis of variance was carried out for the first four blocks only. The results

TABLE 4

Summary of analysis of variance of the response-pattern variation index for the first and second half of acquisition

Play and Win groups

Source	DF	SS	MS	F	P
Between subjects	31				
contingency (A)	1	.07	.07	.13	n.s.
% reward (B)	1	6.40	6.40	11.43	<.01
A x B	1	.87	.87	1.55	n.s.
error	28	15.57	.56		
Within subjects	32				
halves (C)	1	22.48	22.48	66.12	<.001
A x C	1	.19	.19	.56	n.s.
B x C	1	.01	.01	.03	n.s.
A x B x C	1	.00	.00	.00	n.s.
error	28	9.41	.34		
Total	63	55.00			

are summarized in Table 5.

Table 5 about here

Both the blocks variable and the % reward X blocks interaction show significant effects. Since the contingency variable was having no significant effect on response-variation either during acquisition or extinction the scores of the contingent and non-contingent groups were combined and the resulting means are plotted in Figure 4 (top). It is clear from this graph that the variation index increases from

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Figure 4 (top) about here

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block 1 through block 4. In the case of the 100% reward groups most of that increase occurs within the first block of ten extinction trials whereas in the 50% reward groups the increase is spread out over the first three blocks.

The difference in the response-variation index during extinction cannot be attributed to the value of this index at the end of acquisition since a 2 x 2 analysis of variance (% reward X contingency) showed no significant differences for the last block of ten acquisition trials.[1] The values of the index for this block are also shown at the left in the top panel of Figure 4.

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1 The results of this analysis are summarized in Table II of the Appendix.

TABLE 5

Summary of analysis of variance of response-pattern variation indices over the first four blocks of extinction trials

Play and Win groups

Source	DF	SS	MS	F	P
Between subjects	31				
% reward (A)	1	2.051	2.051	1.222	n.s.
contingency (B)	1	2.941	2.941	1.752	n.s.
A x B	1	3.781	3.781	2.252	n.s.
error	28	47.012	1.679		
Within subjects	96				
blocks (C)	3	10.053	3.351	12.097	<.001
A x C	3	2.306	.769	2.776	<.05
B x C	3	.390	.130	.469	n.s.
A x B x C	3	.490	.163	.588	n.s.
error	84	23.285	.277		
Total	127	92.309			

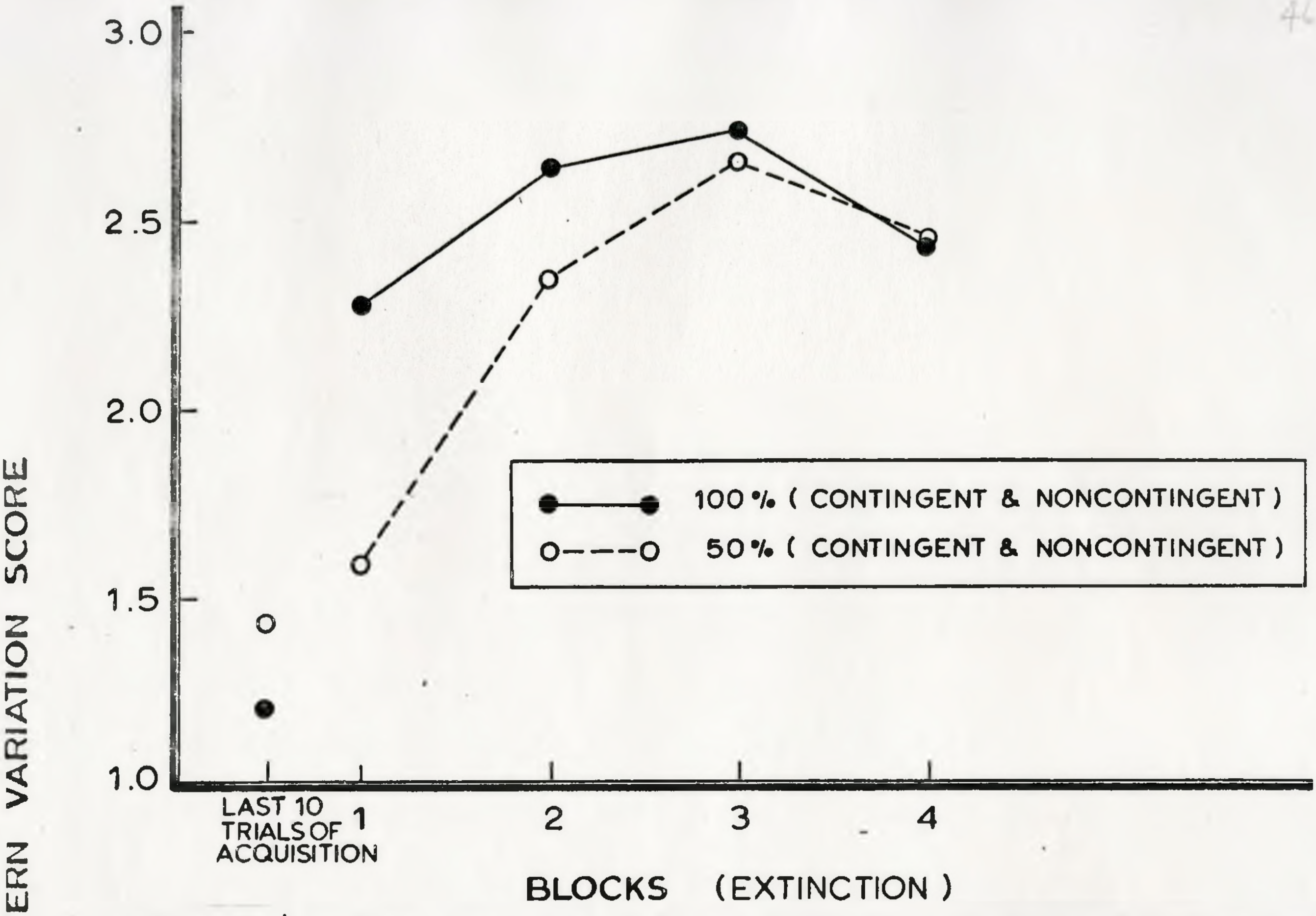

Figure 4. Mean response-pattern variation indices for the last ten trials in acquisition and the first four blocks of extinction trials for the 100% and 50% Play and Win groups. (Scores for the contingent and noncontingent groups combined)

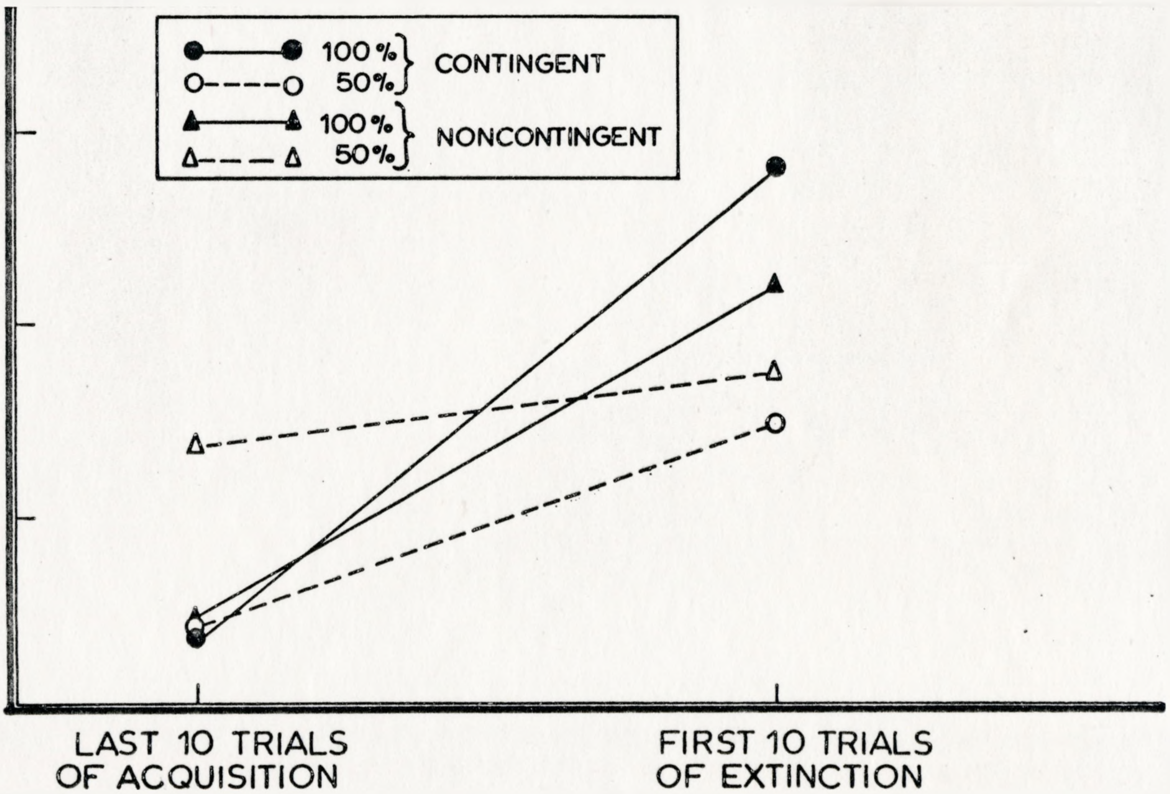

Figure 4. Mean response-pattern variation indices for the last ten trials in acquisition and the first ten trials in extinction for the 100% and 50% Play and Win groups

The lack of a difference between the response variation index at the end of acquisition taken together with a significant interaction between blocks and % reward in extinction implies a differential change in this index from acquisition to extinction in the groups which received 100% or 50% reward. This implication is borne out by an analysis of the change in the response variation index from the last 10 trials of acquisition (first nominal extinction trial included in acquisition block) to the first 10 extinction trials (nominally, extinction trials 2 - 11).[1] These data are shown in the lower panel of Figure 4. A 2 x 2 analysis of variance (% reward x contingency), summarized in Table 6 was carried out on these data. The results show that only the main

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Table 6 about here

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effect of the % reward variable was significant. The 100% groups show a greater increase in pattern variation than do the 50% groups.[2]

Expectancy Scores:

Since subjects took different numbers of trials to complete 16 or 32 correct responses during acquisition, the expectancy scores were vincentized into tenths. The tenths are sometimes here referred

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1. See footnote on Page 40.

2. An analysis of variance on the redefined terminal acquisition response-pattern variation indices is summarized in Table III of the Appendix. Neither % reward nor contingency effects were significant.

