AN EXPERIMENTAL INVESTIGATION OF EXPECTANCY AND OPERANT APPROACHES TO THE PREDICTION OF PERFORMANCE ON A PSYCHOMOTOR TASK

A THESIS

Presented to

The Faculty of the Division of Graduate Studies

By

David Warner Bracken

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Psychology

Georgia Institute of Technology

September, 1977

AN EXPERIMENTAL INVESTIGATION OF EXPECTANCY
AND OPERANT APPROACHES TO THE PREDICTION
OF PERFORMANCE ON A PSYCHOMOTOR TASK

Approved:

Randall M. Chambers, Chairman

M. Jackson Marr

Sherman F. Dallas

Date approved by Chairman 9/20/77

ACKNOWLEDGMENTS

I would like to give special thanks to my thesis committee, chaired by Dr. Randall M. Chambers, along with Dr. M. Jackson Marr and Dr. Sherman F. Dallas. I also wish to thank Dr. Edward H. Loveland who, besides acting as academic advisor, assisted in guiding the literature review which provided the basis for my research. I am grateful to Dr. C. Michael York and Dr. Charles V. Riche for their comments and suggestions as the thesis took on its various forms approximating the final product. Very special appreciation goes to David M. Pincus, friend, confidant, and guinea pig, and to G. David Gentry for his help both in assembling my equipment and in the computer analyses.

This thesis is dedicated to my wife, Elizabeth, who makes it all possible,

and to Anne.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF ILLUSTRATIONS

SUMMARY

Conflicting predictions of performance under continuous reinforcement and intermittent reinforcement provided by expectancy and operant approaches to motivation were tested using a within-subject design. Subjects performed a complex coordination task with manipulations of feedback and instructions with money or nonredeemable points serving as reinforcers. Different variables predicted trends in the data depending on the type of reinforcer used. Expectancy variables and equations did not account for trends in the data nor a significant amount of the response variance. Decrements in response rate were attributed to a loss of information associated with intermittent reinforcement schedules instead of having a motivational basis. An ability measure multiplied by perceptions of equity of payment was the best predictor of performance, suggesting support for generalizations from operant experiments with some supplementing by a motivational construct.

CHAPTER I

THE HISTORICAL AND THEORETICAL BASES OF RESEARCH IN INDUSTRIAL INCENTIVE SYSTEMS

The notion of directly tying reward to performance to improve performance in a work setting is certainly not a novel one, nor have the results been consistent and easily interpretable. Advances in experimental technology and methodology have only relatively recently allowed an investigation of the results of such practice in a scientific manner. Such investigations have led to an attempt to quantify human motivation levels to allow for reliable prediction of performance. As could be expected, prediction of motivation becomes a very complex process when one considers the many factors which first must be considered as primary influences of behavior and then must be considered as they interact. Determinants of motivation can theoretically be within the organism as well as within the environment.

Various approaches to the prediction of motivation place different emphasis on the role of such determinants. One such approach has been labeled "expectancy theory" and is the most widely cited approach to motivation measurement in industrial-organization literature. It emphasizes subjective perceptions of the value of outcomes and the subjective probability of attainment of those outcomes.

Another approach to the prediction of work behavior has its foundation in operant technology and its associated laboratory results. The operant approach has often been characterized by its lack of use of cognitive constructs, rather than basing prediction of future behavior on the observation of past behavior and the organism's interaction with the environment.

Both expectancy theory and the operant approach have value in the prediction of work behavior. In some instances they predict conflicting results for particular situations, and those instances should be investigated. In some instances they can perhaps be combined to enhance the prediction of performance. And in some instances, they should perhaps "borrow" from other theories for prediction of motivation to increase their power.

The initial question is whether incentive plans actually work. Studies undertaken in industrial settings suggest that under proper conditions the possibility of significantly increasing production with the implementation of a monetary incentive system is well worth considering. Wyatt's (1934) classic study reported results in a work organization in which the employees were switched from the typical fixed weekly pay system to a competitive bonus system related to individual productivity. Production increased 46% and this level of performance was maintained for fifteen weeks. A piece-rate system was then introduced which caused a further increase in production of 30%. This level was maintained for twelve weeks, which marked the end of the study.

Viteles (1953) reported a study in which the employees were switched to an individual incentive plan. The results showed a plant-wide increase in production of 16% as well as lowering the accident rate and increasing cooperation with the supervisors. Studies of this nature are often confounded by concurrent changes in the system which accompany such changes in policy. However, in the case of the Western Electric studies (Roethlisberger and Dickinson, 1939), no other changes were implemented except the variation in pay allotment. The production increase was 16%.

Subjects performing tasks in laboratory settings, when told that the amount of money they would earn would be dependent on the effectiveness of their performance, have demonstrated a higher level of performance (Atkinson and Reitman, 1956; Atkinson, 1958; Kaufman, 1962). Cherrington (1973) reported that subjects who were rewarded for performance not only indicated greater satisfaction with their pay but also greater satisfaction with their fellow workers, supervisors, and the task itself.

Expectancy Approaches to Work Incentive Systems

The most widely cited attempt to construct a performance formula is that suggested by Vroom (1964) which has its roots in the works of Tolman (1932) and Lewin (1935, 1938) and states:

$$\text{Motivation} = E \times \Sigma IV$$

where E = expectancy, I = instrumentality, and V = valence. This model is actually a combination of two other models suggested by Vroom (1964). The first is his valence model:

$$V_j = f \sum_{k=1}^{n} (V_k I_{jk})$$

where

V_j = the valence of outcome j

I_{jk} = the cognized instrumentality of outcome j for the attainment of outcome k

V_k = the valence of outcome k

n = the number of outcomes

Perceived instrumentality is defined conceptually by Vroom as the degree to which the person sees the outcome in question as leading to the attainment of other outcomes. Valence is the perceived or anticipated value of an outcome to the individual (Lewin, 1938; Tolman, 1959).

The second model predicts the force toward behavior:

$$F_i = \sum_{j=1}^{n} (E_{ij} V_j)$$

where

F_i = the force on the individual to perform act i

E_{ij} = the strength of the expectancy that act i will be followed by outcome j

V_j = the valence of outcome j

n = the number of outcomes

The concept of force is a Lewinian concept similar to Tolman's performance vector (1959), Atkinson's aroused motivation (1958), Luce's new subjective expected utility (1962), and Rotter's behavior potential (1955).

Vroom defines the individual's expectancy as his belief concerning the probability that the behavior in question will be followed by the outcome of interest. While expectancies are perceived probabilities (action - outcome), instrumentalities are perceived correlations (outcome - outcome) (Mitchell, 1974).

Camann and Lawler (1973) choose to expand the composite model to provide greater explanation.

$$\text{Motivation} = (E \rightarrow P) \times \Sigma\ [(P \rightarrow O)\ (V)]$$

where E = effort, P = performance, O = outcome, and V = valence. $(E \rightarrow P)$ is equivalent to Vroom's expectancy and is the belief that successful performance is possible if effort is expended. Graen (1969) describes this portion of the equation as a person's perception (subjective probability) of how his actions may be related to the attainment of first-level outcomes. Although expectancy may be the least investigated of the variables found in the complete model, most evidence seems to support its usefulness. Studies by Schuster Clark, and Rogers (1971), Arvey (1972), and Motowidlo, Loehr, and Dunnette (1972) all similarly conclude that individuals with low expectancies perform lower than subjects with high expectancies. The role of expectancy was demonstrated by House (1971) wherein managers who increased expectancies got increased responsiveness to incentives. Less direct evidence comes from studies in which expectancy and instrumentality are combined into an effort-outcome ($E \rightarrow 0$) measure. Studies using this measure (Hackman and Porter, 1968; Lawler and Porter, 1967; Porter and Lawler, 1968) report positive relationships between this composite and performance. Negative evidence is reported by Pritchard and Sanders (1973) who reported a correlation of .14 between expectancy and self-reports of effort.

Vroom conceptualized expectancy as a probability and it is usually measured as one. Most commonly it is treated as a probability with values from .00 to 1.00 (Arvey, 1972; Holmstrom and Beach, 1973; Mitchell and Pollard, 1973; Pritchard and Sanders, 1973).

($P \rightarrow 0$) is equivalent to Vroom's instrumentality, the belief that a given performance will be instrumental in attaining a given outcome. That is, a person's attitude toward an occurrence (outcome) depends on his perception of how that outcome is related (instrumental) to the occurrence of other more or less preferred consequences (Graen, 1969). Whereas expectancy involves variables internal to the operator and perhaps the man-machine interaction, instrumentality involves the more complex interactions stemming not only from his work personality but also from his work role (Graen, 1969), thereby involving the effects of his interaction with his co-workers. Schwab (1973) reports the highest instrumentality perceptions for piece-rate workers followed by group incentive workers, and lowest for hourly-paid employees. Yet Schwab and Dyer (1973) report that instrumentality is not related significantly to performance, although valence and expectancy perceptions are.

Experimental attempts to manipulate instrumentality have produced mixed results. Jorgenson, Dunnette, and Pritchard (1973) were able to manipulate instrumentality in a temporary organization formed for experimental purposes. The results indicated a higher level of performance for individuals in a high instrumentality (piece rate) system than for those in a low instrumentality (hourly) system. Yet Arvey (1972) compared subjects who had a .75 probability of earning extra participation points (high instrumentality) with those who had a .25 probability (low instrumentality) and found no difference in performance. Most researchers treat instrumentality as a probability, much like expectancy (Mitchell, 1974).