TABLE 6

Summary of analysis of variance of the difference in response-pattern variation between the last ten trials of acquisition and the first ten trials of extinction

Play and Win groups

Source	DF	SS	MS	F	P
% reward (A)	1	3.850	3.850	7.103	<.05
contingency (B)	1	.878	.878	1.620	n.s.
A X B	1	.000	.000	---	n.s.
error	28	15.174	.542		
Total	31	19.902			

to as Vincent blocks. In extinction, however, all subjects had the same number of trials (100). Results in extinction were averaged over blocks of 10 trials. Figure 5 presents mean expectancy scores during acquisition and extinction for each of the three tasks.

Figure 5 about here

In order to study the effects of percentage of reward, contingency, and the task variable on expectancy scores a 4-way analysis of variance was computed. The two percentages of reward and the two response-reward correlations were factorially combined with the Play and Win and Watch and Win tasks over the last 5 blocks of acquisition. Table 7 summarizes these results. The main effects of % reward, contingency, and blocks are significant.

Table 7 about here

However, there are no significant differences between the Play and Win and Watch and Win groups, nor were any interaction effects significant.

An examination of the upper two-thirds of Figure 5 will make the meaning of these results clear. In all cases the expectancy scores for the groups increased from the sixth block to the tenth

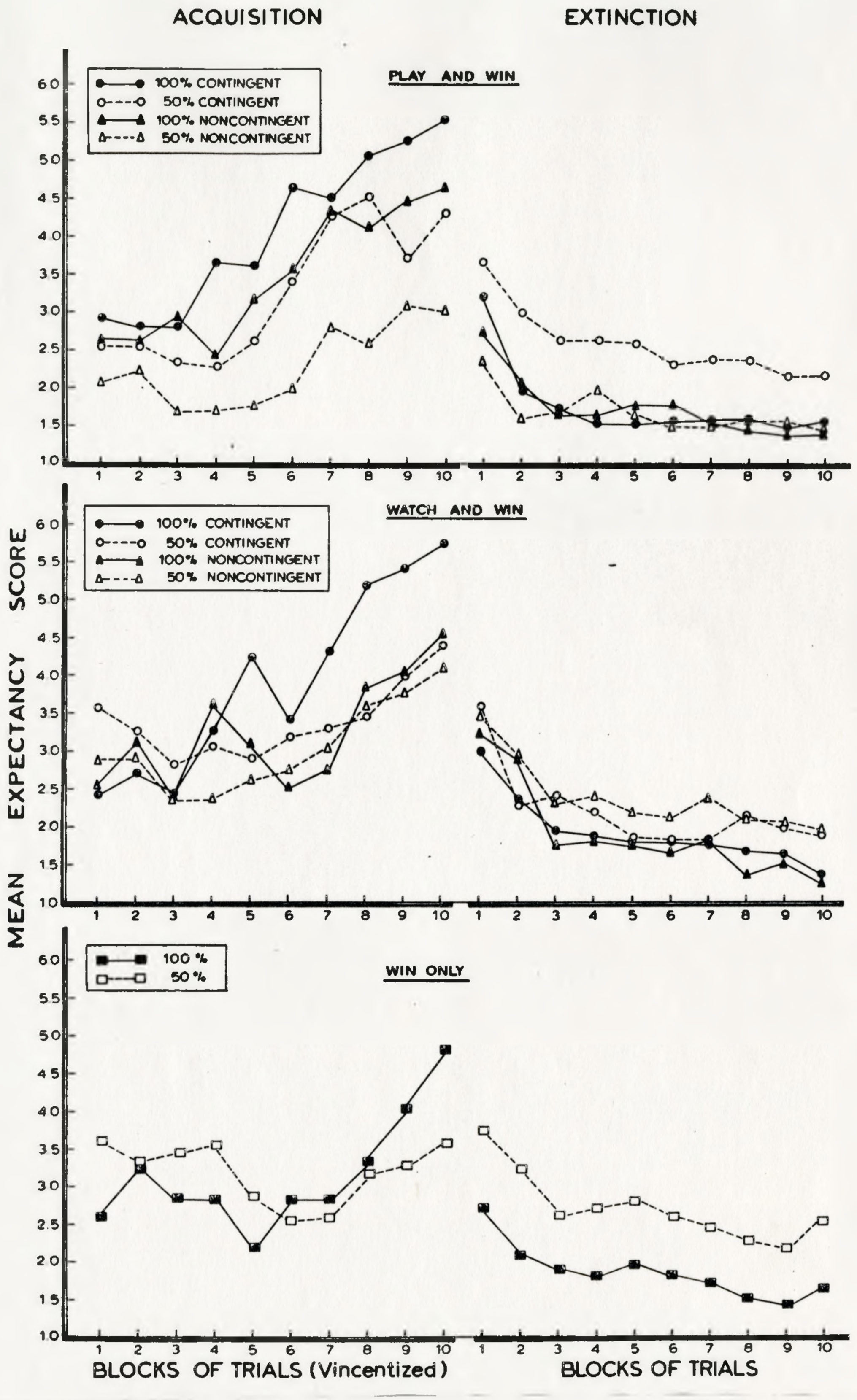

Figure 5. Mean expectancy scores over Vincent blocks of acquisition trials and blocks of ten trials in extinction for all groups.

TABLE 7

Summary of analysis of variance of mean expectancy scores over the last five blocks of acquisition

Play and Win and Watch and Win groups

Source	DF	SS	MS	F	P
Between subjects	63				
contingency (A)	1	71.792	71.792	11.388	<.01
task (B)	1	.322	.322	.051	n.s.
% reward (C)	1	75.632	75.632	11.997	<.01
A X B	1	1.294	1.294	.205	n.s.
A X C	1	2.173	2.173	.345	n.s.
B X C	1	5.721	5.721	.908	n.s.
A X B X C	1	16.513	16.513	2.619	n.s.
error	56	353.014	6.304		
Within subjects	256				
blocks (D)	4	60.562	15.141	14.714	<.001
A X D	4	1.503	.376	.365	n.s.
B X D	4	8.263	2.066	2.008	n.s.
C X D	4	3.580	.895	.870	n.s.
A X B X D	4	2. 186	.547	.532	n.s.
A X C X D	4	.954	.239	.232	n.s.
B X C X D	4	1.916	.479	.466	n.s.
A X B X C X D	4	1.853	.463	.450	n.s.
error	224	230.434	1.029		
Total	319	837.712			

block. In addition the contingently rewarded subjects have higher expectancy scores than do subjects rewarded non-contingently. Finally, subjects rewarded on a 100% schedule have a higher expectancy of reward than do those on a 50% schedule.

The Win Only condition must be viewed as one in which reward is non-contingent. Thus the expectation of reward in the Win Only group might be expected to be similar to that in the non-contingent Play and Win and Watch and Win groups. Further, since we have found a higher expectation of reward in the contingent Play and Win, and Watch and Win groups than in the corresponding non-contingent groups, we would also expect the contingent groups to show higher terminal expectations than the Win Only groups. These surmises were borne out by analyses of variance.

The first analysis was carried out on the Win Only groups along with the Play and Win, and Watch and Win non-contingent groups. The analysis is based on the last 5 blocks of acquisition. The results are summarized in Table 8. Only the effects of % reward and blocks are significant. The 100% reward groups have a higher

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Table 8 about here

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expectancy score than the 50% reward groups. The effect of blocks is due to an increase in expectancy as acquisition progresses. Since the task variable has no significant effect it may be concluded that

TABLE 8

Summary of analysis of variance of mean expectancy scores over the last five blocks of acquisition

Play and Win and Watch and Win non-contingent groups and Win Only groups

Source	DF	SS	MS	F	P
Between Subjects	47				
% reward (A)	1	31.034	31.034	4.862	<.05
task (B)	2	1.902	.951	.149	n.s.
A X B	2	21.772	10.886	1.705	n.s.
error	42	268.099	6.383		
Within subjects	192				
blocks (C)	4	60.360	15.090	16.122	<.001
A X C	4	3.177	.794	.848	n.s.
B X C	8	8.831	1.104	1.179	n.s.
A X B X C	8	2.070	.259	.277	n.s.
error	168	157.230	.936		
Total	239	554.475			

when reward is non-contingent, making responses, or viewing responses plays no role in the development of expectation of reward; - expectation is affected only by the frequency and pattern of reward.

A similar analysis of variance based on the contingent groups together with the same Win Only groups is summarized in Table 9. In this case, the main effect for task, as well as for percentage

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Table 9 about here

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of reward and blocks, is significant. The effects for % reward and for blocks are similar to those previously reported for the non-contingent groups. A Scheffé test shows that the totals in the Play and Win, and Watch and Win groups are significantly above those for the Win Only groups.[1] Thus, when reward is contingent upon responses, or on stimuli which represent response patterns, expectation of reward reaches higher values than when only the frequency and pattern of reward are available to the subject.

Figure 6 plots certain means in order to summarize the comparisons shown to be significant by the above analyses of variance.

Figure 6 about here

The means are taken over the last five Vincent blocks. The Play and Win, and Watch and Win groups have been pooled since they were in no case significantly different. Figure 6 shows mean expectancy to be higher with the higher percentage of reward, and with contingent reward when compared with non-contingent reward. Note that the mean

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1 See Table IV of the Appendix

TABLE 9

Summary of analysis of variance of mean expectancy scores over the last five blocks of acquisition

Play and Win and Watch and Win contingent groups and Win Only groups

Source	DF	SS	MS	F	P
Between subjects	47				
% reward (A)	1	52.896	52.896	11.183	<.01
task (B)	2	69.293	34.647	7.325	<.01
A X B	2	6.109	3.055	.646	n.s.
error	42	198.650	4.730		
Within subjects	192				
blocks (C)	4	49.434	12.359	14.028	<.001
A X C	4	5.070	1.268	1.439	n.s.
B X C	8	6.605	.826	.938	n.s.
A X B X C	8	4.581	.573	.650	n.s.
error	168	148.045	.881		
Total	239	540.683			