Valence represents the third major variable found in Vroom's prediction equation. Valence is defined as ". . . affective orientations toward particular outcomes" (Vroom, 1964), or the degree of desirability of an outcome for an individual. The valence of an outcome can be positive, negative, or neutral. Its directionality is based on individual preference for a designated outcome. Pritchard and Sanders (1973) report valence to be the best single predictor of performance, rather than expectancy, instrumentality, and all multiplicative and additive groupings of these factors. On the negative side, Hackman and Porter (1968) found a median correlation of .16 between measures of performance and valence outcomes in a survey of telephone operators.

Valence measures should range from positive to negative, although few studies use this format (Vroom, 1966; Dackler and Mobley, 1973; Galbraith and Cummings, 1967; Mitchell and Nebeker, 1973; Pritchard and Sanders, 1973). More commonly used are scales with all positive values.

Porter, Lawler, and Hackman (1975) report that research on the importance of rewards suggests that promotion and pay are the most highly valued extrinsic rewards that organizations have to offer. But pay is most often the choice for reward systems due to its flexibility as compared to promotion. The valence of pay is subject to great individual differences as well as moderating influences over time. On one level, Marriott (1957) points out that in countries where the standards of living are high, the basic necessities of life do not act as strong motivating forces except in times of severe economic depression. In such countries the problem is that of maintaining a standard of living instead of securing the basic needs of existence. There is the possibility that the incentive valence may decrease in strength as it becomes more removed from the primary needs.

Numerous attempts have been made to identify individual differences in pay valence among employees. Dalton (1948) distinguished between people for whom pay is important ("rate-busters") and those for whom it is less important ("rate-restrictors"). He observed the rate-busters to be country-born, lone wolf, Republican, money saving, and investing workers without outside interests. The restrictors were found to be city-born, gregarious, New Deal Democrat, spending workers. Lawler's (1971) blue collar data demonstrated that men have a higher pay valence than women and that married individuals have higher pay valence than single individuals. Yet Schwab (1973) found no valence correlation with sex, age, or amount of payment. He also did not find a valence difference between piece-rate and group incentive workers but he did find a slightly higher valence for both these groups over the hourly workers. There are other factors which can influence pay valence, perhaps accounting for reports that variations in the amount of reward have no consistent effects upon performance by human subjects (Bruning, 1964; Elliott, 1966; Lewis and Duncan, 1961). Lawler (1973) suggests that the importance of pay is influenced by pay satisfaction, job level, and pay determination. Klein and Maher (1966) reported an increase in pay dissatisfaction as education level increases. It has also been shown that effective performance itself may constitute a reward as well as a means to the attainment of reward (Lowell, 1952; Atkinson and Raphelson, 1956). It is also possible that there may be a substantial discrepancy between the anticipated satisfaction from an outcome (i.e., its valence) and the actual satisfaction that it provides (i.e., its value).

According to the equity theory proposed by Adams (1963, 1965), an individual must make an evaluation of his input-output balance of a "comparison other" (Lawler, 1973). A rational process of valence determination was suggested by Wyatt, Frost, and Stock (1934) from their findings that output seems to become stabilized at a level which is proportional to the strength of the monetary incentive.

The Role of Ability and the Criterion

A variable not included in Vroom's model is ability; yet he states that ". . . a worker's level of performance on his job is dependent both on his ability and on his motivation" (1964, p. 198). Ability factors could include: 1) the probability that the worker will discriminate between stimuli requiring different responses, 2) the worker's knowledge of the correct response to perform to each stimulus, and 3) the worker's capacity to execute the correct response (Vroom, 1964). Vroom (1964) suggests an interaction between ability and motivation of the following nature:

$$\text{Performance} = f\ (\text{Ability} \times \text{Motivation})$$

House, Shapiro, and Wahba (1974) point out that such a formula would indicate that when ability has a low value, increments in motivation will result in smaller increases in performance than when ability has a high value. Similarly, when motivation has a low value, increments in ability will result in smaller increases in performance than when motivation has a high value. Yet Heneman and Schwab's (1972) review indicates that in most studies ability is unrelated to performance. Methodological limitations may account for the lack of positive results.

When the discussion of ability, effort, and performance is begun, the question of the suitable criterion for the model must be answered before the literature can be surveyed for tests of the composite expectancy model. The model attempts to predict choice or effort, with most research activity being directed at the latter. In most cases, effort has been estimated in terms of self, peer, or supervisor ratings (Mitchell, 1974). The problem becomes one of providing a universally accepted definition and description of what "effort" specifies. Effort is a continuous dimension which is very hard to define.

Even if some definition can be agreed upon, the use of ratings is beset by many problems. When the supervisor is the rater, the most serious problem may be one of opportunity to observe (Campbell and Pritchard, 1976). When self-ratings are used, the individual must provide the ratings of both the independent (expectancy, instrumentality, and valence) and dependent variables. Any correlation could be possibly due to large increments of a common method variance (Campbell and Pritchard, 1976).

In view of the problems inherent in the use of ratings, many researchers attempt to use performance measures as the criterion. Yet Vroom clearly distinguished between effort and performance. As noted earlier, Vroom (1964) generated an entirely separate model for the prediction of performance, as did Lawler and Porter (1967). Many studies continue to use a performance criterion for a model which is meant to predict effort.

Results Using the Complete Model

Mitchell (1974), Wahba and House (1974), and Campbell and Pritchard (1976) have among them thoroughly sampled the available literature on use of the expectancy model as a predictor of behavior. The consensus is that correlations with performance or independent ratings of effort can be expected to usually fall at or below the .30 level. Wahba and House (1974) do report that concurrent and predictive validity coefficients using the model range from .72 for prediction of job satisfaction (Mitchell and Albright, 1972) to as low as .11 for prediction of performance (Lawler and Porter, 1967). Campbell and Pritchard (1976) note that virtually the only time that correlations exceed the .30 level is when self-rated effort is the criterion. As noted earlier, these correlations may be inflated by method variance, which makes their interpretation very tenuous. Campbell and Pritchard also have come to the conclusions that: 1) the multiplicative model only slightly improves on predictions using the individual components alone, and 2) brief aptitude or general intelligence tests usually account for more variance than the motivational variables when a simple repetitive task is used as the dependent variable.

Refinement of the Vroom Model

These determinants of behavior have promise for the prediction of future behavior upon the manipulation of relevant factors in the work setting. As is found in many attempts to quantify behavior as Vroom has attempted to do, the equations are too simplistic to predict behavior reliably across all settings. Two attempts to improve the predictability of the model would be: 1) studying the interaction of the relevant variables and 2) basing predictions on past behavior. Jablonsky and DeVries (1972) suggest that focus on the interaction effects gives a stronger prediction of human behavior. Many interacting variables have been conceptualized and shown to affect production. Marriott (1957) listed fifteen variables which he believes can interact to influence the effect of incentive pay systems. These variables are grouped into three categories: situational determinates, intra-individual determinants, and multiple reward contingencies.

Marriott's list accounts for many of the determining factors but is by no means exhaustive. Pritchard and Curtis (1973) found goal-setting to be a factor in influencing performance, although not a necessity for good performance. This suggests the possibility that establishing objectives may satisfy secondary needs of achievement and recognition. The positive effect of goal-setting on performance and satisfaction has been shown in laboratory studies (Hamner and Harnett, 1974; Ilgen and Hamstra, 1972; Locke, 1968; Locke, Cartledge, and Knerr, 1970) and in at least one field study (Latham and Kinne, 1974). Ronan, Latham, and Kinne (1973) report that goal-setting has a positive effect on performance in an industrial setting only when accompanied by supervision. Heiman (1975) believes that the value of the source of an outcome can influence the value of the outcome in conflict situations, like those which may be a product of management-peer disagreement.

In relation to Vroom's formula ($M = E \times \Sigma\ IV$), Matsui and Terai (1975) found an interaction between the E and IV components such that individuals with a high IV score are more influenced by expectancy variations than are those individuals with low IV scores. Other interesting factors have been shown to be need for achievement (French, 1955), knowledge of results (Ammons, 1953; Bilodeau and Bilodeau, 1961; Braunstein, Klein, and Pachla, 1973; Hundal, 1969), and reliable information about the plan (Camann and Lawler, 1973). The role of groups is also worth consideration. Lower productivity with increases in group size (Marriott, 1949) has been shown to be due in part to the decrease in the relationships individuals "see" between pay and performance (Campbell, 1952). Yet, groups can encourage cooperation and eliminate problems found in individual incentive plans such as restrictive norms and competition.

House et al. (1974) have suggested an alternative prediction formula which states:

$$\text{Motivation} = f\{IV_b + E[IV_a + \Sigma(IV)]\}$$

where

V = Valence

I = Instrumentality

E = Expectancy

IV_a = Intrinsic Valences of Accomplishment; those associated with task accomplishment, such as pride in the work or the satisfaction of achieving a challenging goal.

IV_b = Intrinsic Valences of Behavior; those associated with task performance, such as the development of valued skills or social satisfaction.

Berger, Cummings, and Heneman (1975) tested a somewhat simpler version of the above formula:

$$\text{Motivation} = f(IV_a + IV_b + E + I + V)$$

This combination of variables was found to be significantly

($p < .01$) related to performance in one time period using a secretarial task with females over an extended period of time.

Wyatt (1934) suggested one other factor which has since been shown to be important in behavioristic studies, that factor being the role of rate of responding and rate dependency. Wyatt was able to show that increased motivation resulting from the use of economic incentives had a greater effect on the level of performance of those who were initially performing at a relatively high level than on those who were initially performing at a relatively low level.

Money as a Reinforcer

An "incentive" has been defined by English and English (1958) as "an object or external condition, perceived as capable of satisfying an aroused motive that tends to elicit action to obtain the object or condition." Much of the discussion centers on a definition of the "aroused motive." A widely held hypothesis is that money acts as a generalized conditioned reinforcer because of its repeated pairings with primary reinforcers (Holland and Skinner, 1961; Kelleher and Gollub, 1962; Skinner, 1953). Skinner (1953) stated that such a generalized reinforcer should be extremely effective because some deprivation will usually exist for thich the conditioned reinforcer is appropriate. As an example, Skinner (1953) showed that, using rats and a T-maze, a goal box paired with both food and water deprivation (wet mash being the reinforcer) proved to be a more effective reinforcer than different goal boxes paired with either food or water deprivation. The analogy is made between the wet mash and money, both supposedly acting as generalized reinforcers. One problem with this example is that the difference in reinforcing quality was actually quite small in the above experiment.

Dollard and Miller (1950) claimed to have shown that repeated pairings of money with primary reinforcers establish a new learned drive for money. They attempted to illustrate this by using monkeys working for tokens (poker chips). The monkeys would work for tokens but not unexpectedly refused to work when given a free supply of chips. Therefore, it can be assumed that the act of obtaining the chips serves as a drive reducing function. Yet token studies pair poker chips only with the association with removing a deprivation in a single primary area (food) while money is valued independent of any particular state of deprivation (Opsahl and Dunnette, 1966).

Support for money as a generalized reinforcer is limited and inconclusive. Equally inconclusive are more theoretical approaches to the question of the properties money possesses. Vroom (1964) sees money as an "instrument for gaining desired outcomes." That is, if money is perceived by a given person as instrumental to obtaining security, and if security is desired, money itself acquired positive valence. Brown (1953, 1961) sees money as an "anxiety reducer," suggesting that one becomes anxious in the presence of cues signifying the absence of money and money produces cues for the cessation of anxiety. There seems to be no proof for this theory as of yet. Perhaps money is a "hygiene factor" (Herzberg, Mausner, and Snyderman, 1959). This theory would suggest that money serves as a potential dissatisfier, but not as a satisfier. Therefore the main value of money is that it leads to both the avoidance of economic deprivation and the avoidance of feelings of being treated unfairly. There is no conclusive evidence to support this theory either (King, 1970).

Operant Approaches to Incentives

The current literature suggests operant technology as a means for improving behavior prediction. Heiman (1975) points out that the reinforcing properties of an outcome resemble "valence" and the contingency between behavior and rewards resembles "expectancy." The ahistorical problems found in cognitive expectancy theories can be bypassed in favor of various reward contingencies. Expectancy theories make no reference to past behavior and only consider the state of the organism at the moment. An "operant" strategy would add empirical evidence and historical referent to the concepts of expectancy and valence. Heiman's rationale is that predictability would be increased since past performance and the interaction with the environment are the most valid and reliable predictors of future behavior. Jablonsky and

DeVries (1972) believe that three things are needed for prediction of behavior: 1) historical relationships between the individual and administering agent, 2) strength of reinforcers, and 3) schedules of reinforcement. They cite the advantages also mentioned by Heiman (1975) as well as the utilization of definitions of reward and punishment.

The reported failure to demonstrate success with operant methods in industrial settings may be due to many things, the most basic of which may be the notion that Skinnerian applications may be too general or simple to apply to complex social situations and complex social organisms. Modest results have been obtained showing better performance under variable ratio schedules over continuous reinforcement schedules in laboratory settings (Yukl, Wexley, and Seymour, 1972). In addition, a field experiment revealed that continuous reinforcement produced higher productivity than two variable ratio schedules with equal reinforcement probabilities (Yukl and Latham, 1975). Such a finding presents a basis for questioning the generalizability of operant data obtained from laboratory situations using animals. Beginning with the reports of Ferster and Skinner (1957), such data has consistently shown intermittent reinforcement to be superior to regular or continuous reinforcement when examining rate of response, error rate, and resistance to extinction. For example, using chimpanzees and a complex response, Ferster (1958) reported that behavior was maintained considerably more accurately under intermittent reinforcement than under continuous reinforcement. Sidman (1960) believes that "(E)ven though intermittancy does not have the same quantitative effect in all cases . . . the fact that the variable is so widely effective is an important generalization" (p. 57).

Results such as those reported by Yukl and Latham (1975) in a field study could present a serious problem for those who wish to generalize laboratory findings like those reported above to industrial situations. As Campbell and Pritchard (1976) note, the expectancy model would assert that the greater the individual's instrumentality, the greater the effort expended, other things being equal." However, on their face the laboratory data on reinforcement schedules do not support this assertion and any garden variety Skinnerian would opt for a probability considerably less than 1.0" (Campbell and Pritchard, 1976; p. 84). Explanations for such findings could include: 1) it may be true that social situations add dimensions that counteract schedule effects, 2) both studies actually used mixed schedules where the incentive was used in addition to the typical hourly wage, and 3) the field study used manual laborers whose level of education (and perhaps intelligence) was lower than that of the subjects employed in laboratory studies which used college students.

Another possibility is that Vroom's model may actually be more applicable to complex work settings, since the expectancy model would predict continuous reinforcement to be superior to any other schedule. The following study relates an investigation of such a possibility.

CHAPTER II

A STATEMENT OF THE PROBLEM

The present study represents an alternate means of testing and explaining the major relationships proposed by expectancy and operant approaches to work incentive systems. Conflicting results in the literature will perhaps receive clarification through this laboratory experiment. Specifically, this study attempts to determine if expectancy approaches or operant approaches better predict performance in a laboratory setting where environmental variables can be controlled and manipulated.

Table 1 shows values for different reward congingencies as explained by expectancy theory (Vroom, 1964) and operant learning terminology. Expectancy (E) is shown as the objective probability that a reward will be given for a single response. In situations where the incentive plan is known and understood, this should equal the subjective probability of reinforcement. For illustrative purposes, Valence (V) is shown as +1, or 0, +1 being a positive valence usually associated with money. Force (F) or motivation is the product of the expectancy and valence components.

It is evident from Table 1 that motivation should be greatest when expectancy is 1.0 and the valence is +1, assuming that ability and opportunity to perform are held

Table 1. Expectancy and Operant Treatments of Reinforcement Schedules

E	×	V	=	F	Schedule
1.0		+1		+1.0	CRF
0.5		+1		+0.5	VR2
0.2		+1		+0.2	VR5
0		+1		0	Extinction
1.0		0		0	No reinforcer

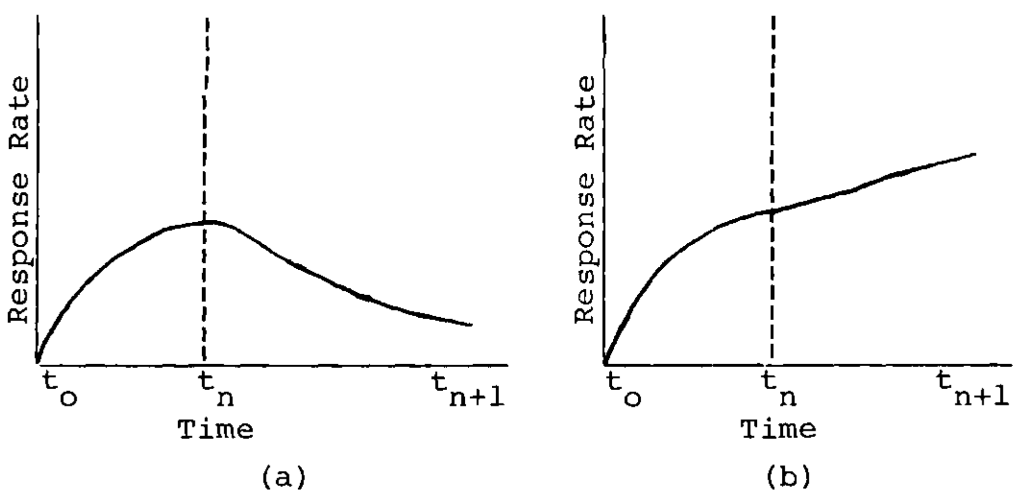

Figure 1. Expectancy (a) and Operant (b) Predictions of Results of Changing from CRF to VR2 at Point t_n (from Mawhinney and Behling, 1973).

constant. This is the same as a continuous reinforcement (CRF) schedule in operant terminology. If expectancy is reduced to .5, the Force product is reduced, predicting poorer performance. This is analogous to a variable ratio (VR2) schedule in which the subject receives reinforcement with every two responses on the average. Operant experiments have repeatedly shown intermittent reinforcement, such as in a VR2 schedule, to be superior to regular reinforcement, such as in a CRF schedule in regard to rate of response, resistance to extinction, and error rate (Ferster and Skinner, 1957; Ferster, 1958; Sidman, 1960).