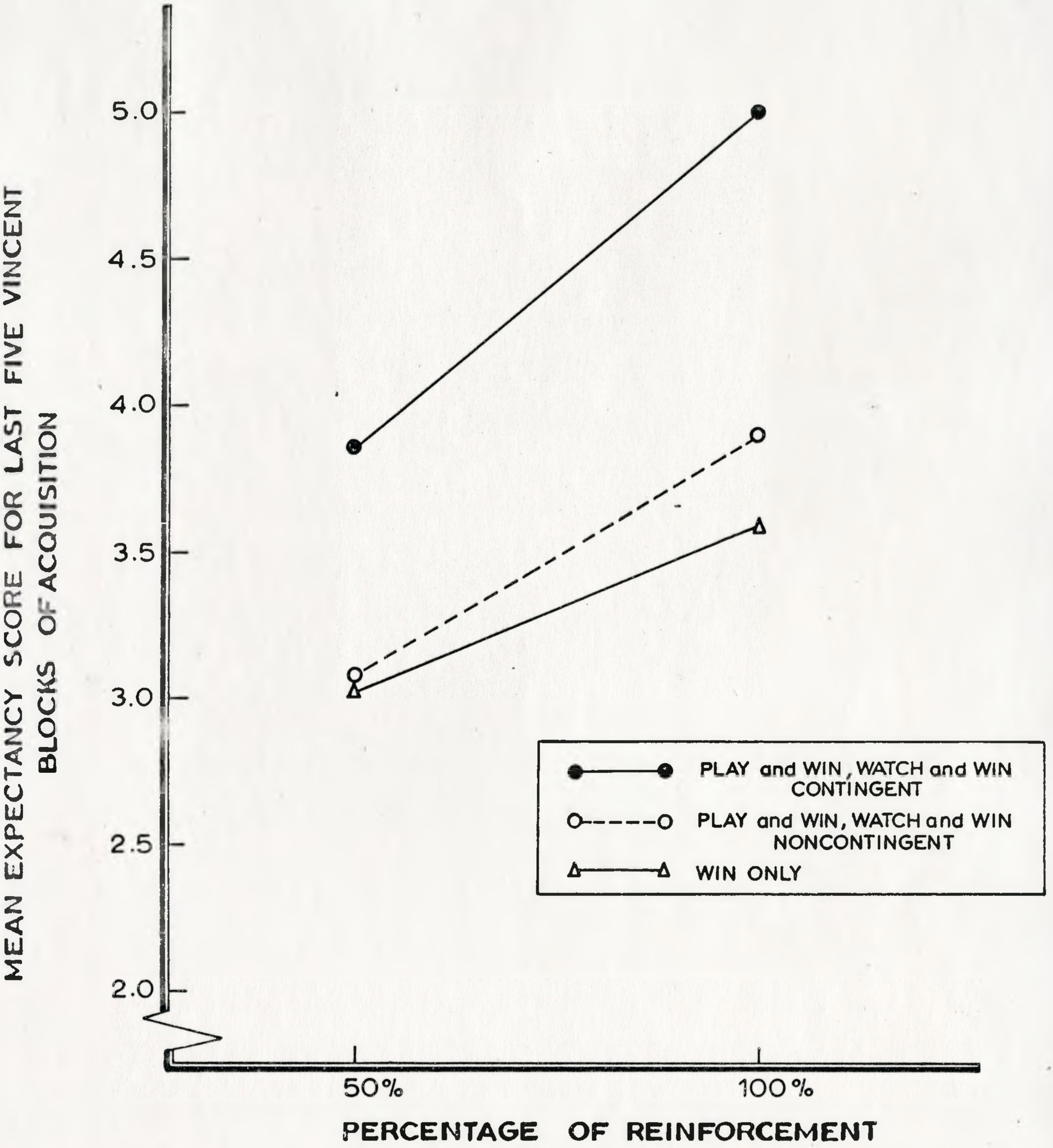

Figure 6. Mean expectancy scores based on the last five Vincent blocks of acquisition as a function of percentage of reinforcement. Play and Win and Watch and Win groups combined.

levels of expectation in the Win Only groups are quite similar to the levels for non-contingent groups.

Because the mean levels of expectation at the end of acquisition differed widely among the several groups, a simple comparison of expectations in extinction is not very instructive. The level of expectation in extinction depends almost entirely on two factors: the level at the end of acquisition and the rapidity of the drop in level from acquisition to the mean for the first block of ten extinction trials (see Figure 5). We have already considered the determinants of the terminal level of expectation in acquisition. Accordingly, we consider now factors that govern the amount of change in expectation between the terminal acquisition (10 trials, including the first nominal extinction trial), and the first 10 trials of extinction (nominal extinction trials 2 - 11). The relevant mean values for all groups are given in Table 10.

Table 10 about here

A 3-way analysis of variance of the differences in expectancy was carried out. The variables were task (Play and Win versus Watch and Win), % reward (100% versus 50%), and contingency (contingent versus non-contingent). The Win Only groups were not included in this analysis. The results, summarized in

TABLE 10

Mean expectancy scores for the last ten trials in acquisition (A) and the first ten trials in extinction (E) and the difference between these two measures (D)

	PLAY AND WIN				WATCH AND WIN				WIN ONLY	
	Contingent		Non-contingent		Contingent		Non-contingent		----------	
	A	E	A	E	A	E	A	E	A	E
100%	5.39	2.83	4.55	2.45	5.51	2.79	4.05	3.15	4.13	2.48
	D		D		D		D		D	
	2.56		2.10		2.72		0.90		1.65	
	A	E	A	E	A	E	A	E	A	E
50%	4.24	3.60	3.09	2.29	4.46	3.36	4.14	3.31	3.51	3.73
	D		D		D		D		D	
	0.64		0.80		1.10		0.83		-0.22	

Table 11, show that only the main effect of % reward is significant.

Table 11 about here

Groups given 100% reward in acquisition show a greater drop in mean expectancy scores than do those given 50% reward in acquisition. A t test on the same scores for the 100% and 50% Win Only groups also shows the same result ($P < .05$).

Now, we have already seen that percentage of reinforcement affects expectation at the end of acquisition and this immediately suggests the possibility that the amount of drop in expectation is related in a simple way to the level of expectation prior to extinction. The relation can be examined in Figure 7, in which the changes in expectation from acquisition to extinction are plotted as a function of the terminal level of expectation in acquisition for each of the 10 experimental groups (data as given in Table 10). The product-moment correlation, r, between terminal level and change is .851 ($P < .01$).

Figure 7 about here

Thus, the change in expectation in the early phase of extinction is well predicted by the expectation of reward prior to extinction.

The next question that might be asked of these results is whether percentage of reward has any residual effect on the change of

TABLE 11

Summary of analysis of variance of expectancy score differences between the mean scores for the last ten trials in acquisition and the mean scores for the first ten trials in extinction

Play and Win and Watch and Win groups

Source	DF	SS	MS	F	P
task (A)	1	.302	.302	.187	n.s.
% reward (B)	1	24.256	24.256	15.029	<.001
contingency (C)	1	5.761	5.761	3.569	n.s.
A X B	1	2.325	2.325	1.441	n.s.
A X C	1	3.239	3.239	2.007	n.s.
B X C	1	4.730	4.730	2.931	n.s.
A X B X C	1	.857	.857	.531	n.s.
error	56	90.387	1.614		
Total	63	131.857			

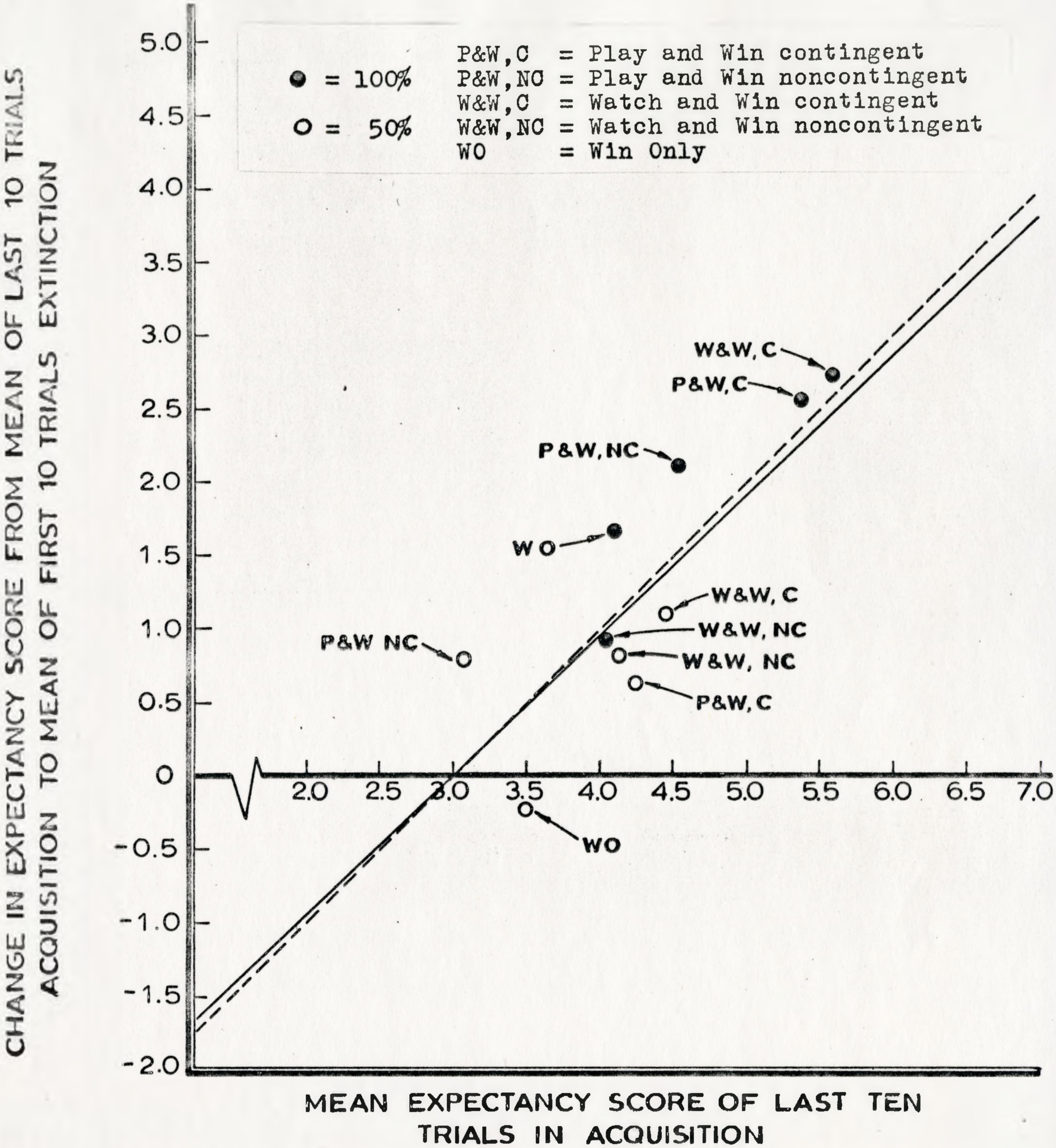

Figure 7. Amount of change in expectancy scores from the mean of the last ten trials in acquisition to the mean of the first ten trials in extinction as a function of terminal acquisition level for all groups.

expectation for groups that have the same level of expectation prior to extinction. The present experiment affords a limited opportunity to examine that question. There are several groups which, although subjected to different percentages of reward, arrive at approximately the same terminal expectation prior to extinction. These groups, 3 of them at 100% and 3 at 50%, were as follows: Group II (Play and Win, 100%, non-contingent), Group IV (Watch and Win, 100%, Non-contingent), Group V (Win Only, 100%), Group VI (Play and Wih, 50%, Contingent), Group VII (Watch and Win, 50%, Contingent), and Group IX (Watch and Win, 50%, Noncontingent). It may be noted that the overall mean for these 100% groups would lie above the overall mean for these 50% groups, suggesting that even for equivalent expectancies prior to extinction, 100% groups drop more rapidly than do 50% groups. However, a t test of the difference between these overall means shows that they do not differ significantly. Thus, the results do not provide a clear answer to the question.

The best fitting straight line (method of least squares) for the set of 10 points is also shown in Figure 7. It is of interest that this best fitting line has a slope of .984 which is very close to 1.0. The dotted line in Figure 7 is drawn through $\bar{x},\bar{y}$ with a slope of 1.0. A slope of 1.0 in the present case would mean that the pre-extinction level of expectation minus the drop in expectation was equal to a constant. In other words, points along the dotted line represent the same mean level of expectation over the first block of 10 extinction trials. Groups whose values lie above this line show too large a drop in expectation to fit this rule while those below the line show too little drop.

It can be seen in Figure 7 that of the five groups lying above the dotted line, four received 100% reward while of the five lying below the line, four received 50% reward. The two-tailed probability for outcomes as or more extreme than this is $<.05$. This distribution reflects the fact that the partial groups tend to have mean expectancy levels in the first extinction block which are above the overall mean level for all groups. This result does not, however, help us to resolve the question of whether percentage of reinforcement in acquisition has effects on expectation in extinction which are not predictable from the terminal level of expectation. The discrepancies, even if assumed to be systematic, may simply mean that the function relating expectation prior to extinction to the change in expectation is curvilinear.

SUMMARY OF RESULTS:

Expectation in Acquisition and Extinction:

(1) The distinction between making and observing responses had no effect on the development of expectation in acquisition or on the loss of expectation in extinction.

(2) For all tasks, and for contingent and non-contingent reward, expectation rose to a higher level in acquisition, and declined more rapidly in extinction, under 100% than under 50% reward.

It is possible that knowledge of the terminal acquisition level of expectation is all that enters into the prediction of the rate of decline in expectation in extinction. In particular, the effect of percentage of reward on rate of decline may be encompassed by the effect of percentage of reward on terminal expectation.

(3) For both the Play and Win and Watch and Win tasks, expectancy scores under contingent reward rose to a higher level than under non-contingent reward.

(4) When responses (made or observed) were non-contingently related to reward, expectation in both acquisition and extinction was not significantly different than the expectation that results from observing only the series of rewards and non-rewards.

Correct Responses in Acquisition and Extinction:

(1) No significant differences were found between the 100% and the 50% Play and Win contingent groups in the number of incorrect responses which occurred between successive correct responses in acquisition. In particular, the density of correct responses at the end of acquisition was very similar under 100% and 50% reward.

(2) The probability of the correct response pattern declined more rapidly in extinction following 100% than following 50% reward.

Response-Pattern Variation Index in Acquisition and Extinction:

(1) Both contingent and non-contingent subjects showed a reduction in variation among response patterns in the course of acquisition. The reduction was greater under 100% than under 50% reward, but was not significantly greater for contingent than for non-contingent reward. Thus contingent and non-contingent groups converged toward a single response pattern to about the same degree.

(2) Response variation increased in extinction. The increase was more rapid following 100% than following 50% reward, but was unaffected by contingency.

CHAPTER FOUR

DISCUSSION

The principal purpose of the present experiment was to examine the effect of conditionality on the growth and decline of expectancy scores when subjects are involved in a selective learning task. The possibility of three different outcomes resulting from the present procedure were discussed earlier. These outcomes are reviewed briefly below. It is assumed in each case that the distinction between producing and simply observing responses has no effect on expectation of reward.

(1) if expectancy scores depend on actual conditionality between response and reward, then

contingent groups > non-contingent groups = Win Only groups
(Play and Win) (Play and Win)
(Watch and Win) (Watch and Win)

(2) if expectancy scores depend on the subject's belief in conditionality, and if the presence of response patterns (made or observed) encourages a spurious belief in conditionality when, in fact, none is present, then

contingent groups $\geq$ non-contingent groups > Win Only groups
(Play and Win) (Play and Win)
(Watch and Win) (Watch and Win)

Since the degree of belief in conditionality might, even on the present assumption, be higher when there is in fact conditionality, the first and second assumptions do not imply distinctively different results for the contingent and non-contingent groups. The distinctive implication of the present assumption is that the expectation of reward in non-contingent groups will exceed that in the Win Only groups.

(3) if neither actual nor spuriously inferred conditionality between responses (made or observed) and rewards is involved in the expectation, then, since the results will depend only on the series of rewards and non-rewards,

contingent groups	=	non-contingent groups	=	Win Only groups
(Play and Win)		(Play and Win)		
(Watch and Win)		(Watch and Win)		

The results for expectancy scores in acquisition fall into a pattern which is consistent only with the first assumption. The expectation of reward reaches a higher value when reward is contingent upon a response pattern than when it is not. Further, when reward is non-contingent, making (or observing) responses along with outcomes does not lead to a significantly higher expectation of reward than when only the series of outcomes is available.

Since the effect of contingency on expectation appears to be the same under the Play and Win and under the Watch and Win tasks, we are led to think that contingency works by providing a basis for discriminating the class of never reinforced occasions from the class of sometimes or always reinforced occasions. The development of the discrimination is accompanied by an increased expectation of reward for the class of reinforced occasions.

These results are puzzling in one respect. We have reviewed certain findings which show that subjects in the non-contingent groups converged toward a single response-pattern to about the same degree as did those in the contingent groups.

Further, on a post-experimental questionnaire, nine of the sixteen subjects in the non-contingent groups stated their belief that rewards were produced by a particular pattern or sequence of response patterns over trials, while thirteen subjects indicated the same belief in the contingent groups. In spite of these signs that a substantial number of subjects in the non-contingent conditions behaved as though reward were contingent, their expectation was no higher than it was for the groups that viewed only the series of rewards and non-rewards. If actual contingency raises the expectation of reward, why does not "imagined" contingency raise it at least somewhat?

Before commenting on this question, it may be of interest to take a closer look at the matter of convergence. Although statistical tests based on the response-pattern variation index for the first and second halves of acquisition failed to show a significant effect for contingency versus non-contingency, there were some indications that in the 50% reward group, the variation at the end of acquisition (last 10 trials) was higher in the non-contingent group. It seems likely that a replication with larger groups would show significantly greater convergence for the contingent 50% reward condition than for the non-contingent 50% reward condition.

The overall similarity in the degree of convergence in contingent and non-contingent groups is explained in part by two types of behavior; the first is referred to by Skinner (1948) as "superstitious behavior", and the second is called "collateral behavior" by Bruner and Revusky (1961).

From an examination of the sequences of response-patterns used by subjects in the non-contingent groups it appears that a number of subjects behaved as though conditionality were present, and they proceeded to settle on a pattern or series of patterns which, because of the increasing probability of reinforcement, they very likely regarded as yielding the greatest number of chips.

The degree of convergence in all four Play and Win groups was limited because many subjects behaved as though sequences of response-patterns over trials were functional in obtaining rewards. When such sequences are used by subjects in the contingent groups, where all but one pattern is irrelevant to the reinforcement contingency, the pressing of the non-functional patterns is called "collateral behavior".

Table XXII in the Appendix illustrates by example certain typical regularities in the use of response patterns in both contingent and non-contingent groups. The example shown for contingent, 100% reward, is particularly interesting since it is obvious that the subject alternated between the correct response pattern and another one, even though his expectation of reward was very low when the correct response was not used. It would appear that for some time this subject believed that the incorrect response pattern "sets up" the reward for the correct pattern.

Even though one may doubt that subjects' convergence on a response pattern, or belief that reward depends on response selection, was as strong in non-contingent groups as it was in contingent groups, it is clear that in the non-contingent groups there was substantial convergence and that a fair proportion of subjects believed in a connection between response selection and reward. Hence the question remains, - why was not the expectation of reward at least somewhat higher on the average in the non-contingent groups than in the Win Only groups where there were no antecedent responses to form the basis for a spurious belief in the predictability of reward?

Although we cannot offer a clear answer to the question, it may be helpful to consider certain differences between the distribution of rewards over response-patterns in the contingent and non-contingent groups. In a somewhat indirect way, identifying differences that might lead to lower expectation under non-contingent reward than under contingent reward reduces the puzzle as to why non-contingent reward gives rise to no higher expectation of reward than does exposure to the reward series alone.

These differences in reward distribution are presented in Table 12. The values in the Table represent mean percentages of

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Table 12 about here

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reward and non-reward for the 'preferred' and for 'other' response

Table 12

Percentage of reward for the 'preferred' and 'other' responses during the first and second halves of acquisition

100% CONTINGENT

		Reward	Non-Reward
First Half	Preferred Response	100%	0%
	Other Responses	0%	100%
Second Half	Preferred Response	100%	0%
	Other Responses	0%	100%

50% CONTINGENT

		Reward	Non-Reward
First Half	Preferred Response	47.94%	52.06%
	Other Responses	0%	100%
Second Half	Preferred Response	51.99%	48.01%
	Other Responses	0%	100%

100% NON-CONTINGENT

		Reward	Non-Reward
First Half	Preferred Response	31.25%	68.75%
	Other Responses	21.79%	78.21%
Second Half	Preferred Response	87.26%	12.74%
	Other Responses	56.55%	43.45%

50% NON-CONTINGENT

		Reward	Non-Reward
First Half	Preferred Response	71.21%	82.79%
	Other Responses	6.36%	93.64%
Second Half	Preferred Response	49.22%	50.78%
	Other Responses	25.18%	74.82%

patterns during the first and second halves of acquisition. The 'preferred' response is defined as that pattern which the subjects used most often throughout the whole of acquisition. In every case this pattern, for both contingent groups, was one designated as correct previous to the experiment.