Under the above conditions, expectancy and operant approaches predict conflicting results. Studies have been done to attempt to demonstrate which theory operates in experiments using human subjects. A laboratory study done by Yukl et al. (1972) showed the VR2 schedule to be superior to the CRF schedule, thereby supporting operant data. A field study by Yukl and Latham (1975) produced opposite results, supporting the expectancy model. Both studies have experimental design problems. The most important difficulty may lie in the treatment of the subjects in which different groups are each given only one schedule exposure, either CRF or VR2. Mawhinney (1975) mentions that reinforcer values (valence) may differ among individuals and that operant principles apply to the individual. Therefore the between-subjects design may confound schedule and reinforcer effects. Mawhinney (1975) believes that if the operant versus expectancy question is to be adequately tested, a within-subject design is needed.

Figure 1 shows what a within-subject design would predict from two approaches. If a CRF schedule is instigated at time t_0 and changed to a VR2 schedule at time t_n, expectancy theory would predict a decrease in performance while an operant explanation would predict an increase or at least maintenance of response rate.

As previously mentioned, expectancy can be equated with objective probability when the contingencies are understood by the subject. The question arises as to what variables and predictive approaches operate when such information is vague or withheld. Camann and Lawler (1973) state that for an employee to respond to an incentive plan, he must have understandable information as to the payoff structure. Motowidlo, Loehr, and Dunnette (1972) report a modest correlation of .29 between objective probability of reward and subjective estimates of expectancy when instructions as to payoff probability are withheld. Feedback as to performance can give varying degrees of information concerning contingencies depending on the amount of information the feedback provides as well as the perceptiveness of the subject. It must be determined if the effects of feedback (Ammons, 1953; Bilodeau and Bilodeau, 1961; Braunstein, Klein, and Pachla, 1973; Hundal, 1969) and the effects of instructions (Camann and Lawler, 1973) are due to their roles in determining whether expectancy or operant approaches predominate, or are due to other factors.

In addition to the effects of feedback and instructions, the present study also examined effects which might be attributed to different reinforcers. In a simulated work environment, money would be the logical reinforcer. Under other conditions which have been shown to maintain responding, such as a game condition, nonredeemable points might be a sufficient reinforcer. Experiments using human subjects have used both forms of reward to test theories and maintain responding with little investigation of what the reinforcer actually is and what effects it might have on the results of the study.

The experiment presented here uses a within subject design to examine operant and expectancy prediction of performance under conditions where feedback, instructions as to reward contingencies, and types of reinforcers are manipulated as subjects respond under both CRF and VR2 schedules of reinforcement.

CHAPTER III

METHOD

Subjects

Sixty-four students (54 males, 10 females) at the Georgia Institute of Technology served as subjects. Descriptive statistics are provided in Table 2. Thirty-two of the subjects received money for participation in the study, the amount of pay depending on performance. These students were recruited through the use of notices in the Psychology Department and in the Student Center. The remaining subjects received course credit for introductory psychology courses.

Apparatus

The primary task was performed on the Langley Complex Coordinator.[1] The stimulus board is represented in Figure 2 and rests at approximately eye level. It consists of four vertical pairs of rows of colored lights. Each pair is associated with a limb of the body. For instance, the upper left pair of rows is controlled by forward and backward movements of a stick held in the left hand. The left hand columns in

[1]The apparatus used in this experiment was obtained through an equipment loan to Dr. R. M. Chambers from the Langley Research Center, National Aeronautics and Space Administration, Hampton, Virginia. The psychomotor testing device used in the experiment is undergoing experimental test and evaluation, and is titled the Langley Complex Coordinator (NASA Control No. 75315-1, NASA Inventory No. 152432).

Table 2. Group Statistics for Variables Measured by the Questionnaire

Variable Name	Explanation	Mean	Std. Dev.	Min.	Max	Notes
EQUITY	Fairness of pay	4.344	1.004	2.0	6.0	7 point scale; N = 32
EFFORT	Effort Rating	5.859	1.052	2.0	7.0	7 point scale
EXPCTY	Expectancy	4.922	3.282	0	10.0	
INSTY	Instrumentality	6.391	3.481	0	10.0	
IVA	Intrinsic value of task	3.500	1.469	1.0	7.0	7 point scale
IVB	Intrinsic value of performance	4.203	1.493	1.0	7.0	7 point scale
NACH	Need for achievement	15.484	4.213	8.0	25.0	
VALMONI	Valence of money	31.563	8.085	3.0	48.0	Pre-experimental measure
VALMON2	Valence of money 2	31.734	7.499	10.0	48.0	Post-experimental measure
SEX	Sex of subject	1.156 (54 males, 10 females)	.366	1.0	2.0	1 = male; 2 = female
CLASS	Year in school	2.344	1.211	1.0	5.0	1 = Freshman 5 = Grad. stud.
VALGAMI	Gambling Valence 1	16.266	4.701	2.0	24.0	Pre-experimental measure
VALGAM2	Gambling Valence 2	15.594	4.879	0	24.0	Post-experimental measure
AGE	Age of S	19.858	2.356	17.0	28.0	
GPA	Grade Point Average	2.675	.587	1.60	4.0	4 pt. scale, N=57
SUPPORT	Pct of school S pays for	48.875	40.682	0	100.0	

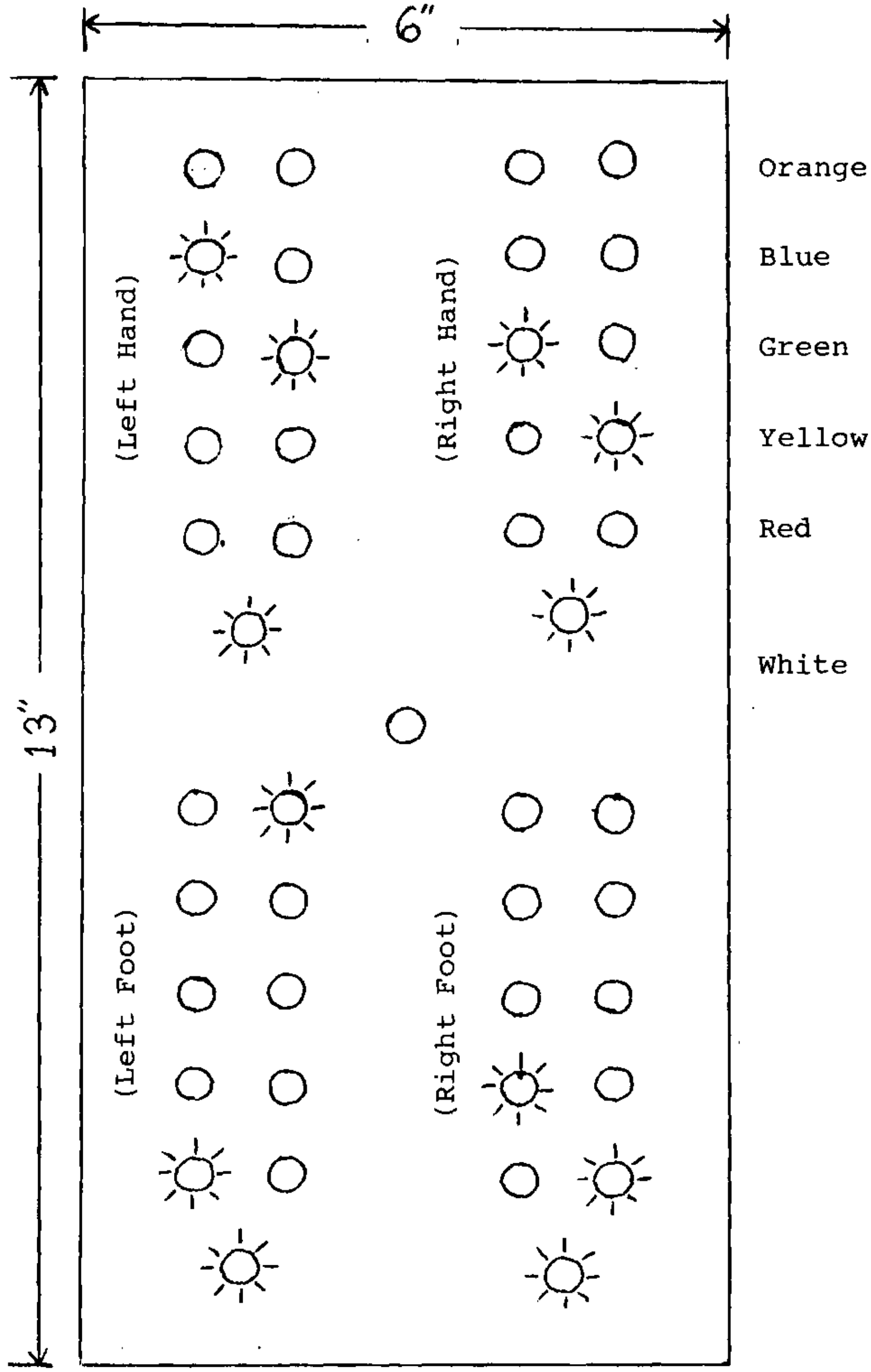

Figure 2. The Stimulus Board and the First Problem.

each pair of colored lights give the problems and are referred to as "problem lights." The lights in the right hand columns are activated through movements of hand sticks by each hand and floor pedals by each foot. Figure 2 illustrates the first problem given the subject as well as the correct answers. When the four white lights below the set of colored lights were activated, the subject had to move the manipulanda until the "moving" lights were one light, or step, below each problem light. For this problem, the blue light for the left arm was activated, requiring the lighting of the green light in the next column. When the correct answer was made for each set of lights, a new problem automatically appeared. For some problems the four white lights went off and the single white light in the middle came on. In this instance the subject had to match the lights one step above each of the problem lights. There were a total of 50 problems which were repeated. All subjects began with the first problem indicated in Figure 2. Immediately below the stimulus board were a counter and a buzzer. Programming and recording instruments were housed in a separate room from that used by the subjects.