The 'preferred' response received a lower percentage of reward in the non-contingent groups than in the contingent groups. The difference is substantial for the first half of acquisition. It continues to be appreciable in the second half only for the 100% groups. In the non-contingent case, responses 'other' than the preferred one are reinforced. Since the number of rewards was fixed, it follows that the total number of reinforcements on the 'preferred' response was less in the non-contingent than in the contingent groups. Perhaps, also, the occurrence of reinforcement on 'other' than the 'preferred' response blurs the discrimination between the class of responses never reinforced and those that are at least sometimes reinforced. Thus in terms of the percentage and frequency of reinforcement for the preferred response pattern, and also in terms of the exclusiveness of reinforcement on the preferred response pattern, the contingent group exceeds the non-contingent group. Any or all of these factors might contribute to higher expectation of reward in contingent groups even though the degree of convergence toward a single response pattern was the same for contingent as for non-contingent reward.

We have examined the dependent variables of the present experiment in terms of contingent and non-contingent reward presentations. Let us now take a closer look at these measures in relation to percentage of reinforcement.

A general result found in all tasks for the present procedure was that during acquisition, expectancy scores increased to a higher level during acquisition and declined more rapidly during the first block of extinction in the 100% reward group than in the 50% group. This finding supports the non-selective learning studies carried out by Lewis and Duncan (1957; 1958a) which showed that the level of expectation during acquisition increases as a function of percentage of reinforcement and also declines in extinction as a function of percentage of reinforcement, with the greater loss following the larger percentage.

However, in both Lewis and Duncan's experiments and in the present research, since the 100% reward groups also had a higher terminal acquisition expectancy level than the 50% group, the effect of the percentage of reinforcement variable on expectancy change is unclear. Although Lewis and Duncan also recognized the limitations involved in interpreting extinction data when terminal acquisition levels vary significantly between groups, it appears that they disregarded the problem in their final analysis and implied that percentage of reinforcement alone affected the amount of loss in expectancy from the end of acquisition to extinction. It is felt that the present way of treating the results provides a better appraisal of the situation.

The question of interest is whether subjects who arrive at the same terminal level of expectation of reward as the result of different histories of reward lose expectation under non-reward at the same or at different rates. As we have seen, the present results fail to show an effect of percentage of reward on the decline in expectation when just those groups with approximately the same terminal levels in acquisition were compared. Still, the regular groups did, on the average, decline more rapidly and to a lower level than did the partial groups and the difference approached significance. The matter is worth further work since there is reason to believe that even though two subjects reach the same expectation of receiving reinforcement on the very next trial, their expectation after a series of non-reinforcement would depend on the entire series of rewards and non-rewards received during acquisition. In particular, it has been shown in animal experiments (Jenkins, 1962; Theios, 1962) that partial reinforcement survives an extensive exposure to regular reinforcement prior to extinction.

The percentage of reward variable was effective for all tasks and contingency groups. The difficulty in interpreting expectancy score data in terms of resistance to extinction arises because the terminal acquisition levels were different for the experimental groups. However, both button-pressing measures (correct response and response-pattern variation indices) were indistinguishable between groups at the end of acquisition, and the extinction data are readily interpreted as showing what may be called classical partial reinforcement effects. In the contingent groups, a correct response rewarded 50% of the time is used more persistently during extinction than is a correct response rewarded 100% of the time. The difference in extinction arises because the 100% group abandons the correct response more rapidly than does the 50% group. For both contingent and non-contingent groups, response variation decreased during acquisition and increased during extinction. Again the increase in variation was more rapid in the group given 100% reward for the correct response (and for the matched non-contingent groups) than for the groups under 50% reward.

The persistence of a correct response, or a preferred response in the case of non-contingent reward, has certain advantages as measures of the partial reinforcement effect over the commonly used measure of number of plays to quitting. The latter measure is subject to a number of extra experimental factors having to do with other activities in which the individual might be engaged were he not in the experiment. By fixing the number of extinction trials and examining the giving up of one response for alternative responses, these extra experimental factors, which must be sources of variability, are reduced.

CHAPTER FIVE

SUMMARY

The present experiment was designed to study the effect of conditionality on the growth and decline of expectancy scores in a selective learning task. Subjects were instructed to learn the correct response and to maximize rewards. Two percentages of reinforcement for the correct response were used: 100% and 50%.

Subjects whose rewards were not conditional upon a correct response were matched with contingently rewarded subjects and received rewards on the same trials as their matched subjects.

In addition to actively playing the acquisition and extinction series, groups engaged in two other tasks were used. One of these tasks was the observation of responses and outcomes received by subjects in the actively responding groups. Again contingent and non-contingent conditions were present. The third task required that subjects simply observe the sequence of rewards and non-rewards generated by subjects in the active groups.

The dependent measures were expectancy scores, correct response patterns, and response-pattern variation indices during acquisition and extinction.

The results showed that the development of expectation in acquisition and the loss of expectation in extinction was the same for subjects who played and watched the response series. The effect of conditionality was to enhance the level of expectation during acquisition, though having no differential effect on response-pattern variation indices. When responses were non-contingently related to reward, expectation in acquisition and loss during extinction was not significantly different than the expectation that results from viewing only the series of outcomes. Also for all tasks, and for contingent and non-contingent reward, expectancies rose to a higher level in acquisition, and declined more rapidly in extinction under 100% than under 50% reward.

The results of both the correct response measures and variation indices show classical partial reinforcement effects.

Two problems arising from the present research were discussed. The first pertains to the question of why the expectation of reward for subjects in the Play and Win non-contingent groups was not any higher than were these expectancy scores for subjects who viewed only the outcome series, when it was shown that both non-contingent and contingent subjects had similar response-pattern variation indices. Several possible explanations for this apparent discrepancy were discussed. The second problem is that of interpreting expectancy score data in extinction when the levels of expectation for groups at the end of acquisition are different. Further experimentation is needed to clarify the issue.

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APPENDIX

TABLE I

Summary of Statistical Analyses+

1. t Test comparing the total number of incorrect responses made before each of the third to the sixteenth successive correct responses between the Play and Win contingent 100% and 50% groups

$t = 1.913$ $df = 14$

2. t Test comparing the number of incorrect responses made before the first correct response between the Play and Win contingent 100% and 50% groups

$t = 0.929$ $df = 14$

3. t Test comparing the number of correct responses in the last ten acquisition trials between the Play and Win contingent 100% and 50% groups

$t = 0.495$ $df = 14$

4. Mann-Whitney U Test comparing the number of correct responses during extinction between the Play and Win contingent 100% and 50% groups

$U = 11$ $P = .028$

$n_1 = 8$ $n_2 = 8$

5. t Test comparing the difference in the number of correct responses made between the last ten trials in acquisition and the first ten trials in extinction between the Play and Win contingent 100% and 50% groups

$t = 4.11^{**}$ $df = 14$

6. t Test comparing the number of correct responses in the last ten trials of acquisition between the Play and Win contingent 100% and 50% groups (for set of redefined ten acquisition and extinction trials)

$t = 0.514$ $df = 14$

7. t Test comparing the difference in expectancy scores between the last ten trials in acquisition and the first ten trials in extinction between the Win Only 100% and 50% groups

$t = 2.58^{*}$ $df = 14$

8. t Test comparing the difference in expectancy scores between the last ten trials in acquisition and the first ten trials in extinction between the three 100% groups and the three 50% groups which have the same terminal acquisition expectancy scores

$t = 1.714$ $df = 46$

+ All two-tailed probability

* $P < .05$

** $P < .01$

TABLE II

Summary of analysis of variance of response-pattern variation indices for the last ten trials in acquisition

Play and Win groups

Source	DF	SS	MS	F	P
% reward (A)	1	.453	.453	3.307	n.s.
contingency (B)	1	.553	.553	4.036	n.s.
A X B	1	.359	.359	2.620	n.s.
error	28	3.845	.137		
Total	31	5.210			

TABLE III

Summary of analysis of variance of response-pattern variation indices for the last ten trials in acquisition

Play and Win groups[1]

Source	DF	SS	MS	F	P
% reward (A)	1	.386	.386	2.777	n.s.
contingency (B)	1	.526	.526	3.784	n.s.
A X B	1	.517	.517	3.719	n.s.
error	28	3.886	.139		
Total	31	5.315			

[1] This analysis is based on the indices derived from the redefined terminal adquisition response-pattern variation indices. See page 40, footnote.

TABLE IV

Summary of the Scheffé multiple comparisons test comparing total expectancy scores based on the last five blocks of acquisition trials between the Play and Win and Watch and Win contingent groups and the Win Only groups (scores for 100% and 50% groups combined)

	observed difference	critical value (.05)	critical value (.01)
T_1 (Play and Win) - T_2 (Watch and Win)	15.25	69.92	88.55
T_1 (Play and Win) - T_3 (Win Only)	97.85**	69.92	88.55
T_2 (Watch and Win) - T_3 (Win Only)	82.60*	69.92	88.55

df = 2 and 42 n = 80

* significant at .05 level

** significant at .01 level

TABLE V

Summary of the exact probability test for determining the probability of outcomes for terminal acquisition expectancy scores for all groups

$$\frac{\text{number of combinations of 5 things taken 4 at a time} + \text{number of combinations of 5 things taken 5 at a time}}{\text{number of combinations of 10 things taken 5 at a time}} = \frac{C_4^5 + C_5^5}{C_5^{10}} = \frac{1}{42}$$

for two tailed test: $\frac{1}{42} \times 2 = \frac{1}{21}$ $P < .05$

TABLE VI

Variable ratio schedules of reinforcement of correct responses for subjects in the Play and Win 50% Contingent Group.

Subjects in Group II	Correct Response Reinforcement Trials
1	1-6-9-11-12-13-14-15-18-20-21-22-23-25-30-32
2	1-2-3-7-9-10-14-16-19-20-22-25-27-30-31-32
3	1-2-5-7-9-12-13-16-17-18-20-23-26-27-28-32
4	1-6-7-8-10-11-14-16-18-20-21-23-24-27-28-32
5	1-2-3-6-8-10-11-13-17-18-19-21-22-23-26-32
6	1-2-4-11-12-14-15-16-17-21-22-23-24-25-31-32
7	1-4-5-6-10-13-15-16-21-23-24-25-26-28-30-32
8	1-5-6-7-9-10-13-15-19-21-23-24-25-28-30-32

TABLE VII

Number of trials to acquisition and actual probability of reward during acquisition for the 100% and 50% groups

	Subject	Number of trials	Probability of reward
100%	1	21	.762
	2	68	.235
	3	20	.800
	4	28	.571
	5	43	.372
	6	43	.372
	7	30	.533
	8	22	.727
50%	9	135	.118
	10	101	.158
	11	53	.302
	12	66	.242
	13	92	.174
	14	83	.193
	15	55	.291
	16	66	.242

TABLE VIII

Actual probability of reward for each Vincent block of acquisition trials

		Vincent Blocks									
	Subject	1	2	3	4	5	6	7	8	9	10
	1	0.000	0.000	0.500	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	2	0.000	0.000	0.000	0.167	0.000	0.000	0.429	0.500	0.429	0.857
	3	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	4	0.333	0.667	0.333	0.500	0.667	1.000	0.000	0.500	0.667	1.000
100%	5	0.000	0.000	0.000	0.000	0.000	0.400	0.500	0.750	1.000	1.000
	6	0.000	0.500	0.200	0.000	0.000	0.000	0.250	1.000	1.000	0.750
	7	0.000	0.000	0.000	0.000	0.333	1.000	1.000	1.000	1.000	1.000
	8	0.000	0.500	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	9	0.077	0.000	0.000	0.000	0.000	0.071	0.000	0.143	0.385	0.500
	10	0.000	0.300	0.100	0.000	0.182	0.100	0.100	0.200	0.200	0.400
	11	0.000	0.000	0.333	0.000	0.200	0.333	0.600	0.600	0.500	0.400
50%	12	0.000	0.000	0.000	0.000	0.000	0.286	0.571	0.500	0.571	0.500
	13	0.000	0.000	0.000	0.000	0.111	0.333	0.444	0.400	0.333	0.111
	14	0.250	0.125	0.000	0.125	0.250	0.222	0.125	0.375	0.222	0.250
	15	0.200	0.000	0.000	0.333	0.200	0.167	0.400	0.333	0.800	0.500
	16	0.000	0.167	0.000	0.000	0.000	0.429	0.429	0.333	0.571	0.500

TABLE IX

Number of incorrect responses between the n-1 and the nth correct response for the first sixteen reinforcements during acquisition Play and Win contingent groups

	Subjects	Successive correct responses (n)															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	23	18	1	2	1	1	1	1	1	1	1	1	0	0	0	0
	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100%	4	2	0	0	1	2	2	0	0	0	0	4	0	1	0	0	0
	5	21	1	4	0	1	0	0	0	0	0	0	0	0	0	0	0
	6	4	1	5	14	2	0	0	0	0	0	0	0	0	0	0	1
	7	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	9	9	17	14	9	13	8	4	4	13	3	1	5	0	0	0	0
	10	12	0	0	0	4	3	4	2	9	0	0	2	1	3	0	8
50%	11	12	2	0	2	3	0	1	1	0	0	0	0	0	0	0	0
	12	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	13	45	1	0	0	1	0	1	0	0	1	0	1	0	0	0	1
	14	1	5	0	2	0	1	3	2	6	1	1	3	2	0	5	1
	15	2	0	8	7	0	0	0	0	1	3	0	1	1	0	0	0
	16	8	11	5	3	6	0	0	0	0	0	0	0	0	0	0	0

TABLE X

Number of correct responses over blocks of extinction trials

Play and Win contingent groups

	Subjects	Blocks 1	2	3	4	5	6	7	8	9	10
	1	3	1	1	2	1	1	2	1	1	1
	2	6	3	2	2	4	5	3	2	1	2
	3	1	2	2	2	2	1	3	0	0	0
	4	2	3	1	0	1	2	1	2	0	0
100%	5	3	1	2	2	2	2	2	1	2	2
	6	0	1	2	0	1	0	0	0	0	4
	7	3	1	1	2	1	1	1	1	0	2
	8	6	4	10	10	10	10	10	10	10	10
	9	9	3	4	0	0	0	1	1	0	2
	10	4	3	4	2	4	2	3	3	4	4
	11	10	6	4	1	3	6	2	7	0	3
50%	12	10	5	1	0	3	1	0	0	3	4
	13	6	6	7	6	5	7	6	6	6	5
	14	7	5	4	6	5	4	4	5	3	3
	15	5	4	2	4	2	1	4	2	0	1
	16	7	3	3	2	4	3	2	2	4	2

TABLE XI

Number of correct responses in the last ten trials of acquisition and the first ten trials of extinction

Play and Win contingent groups

	Subject	Number of correct responses in last ten trials acquisition	Number of correct responses in first ten trials extinction
	1	10	2
	2	8	5
	3	10	0
100%	4	6	2
	5	10	2
	6	8	0
	7	10	2
	8	10	6
	9	9	8
	10	7	4
	11	10	10
50%	12	10	10
	13	7	6
	14	7	6
	15	10	4
	16	9	6

TABLE XII

Response-pattern variation indices for the first and second half of acquisition

Play and Win groups

	Contingent			Noncontingent		
	Subject	1st half	2nd half	Subject	1st half	2nd half
	1	2.00	1.00	17	2.36	1.00
	2	3.38	1.85	18	3.21	1.85
	3	2.00	1.00	19	3.10	2.30
	4	2.21	2.07	20	1.00	1.00
	5	3.41	1.62	21	2.95	1.43
100%	6	3.32	2.14	22	2.50	1.10
	7	3.60	1.00	23	2.33	1.00
	8	1.82	1.00	24	2.18	1.45
	9	3.94	2.91	25	3.50	3.54
	10	3.10	2.98	26	3.55	3.56
	11	2.93	1.04	27	2.63	2.08
50%	12	3.18	1.03	28	3.88	1.48
	13	2.74	1.52	29	4.22	1.85
	14	2.60	2.41	30	2.62	2.07
	15	3.04	1.37	31	2.75	2.15
	16	3.70	1.33	32	3.52	1.21

TABLE XIII

Response-pattern variation indices for blocks of extinction trials

Play and Win groups

CONTINGENT

	Subjects	1	2	3	4	5	6	7	8	9	10
	1	2.7	3.8	3.4	3.9	3.9	3.9	3.9	3.9	3.4	3.4
	2	1.4	2.7	3.2	1.8	2.6	1.6	2.8	3.1	3.9	3.4
	3	3.4	2.8	3.4	3.9	3.9	3.9	3.2	3.4	2.8	2.8
	4	3.4	2.6	3.1	2.2	3.4	3.9	3.4	2.8	2.6	1.7
100%	5	2.8	3.9	3.4	3.1	3.4	3.2	3.4	3.4	3.4	2.6
	6	1.3	3.2	3.9	3.4	2.6	1.5	1.5	1.8	2.0	3.1
	7	2.8	3.1	2.6	3.4	3.9	3.9	3.2	3.9	3.4	3.1
	8	2.0	2.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9	1.1	2.7	2.0	1.4	1.0	1.0	1.6	1.6	1.0	1.4
	10	2.6	3.2	2.3	3.4	2.3	2.8	2.7	3.2	2.6	2.2
	11	1.0	1.6	2.6	1.9	3.2	2.0	2.3	1.4	2.3	3.2
50%	12	1.0	2.5	3.9	3.4	2.7	3.9	2.6	2.2	2.4	2.6
	13	1.6	1.6	1.6	1.4	1.9	1.4	1.6	1.7	1.5	1.8
	14	1.4	1.9	2.3	1.7	1.9	1.9	2.0	1.8	2.8	2.8
	15	2.5	2.3	3.4	3.1	3.9	3.4	2.6	3.2	2.8	3.9
	16	1.3	2.0	3.2	3.9	2.0	2.2	2.3	2.8	2.2	2.3
	NON-CONTINGENT										
	17	3.9	3.1	3.9	3.1	3.2	2.8	2.6	1.9	2.5	3.9
	18	2.1	2.1	2.8	1.8	2.8	1.9	2.2	2.3	1.8	2.6
	19	3.1	2.8	3.1	2.5	1.5	1.7	2.1	2.8	2.8	2.8
100%	20	1.0	1.5	1.6	1.0	1.1	1.0	1.3	1.3	1.0	1.0
	21	1.3	1.4	1.8	1.0	1.3	1.8	1.5	3.8	1.0	1.5
	22	1.7	2.1	2.3	3.0	2.3	2.8	2.6	2.3	2.6	2.2
	23	1.0	1.2	1.0	1.2	1.0	2.6	1.7	1.7	1.0	1.7
	24	2.5	3.4	3.2	2.7	2.2	1.6	1.0	1.0	1.0	1.0
	25	1.7	2.8	2.4	2.4	1.8	2.4	3.2	3.9	2.6	1.9
	26	2.2	2.3	2.6	2.6	3.4	2.8	1.6	3.4	2.6	2.6
	27	1.4	2.4	3.9	2.8	2.6	3.4	2.8	2.1	2.4	3.4
50%	28	1.5	2.7	3.4	3.4	3.4	2.4	3.4	1.4	2.2	3.1
	29	1.6	2.7	2.6	2.3	2.3	3.4	2.3	1.6	2.4	1.9
	30	1.7	2.6	2.4	2.6	1.9	3.1	3.1	1.6	1.6	3.0
	31	1.9	2.6	2.6	1.8	2.6	3.1	2.8	2.2	2.6	1.4
	32	1.0	1.7	1.4	1.1	3.4	3.9	2.3	2.3	3.4	2.0

TABLE XIV

Response-pattern variation indices for the last ten trials of acquisition (A) and the first ten trials of extinction (E)

Play and Win groups

	CONTINGENT			NON-CONTINGENT		
	Subject	A	E	Subject	A	E
	1	1.0	2.8	17	1.0	3.9
	2	1.2	1.5	18	1.0	2.1
	3	1.0	2.8	19	2.3	2.8
100%	4	2.0	2.8	20	1.0	1.0
	5	1.0	2.8	21	1.0	1.3
	6	1.3	1.5	22	1.0	1.9
	7	1.0	3.1	23	1.0	1.1
	8	1.0	2.0	24	1.4	2.8
	9	1.1	1.2	25	1.9	2.1
	10	1.6	3.1	26	1.8	2.3
	11	1.0	1.0	27	2.3	2.4
50%	12	1.0	1.0	28	1.4	1.8
	13	1.4	1.6	29	2.0	1.7
	14	1.4	1.5	30	1.7	1.9
	15	1.0	3.1	31	1.4	1.9
	16	1.1	1.4	32	1.0	1.0