Procedure

The subjects were seated at the Complex Coordinator Apparatus in an experimental room. They were told that instructions were to be given from the next room through a single speaker located a few feet away. The experimenter left the room and immediately gave the following instructions through the speaker system.

> In front of you is the complex coordinator apparatus. Reach out with your left hand and grasp the left control stick. Move it forward and backward a few times. (Pause) Now move the stick until the moving light is one step below the light in the next column and hold it there. (Experimenter says "That's right" if the correct answer is made. If not, the preceding sentence is repeated until the correct answer is made.) This is a correct match for the left arm when the four white lights are lit as they are now. Now take your hand away.
>
> A correct response is made for this machine when the four white lights are on by simultaneously moving the two sticks with your hands and the two floor pedals with your feet until all four lights are one step below the colored problem lights in the next columns, just as you did with your left hand. When the single white light in the middle comes on, you must match the lights one step <u>above</u> each colored problem light. Let me repeat: when the four lights are on, match one step below each problem light. If, for instance, you are to match one step above the top light, the correct answer would be the bottom light. When you have correctly matched all four sets of lights, a new problem will automatically appear. When I say begin, you will work for five minutes after which I will tell you to stop and rest. Get ready,and begin.

At this point the subject began working for a five minute unrewarded session. If the subject did not get an answer in the first 30 seconds, help was given, usually consisting of telling the subject that "the correct answer for the left leg is the top light," since this transfer was not always understood (see Figure 2). The second problem was of the "matched above" nature. If no answer was given for any extremity for fifteen seconds, the subject was told, "you should now be matching one step above each light." No further help was given and all subjects proceeded well from here on.

Following the five minute session, the subject was given a two minute rest period. After the rest period, the subject was given five 10 minute sessions with 2 minutes rest between each session. During the first three sessions each correct response was worth one cent (or point). During the last two 10 minute sessions each correct response was worth one cent (point) 50 percent of the time on a random basis (Variable Ratio 2). Before beginning the next work period, he was given instructions depending on the experimental treatment. The design was a 2×2×2 factorial design with 8 subjects per cell (one additional cell was added later and will be explained in the Results section). The first independent variable determined if the subjects received performance-dependent money or non-redeemable points (subjects working for points received class credit regardless of performance). The second independent variable determined if instructions were given (I) or not given (NI). The third independent variable determined if feedback was given (F) or not given (NF). Below are the instructions for each cell in the money condition. Numbers before statements indicate which sessions the instructions precede.

Group 1 (IF):

1) When I say to begin, you will work for ten minutes. Each time you make a correct response, you will earn one cent. Each penny earned will be registered on the counter in front of you and a buzzer will sound like this . . . to tell that you have earned a penny. There is no limit to how much you can earn in the time given.

2,3) When I say to begin you will work for a ten minute session.

4) During the next two ten minute sessions each correct answer will be worth a penny fifty per cent of the time. That is, there will be a 50-50 chance that you will get a penny with each correct response. When you earn a penny, it will still be registered on the counter and the buzzer will sound. When I say to begin you will work for a ten minute session.

5) When I say to begin you will work for a ten minute session.

Group 2 (I-NF):

1) When I say to begin you will work for ten minutes. Each time you make a correct response you will earn one cent. A machine in the next room will keep track of how much you have earned and you will be paid at the completion of the experiment. There is no limit to how much you can earn in the time given.

2,3) When I say to begin, you will work for a ten minute session.

4) During the next two ten minute sessions, each correct answer will be worth a penny fifty per cent of the time. That is, there will be a 50-50 chance that you will get a penny with each correct response. A machine in the next room will keep track of how much you have earned. When I say to begin, you will work for a ten minute session.

5) When I say to begin, you will work for a ten minute session.

Group 3 (NI-F):

1) You are going to be paid according to your performance. The amount you receive will depend on how well you do. When I say to begin, you will work for ten minutes. A buzzer will sound like this . . . and the counter in front of you will operate to tell you that you have earned a penny. There is no limit to how much you can earn in the time given.

2-5) When I say to begin, you will work for a ten minute session.

Group 4 (NI-NF):

1) You are going to be paid according to your performance. The amount of pay you receive will depend on how well you do. When I say to begin, you will work for ten minutes. A machine in the next room will keep track of how much you have earned and you will be paid at the completion of the experiment. There is no limit to how much you can earn in the time given.

2-5) When I say to begin, you will work for a ten minute session.

Subjects working for points instead of money received modified instructions with "points" replacing "money" references. A line was also inserted stating that the points were for the information of the subject only (i.e. nonredeemable).

CHAPTER IV

RESULTS

Questionnaire Contents and Item Reliability

Questionnaires were administered to the subjects pre- and post-experimentally to obtain demographic information as well as subject reactions to expectancy and motivation oriented questions. A pilot sample of nine subjects was tested twice with a one week interval to provide test-retest reliability estimates. These subjects received class credit and no pay for participation. A copy of the questionnaire is provided in Appendix A.

All demographic variables proved to be perfectly reliable in a test-retest measure. These variables included sex, age, year in school, marital status, major, grade point average, financial aid, and percentage of schooling subject pays for. Correlations are test-retest measures unless otherwise noted.

Equity: A seven-point scale was used post-experimentally to measure fairness of pay perceptions for those subjects who received money for participation (N=32). Test-retest reliability was not obtained on this question exactly since the pilot subjects received no pay. Instead they were asked for judgments as to what fair pay should be considering the time and effort expended. Responses ranged from nothing (no pay) to $10.00 with a mean of $4.13 ($r = .93$).

Effort: A seven-point scale measured self-reports of effort expended ($r = .64$).

Subjective Probability of Reinforcement: Subjects were asked post-experimentally for an estimate of the number of reinforcements given on the average for every ten correct responses ($r = -.57$).

Expectancy: An expectancy measure was obtained post-experimentally as the subjective probability (chances in 10) that an increase in effort would lead to better performance ($r = .55$).

Instrumentality: Instrumentality was measured post-experimentally as the subjective probability (chances in 10) that an increase in performance would lead to more pay (or more points) ($r = .04$).

Intrinsic Valence of the Task: IV_a was measured post-experimentally using a seven point scale concerning the value of learning the task ($r = .81$).

Intrinsic Valence of Accomplishment: IV_b was measured post-experimentally using a seven-point scale concerning the value of doing well on the task ($r = .90$).

Valence: The valence of 13 possible outcomes was measured both pre and post-experimentally. Each outcome was rated for its value on a 13-point scale ranging from -6 (Extremely Bad) to +6 (Extremely Good) with a neutral point of 0. Outcomes included receiving money, class credit, recognition, a good grade in a class, and nothing. Also included were outcomes measuring gambling valence. Six test-retest reliability coefficients were calculated on the four administrations of the questionnaire to the pilot groups. Coefficients ranged from .76 (2-3) to .97 (1-4) with a median of .91.

Need for Achievement: NACH was measured pre-experimentally using the 28 items selected from the Edwards Personal Preference Schedule (Edwards, 1959) which measure need for achievement along with two randomly selected "dummy" questions. Scores were calculated as "Right" or "Wrong" on each item with a maximum score of 28 being possible. Test-retest reliability was calculated as .59 for this sample. Other studies reporting test-retest reliabilities for this index use time spans of 1 week and greater as follows: Edwards (1959), 1 week, $r = .74$; Horst and Wright (1959), 1 week, $r = .83$; Mann (1958), 3 weeks, $r = .64$; Caputo et al. (1966), 15 months, $r = .47$. The Kuder-Richardson 20 reliability coefficient for the total sample of 64 subjects was .72.

Analysis of the Effects of the Manipulated Variables

The hypothesized result predicted by a multiplicative expectancy function, i.e., a decrement in performance upon changing schedules from CRF to VR2, is founded upon the idea that such a manipulation cuts the probability of reinforcement in half and that such a manipulation should be reflected in a reduction in the individual's perceptions of instrumentality. Instrumentality is the subjective perception of the connection between performance and reward, usually measured in terms of the probability that a change in performance would be reflected in a change in reward. Although ratio schedules guarantee by definition that a change in performance will be reflected in a change in reward frequency, it is assumed that the subjective instrumentality should be reduced as the ratio increases. Subjects indicated instrumentality perceptions at the end of the experimental session by responding to the question: "What did you feel the chances were that an increase in performance would lead to earning more money (points)? ____ out of 10." If the experimental manipulation of schedule change had its predicted effect, those subjects who received feedback and/or instructions as to reward schedule should have their instrumentalities lowered when compared to subjects receiving no information.