TABLE XV

Mean expectancy scores over Vincentized blocks of acquisition trials

Play and Win groups

CONTINGENT

	Subjects	blocks 1	2	3	4	5	6	7	8	9	10
	1	4.00	4.00	4.00	5.50	6.00	6.00	6.00	6.00	6.00	6.00
	2	3.00	3.00	2.57	2.33	2.57	2.29	2.71	3.50	3.14	4.43
	3	2.00	2.00	3.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
	4	3.00	5.00	4.00	5.50	4.67	6.00	2.00	4.00	5.00	6.00
100%	5	4.75	2.50	2.20	1.50	1.00	2.40	3.25	5.00	6.00	6.00
	6	3.50	3.50	3.80	4.50	3.25	3.80	4.00	4.00	4.00	4.00
	7	1.67	1.00	1.00	1.00	1.00	4.67	6.00	6.00	6.00	6.00
	8	1.50	1.50	2.00	3.00	4.50	6.00	6.00	6.00	6.00	6.00
	9	1.92	2.43	1.85	1.29	3.23	5.50	6.00	6.00	6.00	6.00
	10	5.40	5.10	4.90	4.90	5.27	5.00	5.20	5.20	3.30	4.10
	11	1.00	1.00	1.00	1.80	2.00	3.50	3.80	4.20	3.83	4.20
	12	2.00	1.83	1.00	1.00	1.00	1.71	3.86	4.67	5.43	5.17
50%	13	2.00	1.11	1.00	1.00	1.22	3.33	4.00	4.00	3.44	3.89
	14	4.13	4.63	4.33	4.13	3.88	2.89	3.13	3.38	3.11	4.25
	15	2.20	2.17	3.20	3.00	3.40	3.50	3.00	3.67	3.60	4.00
	16	1.71	2.00	1.43	1.00	1.00	1.86	5.29	5.17	1.00	3.00

NON-CONTINGENT

	Subjects	1	2	3	4	5	6	7	8	9	10
	17	1.00	1.00	1.00	2.00	5.00	6.00	6.00	6.00	6.00	6.00
	18	3.00	2.71	2.86	2.33	2.86	2.14	2.14	2.33	2.71	3.43
	19	1.50	2.50	4.00	2.50	4.00	2.50	6.00	6.00	6.00	6.00
	20	3.67	3.33	4.00	3.50	3.00	4.00	3.33	3.50	3.33	4.00
100%	21	2.50	2.00	2.00	1.00	1.00	1.00	2.75	2.25	4.80	4.50
	22	4.25	4.50	4.40	4.00	4.50	4.00	2.50	1.00	1.00	1.25
	23	2.00	2.00	2.00	2.00	1.67	4.00	6.00	6.00	6.00	6.00
	24	3.00	3.00	3.33	2.00	3.50	5.00	5.33	6.00	6.00	6.00
	25	1.62	1.00	1.00	1.00	1.00	1.29	1.23	1.50	2.77	3.29
	26	2.80	4.50	2.80	2.50	2.09	2.40	2.10	3.20	2.30	4.50
	27	3.80	3.80	4.00	4.60	4.40	4.83	4.20	4.40	4.17	4.60
50%	28	1.71	3.17	1.00	1.00	1.33	1.71	5.00	3.50	5.29	3.83
	29	2.00	1.33	1.00	1.00	1.00	2.11	2.67	2.40	2.33	1.56
	30	1.75	1.88	1.33	1.13	1.00	1.00	1.63	1.00	2.11	2.38
	31	1.80	1.50	1.40	1.33	2.40	1.17	2.00	2.17	2.80	2.33
	32	1.00	1.00	1.00	1.00	1.00	1.43	3.71	2.50	2.71	1.50

TABLE XVI

Mean expectancy scores over vincentized blocks of acquisition trials

Watch and Win groups

CONTINGENT

	Subjects	blocks 1	2	3	4	5	6	7	8	9	10
	33	1.00	1.00	1.50	2.00	6.00	6.00	6.00	6.00	6.00	6.00
	34	2.43	1.57	1.57	2.67	1.86	1.29	3.29	3.50	3.14	5.29
	35	3.50	3.00	3.50	6.00	6.00	6.00	6.00	6.00	6.00	6.00
	36	1.67	3.67	2.67	3.50	4.33	6.00	1.33	3.50	4.33	6.00
100%	37	3.50	4.25	4.00	4.00	4.25	2.20	3.75	4.75	6.00	6.00
	38	3.00	3.50	2.00	1.00	1.00	1.00	2.25	6.00	6.00	4.75
	39	3.33	3.67	3.67	4.00	4.67	5.67	6.00	6.00	6.00	6.00
	40	1.00	1.00	1.00	3.00	6.00	6.00	6.00	6.00	6.00	6.00
	41	3.62	1.71	1.00	1.36	1.08	2.57	1.38	1.71	4.46	5.64
	42	3.40	3.80	3.20	3.20	2.73	2.40	2.00	2.10	2.10	2.90
	43	4.00	3.60	3.67	4.60	4.00	3.83	3.60	4.20	4.67	5.20
	44	3.29	1.83	2.00	1.14	1.17	4.00	5.71	5.67	6.00	5.50
50%	45	3.78	4.33	1.56	3.70	2.67	3.33	5.00	4.30	3.89	4.56
	46	3.38	3.75	3.56	3.50	3.38	1.89	2.88	3.50	2.88	4.50
	47	3.20	3.67	4.00	4.17	4.40	3.33	3.20	2.50	3.00	3.33
	48	3.86	3.50	3.71	3.00	3.83	4.14	2.71	3.83	5.00	3.67

NON-CONTINGENT

	Subjects	1	2	3	4	5	6	7	8	9	10
	49	3.50	5.00	2.00	3.00	4.33	2.50	1.00	6.00	6.00	6.00
	50	3.00	3.14	2.14	1.50	3.00	2.71	2.43	3.00	2.86	2.43
	51	1.00	1.00	3.50	4.00	1.00	1.00	1.00	1.00	3.50	6.00
100%	52	3.67	4.67	3.00	4.50	5.67	2.67	3.67	6.00	2.67	2.33
	53	3.75	2.25	2.80	2.75	3.00	2.80	2.00	3.25	4.80	5.00
	54	1.75	3.00	1.00	4.75	2.25	1.00	2.25	2.75	3.60	5.25
	55	1.00	2.33	3.67	5.67	3.67	6.00	6.00	6.00	6.00	6.00
	56	3.00	3.50	1.33	3.00	2.00	1.50	4.00	3.00	3.00	3.50
	57	2.69	1.36	1.00	1.71	2.31	2.50	1.00	1.36	2.15	4.21
	58	3.70	5.00	4.20	2.60	3.27	4.10	4.50	4.10	3.90	3.90
	59	3.00	4.60	3.33	4.20	4.00	2.50	4.20	5.00	4.33	3.00
50%	60	2.57	1.00	1.00	1.00	1.00	1.00	2.71	3.17	3.29	4.33
	61	3.11	1.78	1.11	1.00	1.33	3.00	2.56	2.70	4.33	3.56
	62	1.63	2.13	2.11	1.00	2.50	1.89	1.00	2.25	1.56	2.88
	63	2.60	2.83	3.00	4.00	2.40	3.67	3.80	4.83	5.40	5.33
	64	3.71	4.67	3.43	3.57	4.50	3.57	4.86	5.50	5.43	5.67

TABLE XVII

Mean expectancy scores over vincentized blocks of acquisition trials

Win Only Groups

	Subject	blocks 1	2	3	4	5	6	7	8	9	10
	65	3.00	5.00	4.50	3.50	3.00	1.00	2.50	4.50	2.00	6.00
	66	2.00	1.00	1.00	2.00	1.00	1.00	2.00	2.33	3.14	3.86
	67	1.50	4.50	2.50	1.00	1.50	3.00	4.50	6.00	6.00	6.00
	68	3.33	1.67	2.67	3.50	1.00	6.00	6.00	3.50	4.33	4.33
100%	69	4.00	4.00	4.00	4.00	4.00	3.20	2.50	3.00	4.60	6.00
	70	1.00	1.25	2.00	2.25	1.25	1.00	1.00	1.50	4.00	4.00
	71	3.33	4.00	3.67	3.33	1.67	3.33	3.33	3.00	4.33	3.33
	72	2.50	4.50	2.33	3.00	4.00	4.00	1.00	3.00	4.00	5.00
	73	3.69	4.43	4.85	4.14	3.46	3.36	2.08	2.93	3.15	3.43
	74	3.00	3.30	2.50	2.30	1.55	2.00	1.00	3.00	1.00	1.50
	75	3.80	1.20	1.00	2.800	2.40	1.67	2.40	2.60	3.17	3.80
	76	4.57	3.50	3.71	3.57	3.17	3.00	2.57	3.67	4.29	3.17
50%	77	4.00	4.56	4.44	4.70	4.00	4.11	4.22	3.90	4.22	4.78
	78	3.75	2.50	4.33	4.25	2.50	2.33	2.88	2.75	3.22	3.88
	79	2.00	3.67	3.20	2.33	2.00	1.83	2.00	2.50	3.00	3.00
	80	4.00	3.33	3.29	4.29	3.83	2.14	3.57	4.00	4.29	5.00

TABLE XVIII

Mean expectancy scores for the last ten trials
of acquisition (A) and the first ten trials of extinction (E)

	PLAY AND WIN						WATCH AND WIN						WIN ONLY		
	Contingent			Non-contingent			Contingent			Non-contingent			-----------		
	S	A	E	S	A	E	S	A	E	S	A	E	S	A	E
100%	1	6.0	3.1	17	6.0	1.1	33	6.0	1.6	49	4.8	1.5	65	3.7	3.6
	2	4.4	2.7	18	3.4	2.9	34	5.0	2.5	50	2.5	3.5	66	4.0	1.3
	3	6.0	1.9	19	5.7	2.4	35	6.0	3.6	51	3.0	4.5	67	5.5	1.9
	4	4.5	3.2	20	3.6	2.7	36	4.1	1.9	52	3.4	3.8	68	4.0	3.5
	5	6.0	4.0	21	4.7	2.4	37	6.0	3.2	53	4.9	3.6	69	5.3	1.0
	6	4.2	3.4	22	1.2	2.8	38	5.0	1.0	54	4.3	3.7	70	3.8	2.0
	7	6.0	1.2	23	6.0	3.1	39	6.0	5.0	55	6.0	2.2	71	3.4	2.4
	8	6.0	3.1	24	5.8	2.2	40	6.0	3.5	56	3.5	2.4	72	3.3	4.1
50%	9	6.0	6.0	25	2.9	2.1	41	5.5	3.4	57	3.5	3.0	73	3.5	3.8
	10	4.1	3.3	26	4.5	3.4	42	2.9	1.8	58	3.9	3.2	74	1.8	4.3
	11	4.1	3.7	27	4.5	4.3	43	4.8	4.1	59	3.6	3.8	75	2.9	2.9
	12	5.3	4.0	28	4.7	2.7	44	5.7	3.7	60	4.5	2.8	76	3.9	3.2
	13	4.0	3.4	29	1.5	1.8	45	4.7	4.5	61	3.6	2.7	77	4.4	4.9
	14	4.3	3.8	30	2.1	1.1	46	4.3	3.5	62	3.0	2.5	78	4.2	3.9
	15	3.9	2.6	31	2.9	1.0	47	3.3	3.1	63	5.3	4.3	79	3.2	3.1
	16	2.2	2.0	32	1.6	1.9	48	4.5	2.8	64	5.7	4.2	80	4.2	3.7

TABLE XIX

Mean expectancy scores over blocks of extinction trials

Play and Win groups

CONTINGENT

	Subjects	blocks 1	2	3	4	5	6	7	8	9	10
	1	3.6	1.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	2	3.1	2.8	2.2	1.8	1.8	2.3	2.4	2.1	1.5	2.2
	3	2.3	1.1	1.3	1.4	1.3	1.8	1.4	1.6	1.4	1.0
	4	3.2	1.9	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0
100%	5	4.3	3.0	2.1	1.0	1.0	1.0	1.0	1.0	1.3	2.2
	6	3.9	3.5	3.4	3.7	4.0	3.1	3.7	3.8	3.7	3.0
	7	1.7	1.0	1.0	1.2	1.0	1.0	1.0	1.0	1.0	1.0
	8	3.4	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	9	6.0	5.6	5.8	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	10	2.9	3.8	3.1	3.0	3.8	2.6	3.0	3.0	2.6	3.0
	11	4.0	2.4	2.0	2.0	2.0	2.0	2.0	2.4	2.02	2.0
	12	4.3	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
50%	13	3.6	2.6	2.5	2.5	2.6	2.1	2.1	2.1	2.1	2.2
	14	4.0	4.1	3.0	2.7	2.4	2.2	2.3	2.2	1.6	1.0
	15	2.7	3.1	2.6	2.9	2.0	1.6	1.7	1.2	1.1	1.1
	16	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

NON-CONTINGENT

	Subjects	1	2	3	4	5	6	7	8	9	10
	17	1.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	18	3.0	2.8	2.6	2.0	1.9	1.8	1.8	1.9	2.2	1.7
	19	2.9	1.9	1.0	2.9	3.7	3.3	2.0	1.7	2.2	1.9
	20	2.8	2.5	1.6	1.0	1.9	2.0	1.3	1.7	1.0	1.8
100%	21	2.7	1.1	1.0	1.1	1.0	1.0	1.0	1.0	1.4	1.0
	22	2.7	3.3	2.8	2.2	1.5	2.1	1.0	1.0	1.1	1.3
	23	3.4	2.2	2.0	2.0	2.0	2.0	3.5	2.0	1.0	1.0
	24	2.6	1.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	25	2.1	1.3	1.9	1.1	1.0	1.0	1.0	1.0	1.0	1.0
	26	3.9	2.4	1.7	2.6	1.5	1.8	2.1	2.2	1.9	2.3
	27	4.4	2.8	3.5	3.7	3.1	2.8	3.3	3.1	3.2	2.2
50%	28	3.2	1.8	1.4	3.6	2.4	2.2	1.8	2.3	2.4	1.5
	29	1.8	1.0	1.8	1.7	1.1	1.0	1.0	1.0	1.0	1.0
	30	1.1	1.0	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0
	31	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	32	1.9	1.2	1.0	1.2	1.7	1.0	1.0	1.0	1.0	1.3

TABLE XX

Mean expectancy scores over blocks of extinction trials

Watch and Win groups

CONTINGENT

	Subjects	blocks 1	2	3	4	5	6	7	8	9	10
	33	2.1	1.4	1.7	1.1	1.1	1.3	1.0	1.0	1.0	1.0
	34	3.0	1.1	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	35	3.8	3.1	4.0	3.9	4.2	4.2	3.8	4.4	3.0	2.7
100%	36	1.9	2.4	1.5	1.0	1.5	1.0	1.0	1.0	1.0	1.0
	37	3.7	4.6	4.5	4.9	3.3	4.2	5.0	3.3	4.7	2.7
	38	1.0	1.5	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	39	5.2	2.8	1.0	1.6	1.0	1.0	1.0	1.0	1.0	1.0
	40	3.6	2.3	1.0	1.0	1.6	1.0	1.0	1.2	1.0	1.0
	41	3.9	1.8	2.6	1.0	1.0	1.0	1.5	1.5	1.0	1.0
	42	1.8	1.6	1.3	1.3	1.2	1.1	1.0	1.4	1.0	1.0
	43	4.1	4.0	4.2	4.2	3.8	3.4	4.0	3.5	4.4	3.3
50%	44	4.2	1.4	1.3	1.0	1.6	1.0	1.0	1.0	1.5	1.3
	45	4.5	3.3	4.0	3.9	4.0	4.1	3.0	3.7	4.1	4.9
	46	4.0	2.6	2.6	3.0	1.2	1.0	1.0	1.0	1.0	1.0
	47	3.1	2.8	2.6	2.4	1.0	1.0	1.0	1.0	1.0	1.0
	48	3.3	1.0	1.1	1.0	1.3	2.1	2.6	4.4	2.3	2.1

NON-CONTINGENT

	Subjects	1	2	3	4	5	6	7	8	9	10
	49	2.0	3.7	1.6	1.5	2.5	1.5	2.0	1.5	1.0	1.0
	50	3.4	2.9	2.3	1.6	1.5	1.6	1.3	1.3	1.0	1.0
	51	4.5	3.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0
100%	52	3.8	3.0	1.3	1.8	1.6	1.0	1.5	1.0	1.0	1.0
	53	3.6	3.3	2.5	4.2	2.2	3.5	2.9	2.7	4.2	2.3
	54	3.7	3.8	1.5	1.8	1.7	1.0	1.6	1.0	1.0	1.0
	55	2.7	1.0	1.7	1.9	2.5	3.1	3.1	1.7	2.4	2.4
	56	2.4	2.8	1.8	1.3	1.5	1.0	1.5	1.0	1.0	1.0
	57	2.5	3.0	1.0	1.0	1.0	1.0	2.5	1.0	1.0	1.0
	58	3.3	3.8	4.1	3.4	3.3	3.5	3.8	3.5	3.4	3.8
	59	4.1	2.8	2.8	3.3	2.9	2.5	2.6	1.9	2.6	2.4
50%	60	3.2	2.2	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	61	3.0	2.5	1.9	1.4	1.4	1.2	1.2	1.2	1.0	1.0
	62	3.0	2.0	2.5	2.5	1.5	1.5	1.5	1.5	1.0	1.5
	63	4.5	2.5	2.8	3.3	3.5	2.8	2.6	3.5	2.2	1.9
	64	4.4	5.1	2.7	3.9	3.3	4.0	4.2	3.8	4.6	3.6

TABLE XXI

Mean expectancy scores over blocks of extinction trials

Win Only groups

	Subjects	blocks 1	2	3	4	5	6	7	8	9	10
	65	3.7	4.4	4.3	3.3	4.6	4.5	3.8	2.8	3.6	3.7
	66	1.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	67	2.4	2.0	1.2	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	68	3.5	1.5	1.0	1.0	1.5	1.0	1.0	1.0	1.0	1.0
100%	69	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	70	2.0	2.0	2.0	2.8	3.0	3.0	3.0	2.5	2.0	2.4
	71	2.5	1.5	1.5	1.5	1.4	1.1	1.0	1.0	1.0	1.0
	72	4.4	3.4	3.5	2.9	2.3	2.0	2.0	2.0	2.0	2.0
	73	4.1	2.9	2.6	3.2	3.2	3.0	3.7	3.3	2.4	3.6
	74	4.4	3.3	1.1	1.0	1.6	2.1	1.6	1.2	1.1	1.0
	75	2.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.6
50%	76	3.4	3.6	2.7	3.8	4.6	3.1	3.8	4.0	3.3	5.1
	77	4.5	4.1	3.6	3.4	3.9	3.8	3.6	3.5	4.1	3.6
	78	4.1	4.3	4.6	3.9	3.7	3.3	2.0	1.0	1.1	1.0
	79	2.8	2.4	1.5	1.2	1.0	1.0	1.0	1.1	1.0	1.0
	80	3.8	4.3	4.0	4.4	3.5	3.5	3.1	3.1	3.7	3.5

TABLE XXII

Trial by trial response data for one subject selected from each of the four Play and Win groups

	CONTINGENT						NON-CONTINGENT					
	100%			50%			100%			50%		
	trial	pattern	exp. score	trial	pattern	exp. score	trial	pattern	exp. score	trial	pattern	exp. score
Acquisition	50	*RLL	6	74	*RLL	4	8	*RRL	3	51	RRR	6
	51	LRR	1	75	RLR	2	9	*RLR	4	52	*LLL	1
	52	*RLL	6	76	*RLL	4	10	*LRL	4	53	LLL	6
	53	LRR	1	77	RLR	2	11	*RRL	2	54	*RRR	6
	54	*RLL	6	78	*RLL	4	12	*LLR	3	55	*LLL	6
	55	LRR	1	79	RLL	4	13	*RLR	6	56	RRR	6
	56	*RLL	6	80	RLL	5	14	*LRL	6	57	*RRR	1
	57	LRR	1	81	LRL	3	15	*RRL	6	58	*LLL	6
	58	*RLL	6	82	LRL	3	16	*LLR	6	59	RRR	6
	59	LRR	1	83	*RLL	4	17	*RLR	6	60	LLL	6
	60	*RLL	6	84	RLL	5	18	*LRL	6	61	*RRR	1
	61	LRR	1	85	RLL	6	19	*RRL	6	62	*RRR	1
	62	*RLL	6	86	LRR	3	20	*LLR	6	63	LLL	6
	63	LRR	1	87	LRR	2				64	LLL	6
	64	*RLL	6	88	RLL	4				65	LLL	3
	65	*RLL	1	89	RLL	4				66	*RRR	6
	66	*RLL	5	90	RLL	4						
	67	*RLL	6	91	LRR	4						
	68	*RLL	6	92	*RLL	3						
Extinction	69	RLL	6	93	RLL	5	21	RLR	6	67	LLL	6
	70	RLL	4	94	LRL	2	22	LRL	5	68	LLL	1
	71	LRR	4	95	RLL	5	23	RRL	2	69	LLL	6
	72	LRR	1	96	RLL	5	24	LLR	2	70	RRR	4
	73	RLL	6	97	LRL	2	25	RRL	3	71	LLL	4
	74	LRR	1	98	RLR	3	26	LLL	2	72	RRR	4
	75	RLL	4	99	RLL	4	27	RRR	1	73	RRR	3
	76	RLL	1	100	RLL	4	28	RLR	3	74	LLL	2
	77	RLL	3	101	RLR	2	29	LRL	3	75	LLL	1
	78	LRR	1	102	RLL	4						
	79	LRR	2	103	RLL	3						

* reward obtained   exp. = expectancy score