Table 3 shows that the predicted effect was obtained to some extent for those subjects who worked for money but not for those subjects who worked for nonredeemable points. In the money subsample, those subjects who received both types of information (feedback and instructions) showed significantly ($p < .005$) lower instrumentality perceptions when compared to subjects who received only one type of information or no information at all as to reward schedule. No differences were found between the remaining three groups in the

Table 3. Mean Instrumentality Perceptions for Each Cell of the 2×2×2 Factorial Design

		MONEY		
	F-I	NF-I	F-NI	NF-NI
Mean	2.375*	8.125	6.125	7.25
σ^2	2.734	8.359	8.609	8.688
		POINTS		
Mean	6.125	7.375	6.125	7.625
σ^2	11.859	11.234	16.359	4.984

*Student's t statistic shows this value to be significantly ($p < .005$) different from all seven other values.

money subsample nor between all groups in the points subsample. It can also be shown that, in the case of those subjects who received money, individuals who received feedback had lower instrumentality perceptions than those who did not ($t = 3.250$, $p < .005$).

These results suggest that those subjects who received money as reward used the information given through feedback and instructions, while those subjects to whom the information only indicated the presence of nonredeemable points perhaps treated this information as to be of extraneous value, reinforcement perhaps coming more from the task itself than from any manipulation on the part of the experimenter.

Such an hypothesis as stated above can perhaps be strengthened by asking subjects who received feedback, in particular in the form of the counter which kept track of their earnings, how much they had earned for the entire session. Upon leaving the experimental chamber, the first thing the subjects who received feedback were asked to do was to write down how many points/cents they had earned. Out of the 16 subjects in each group who had feedback, three (3) who received money gave inexact reports while eight (8) who received points gave erroneous reports. This again points to the possibility that the information provided may have been only of secondary importance to more of the subjects who received points than to those who received money.

Estimates for the frequency of reinforcement during VR2 underestimated the actual frequency for both the money and points subsamples. Mean estimates for the probability of reinforcement were .408 ($r = .17$, with objective probability) for the money subsample and .406 ($r = .14$) for the point subsample. Due to the use of the probability generator, the actual probability of reinforcement was not the same for each group. The average probability of reinforcement for the money subsample was .477 and .499 for the point subsample. Thus a larger discrepancy was shown between subjective estimates of frequency of reinforcement and objective probability for those subjects working for points.

The results reported concerning instrumentality perceptions and erroneous reports of earnings suggest that, while both money earners and point earners give us valuable information about motivation in such experimental settings, it may be the money group alone which provides the greatest external validity when considering the roles of feedback and instructions in an incentive work program. For this reason, results will be provided for both the total sample and also for the money subsample by itself.

Analysis of Response Curves

In order to see if the change from CRF to VR2 had the result within subjects as predicted by expectancy theory, response totals for each of the five 10-minute sessions were examined. Descriptive statistics for the response measures are provided in Table 4. In its strongest interpretation, expectancy theory would predict an acquisition curve for the three CRF sessions with a progressive decline in responding for the two VR2 trials. A less strong interpretation might predict a motivation decrement, as indicated by a depression in the response rate, but allow for a continued acquisition function.

Table 5 presents response totals for individual subjects which might be interpreted as providing some support for expectancy theory predictions. Three (3) subjects seen to provide strong support for a motivation decrement resulting from the decrease in reinforcement probability, indicated by a lower rate in session 5 than in session 4. For one of

Table 4. Group Statistics for Response Measures

Variable Name	Explanation	Mean	Std. Dev.	Min.	Max.
ANSVR2	Answers during VR2	190.234	37.141	114.0	270.0
ANSCRF	Answers during CRF	235.016	52.864	102.0	325.0
ANSTOT	Answers during entire session	425.250	87.754	216.0	595.0
ERRVR2	Errors during VR2	977.524	240.469	538.0	2164.0
ERRCRF	Errors during CRF	1250.794	253.052	587.0	1737.0
ERRTOT	Errors during entire session	2228.317	464.010	1125.0	3645.0
ABLTYA	Ability in answers, 5 min. unreinforced responding	18.328	8,325	1.0	33.0
ABLTYE	Ability in errors, 5 min. unreinforced responding	141.844	45.657	21.0	232.0

Table 5. Within-subject Support for Expectancy Theory from Response Totals During 5 10-Minute Sessions under CRF and VR2

Subject	Points or Money	Condition	CRF 1	CRF 2	CRF 3	VR2 4	VR2 5
		STRONG					
223	M	F-NI	51	64	72	61	60
307*	P	NF-NI	63	74	83	82	81
322*	P	F-NI	73	92	90	81	78
		MODERATE					
204	M	F-NI	49	70	81	71	79
214	M	NF-I	64	86	101	97	99
232	M	F-NI	62	76	87	77	83
301	P	F-I	70	88	99	89	89
313*	P	NF-NI	82	90	101	96	97
315	P	F-NI	63	72	74	66	69
		WEAK					
201	M	F-I	61	71	86	82	95
205	M	F-NI	18	46	60	55	65
216	M	F-I	70	86	88	87	90
222	M	F-NI	83	95	102	99	104
304	P	F-NI	66	75	85	83	91
308	P	F-I	71	92	107	103	112
312*	P	NF-NI	84	103	116	111	116
323	P	F-NI	70	87	97	94	100
325	P	F-I	50	67	83	80	88
330	P	NF-I	77	97	111	108	122
331	P	F-I	66	66	76	72	77

*The response curves for these subjects meet a priori requirements for possible support for expectancy theory, while other considerations suggest their exclusion from this table as true support.

these three subjects (307), the effect is just barely indicated, with a ceiling effect being possible. In addition, this subject's data could not support expectancy theory since the condition he was in (NF-NI) did not provide information that reinforcement had been halved, as is also the case for subjects 312 and 313. In the case of Subject 322, the downward trend actually began in session 3, suggesting an effect due to causes other than reduction of reinforcement probability. Thus only Subject 223 can provide good support for an expectancy effect. Figure 3 shows this subject's total response curve for the odd numbered trials, a trial defined as a 30 second interval. Reporting every other trial was chosen to reduce the variability in the graph. Since it is possible to work at a rate of 4.5 responses every 30 seconds, for example, recording response counts at these intervals would produce a series of 4,5,4,5 . . . Sampling every other trial therefore removes some of this variability to allow for easier identification of trends in the data. This subject's questionnaire data was also examined. No responses were especially unusual. Somewhat low reports were given for subjective probability of reinforcement (.3), instrumentality (.2), and expectancy (.3).

The remaining cases given in Table 5 give moderate expectancy support where responses decrease in session 4 but increase in session 5, although still below the level achieved under CRF, and weak support in the cases where responding in

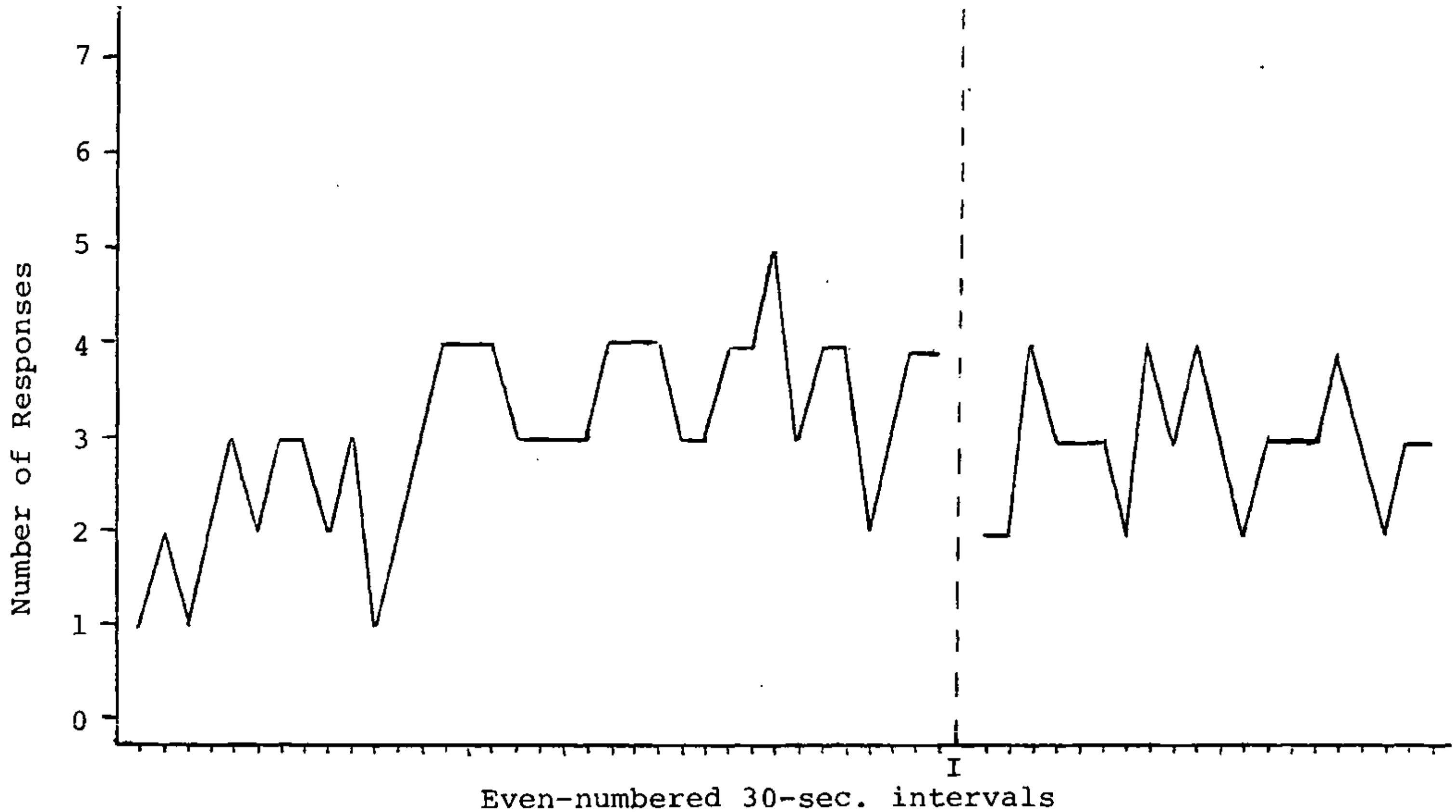

Figure 3. Response Curve for Subject 223 (Money, F-NI) Showing Possible Support for Expectancy Theory.

session 5 recovers to a level above that attained under CRF. The most noticeable result is that across these 20 cases, few (5 out of 20) given in Table 5 fell into the conditions in which feedback was not given.

Group response curves are provided in Appendix C.

Time-Series Analysis

A time-series analysis, as described by Glass, Willson, and Gottman (1975) was applied to the data to test for effects on response rate caused by the change in reinforcement frequency. In the typical time series analysis, repeated observations are made on some variable over time. Between two of the observations an intervention is introduced. An abrupt change such as a change in level or change in drift direction which coincides with the intervention can often be attributed to that intervention. The bases for time-series experiments and their analysis is amplified further in Appendix D.

Tables 6 and 7 show the t-statistics for the testing of significance for the design parameters (level change, drift, and drift change). The t-statistics are those associated with the θ_1 for each case where the error variance was at its minimum. Significance was tested at $\alpha = .05$ with 106 degrees of freedom.

Of 64 subjects, 63 showed significant ($p < .05$) deterministic drift, the one exception showing positive drift

Table 6. Time-series Analysis for the Money Subsample

Subject	Condition	Level Chg.	Drift	Drift Chg.
1	F-I	-1.677	6.749*	-1.318
2	NF-I	-0.188	7.863*	-3.267*
3	NF-I	-2.224*	7.656*	-1.726
4	F-NI	-3.691*	8.422*	-2.163*
5	F-NI	-3.780*	10.813*	-1.741
6	NF-NI	-0.138	6.590*	-1.734
7	NF-NI	-0.251	10.095*	-4.692*
8	F-I	-0.693	6.266*	-3.733*
9	NF-NI	-0.255	6.118*	-1.387
10	F-I	-0.955	5.646*	-2.309*
11	F-NI	-1.131	3.127*	-1.286*
12	NF-NI	0.470	4.381*	-1.774
13	NF-NI	-0.010	7.796*	-3.389*
14	NF-I	-1.073	6.553*	-2.858*
15	F-NI	-2.716*	7.665*	-0.181
16	F-I	-2.128*	3.143*	-0.880
17	NF-I	-0.648	7.956*	-2.267*
18	NF-I	-0.639	4.856*	-1.963
19	NF-NI	0.674	2.957*	-1.872
20	F-I	-0.039	5.543*	-0.857
21	NF-I	0.068	5.362*	-1.496
22	F-NI	-2.900*	6.643*	-1.147
23	F-NI	-3.525*	6.102*	-2.055*
24	NF-NI	-0.246	5.744*	-2.003*
25	F-I	-1.146	6.837*	-1.712
26	F-NI	-0.233	4.826*	-0.904
27	F-I	-1.295	4.009*	-1.687
28	NF-I	-0.888	7.802*	-2.800*
29	NF-NI	1.144	4.768*	-1.819
30	NF-I	-1.645	8.794*	-3.592*
31	F-I	-1.383	3.706*	-1.098
32	F-NI	-4.052*	8.445*	-2.089*

Table 6a. Frequency of Time-series Effects ($p < .05$) for the Money Subsample.

		Level Change				Drift Change	
		Instructions				Instructions	
		Yes	No			Yes	No
Feedback	Yes	1	6	Feedback	Yes	2	3
	No	1	0		No	5	3

*$p < .05$

Table 7. Time Series Analysis for the Point Subsample

Subject	Condition	Level Chg.	Drift	Drift Chg.
1	F-I	-2.767*	4.683*	-0.590
2	NF-I	-1.233	11.657*	-3.609*
3	NF-I	-1.165	5.933*	-0.853
4	F-NI	-1.990*	6.830*	-1.842
5	F-NI	0.174	5.418*	-3.421*
6	NF-NI	-0.525	7.182*	-3.057*
7	NF-NI	-0.475	2.600*	-1.733
8	F-I	-3.450*	11.025*	-2.880*
9	NF-NI	-2.498*	9.815*	-2.525*
10	F-I	0.234	8.250*	-4.249*
11	F-NI	-0.655	2.684*	-1.390
12	NF-NI	-1.294	2.395*	-1.122
13	NF-NI	-2.793*	7.360*	-2.236*
14	NF-I	-0.852	8.570*	-2.820*
15	F-NI	-0.232	1.957	-1.237
16	F-I	0.589	2.074*	-1.398
17	NF-I	-0.324	2.842*	-1.502
18	NF-I	-1.736	8.030*	-1.710
19	NF-NI	-0.776	6.569*	-2.746*
20	F-I	-0.307	3.194*	-1.462
21	NF-I	-1.405	8.349*	-2.842*
22	F-NI	-1.466	4.405*	-3.252*
23	F-NI	-2.487*	7.232*	-1.680
24	NF-NI	-1.267	9.176*	-2.709*
25	F-I	-2.445*	9.625*	-2.626*
26	F-NI	-0.752	4.396*	-2.207*
27	F-I	-0.276	4.770*	-1.948
28	NF-I	-1.961	9.826*	-2.595*
29	NF-NI	-1.166	10.423*	-3.677*
30	NF-I	-1.662	4.204*	-1.380
31	F-I	-0.841	3.625*	-1.497
32	F-NI	-1.219	5.293*	-0.364

Table 7a. Frequency of Time-series Effects (p < .05) for the Points Subsample.

		Level Change Instructions				Drift Change Instructions	
		Yes	No			Yes	No
Feedback	Yes	3	2	Feedback	Yes	3	3
	No	0	2		No	4	6

*p < .05

just shy of significance at the .05 level. Also shown are t-statistics for tests of level change and drift change. Of the 64 subjects, 57 showed a negative level change. Of these, 15 subjects had significant ($p < .05$) level changes, showing a pronounced and immediate drop in response rate at the point of intervention. Figure 4 is provided showing a response curve for a subject who showed a strong negative level change. No positive level changes were significant ($p > .05$).

All subjects showed a negative drift change, a negative acceleration which could be predicted due to the ceiling effect in the acquisition curve. Pronounced changes in the acceleration of the function at the region of intervention were found for 29 of the subjects ($p < .05$), 13 who worked for for money and 16 who worked for points. Figure 5 is provided showing the response curve for a subject who showed a strong drift change.

Tables 6a and 7a illustrates the factorial design of the study and the frequency count per cell of significant level change and drift change. Although the total number of subjects showing drift change and level change in the money and point conditions did not differ greatly, the cell frequencies show differences which should be accounted for. Of particular note are the two instances where 6 subjects working for money in the F-NI condition showed significant decreases in the rate of responding at the point of

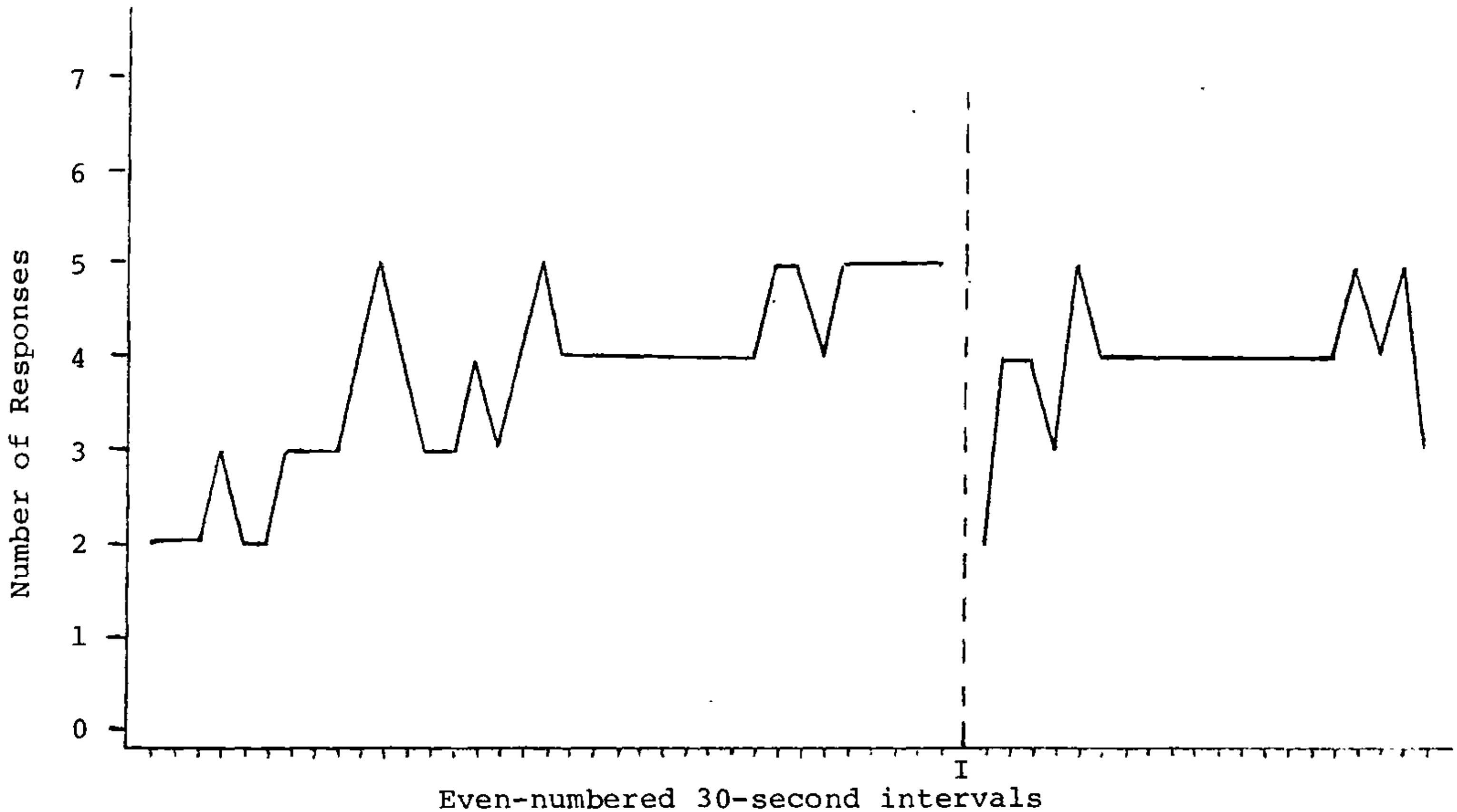

Figure 4. Response Curve for Subject 232 (Money, F-NI) Showing Significant ($t = -4.052$, $p < .001$) Level Change.

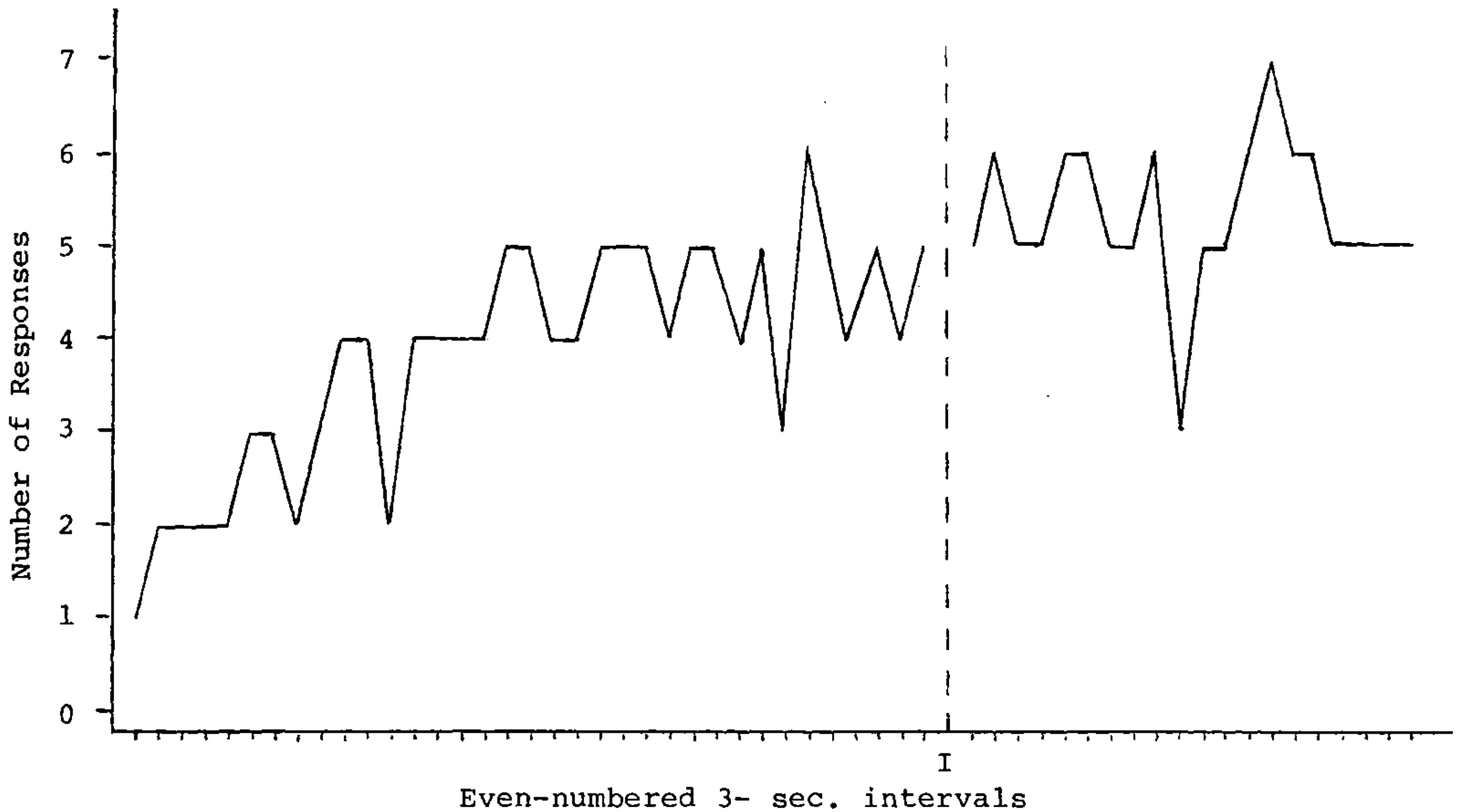

Figure 5. Response Curve for Subject 207 (Money, NF-NI) Showing Significant ($t = -4.692$, $p < .001$) Drift Change.

intervention. Only two subjects in the same cell who worked for points showed a similar pattern. Likewise 6 subjects in the NF-NI cell who worked for points showed a significant negative drift change while only three similarly treated subjects who worked for points showed the same effect.

The data in Tables 6a and 7a suggests that feedback plays an important role, particularly in the effect measured by level change. At least two explanations can be suggested which might predict the reported results in regard to the large proportions of subjects in the Money F-NI cell, explanations free of the need to use motivational constructs. One such explanation would be that the new feedback conditions in the VR2 condition present an unexpected "novelty" situation for the subject, or Hawthorne effect, resulting in a depression of response rate from which he can recover. A second explanation could be in terms of loss of information (Estes, 1971; Bandura, 1971). In the CRF condition a correct response is signalled simultaneously by the buzzer and the presentation of a new problem. Once VR2 begins, the buzzer becomes an unreliable source of information as to whether a correct response has been made. Both these explanations should have predicted similar effects in the points condition as in the money condition, unless feedback is of different value to the subjects in each condition.

To test for a "novelty" effect or a loss of information effect, eight additional subjects were used who worked for neither points or money. The subjects received course credit only. Conditions were identical to subjects in F-NI conditions with the exception of having the counter disconnected. In this case, the buzzer was operative as in earlier conditions. The "meaning" of the buzzer was not explained to the subjects.

Results from this group of subjects is given in Table 8. The data is similar to that obtained from the F-NI group in the points condition. All subjects showed significant drift ($p < .05$). A significant negative level change was shown by 2 subjects while 4 of the 8 showed significant negative drift change at the point of intervention. A "novelty" effect of the magnitude suggested in Table 4a for the money subsample does not appear to be supported.

The possibility of identifying feedback as a predictor of level change under certain conditions suggested an investigation of which variables best predicted group membership in the significant level change and significant drift change groups. The possibility of a ceiling effect accounting for the drift change could also be investigated in this way, being supported if pre-intervention response rate was the best predictor of group membership for the subjects showing significant drift change. A discriminant analysis was done to investigate these possibilities.

Table 8. Time Series Analysis to Test for a "Novelty" Effect.

Subject	Condition	Level Change	Drift	Drift Change
1	NF-NI	-1.613	6.928*	-2.338*
2	NF-NI	-2.907*	6.921*	-2.337*
3	NF-NI	-1.673	8.002*	-1.744
4	NF-NI	-0.606	2.764*	-1.609
5	NF-NI	-1.876	4.940*	-3.304*
6	NF-NI	-0.925	4.982*	-2.637*
7	NF-NI	-3.408*	4.918*	0.659
8	NF-NI	0.171	2.606*	-1.474

*$p < .05$.

Discriminant Analysis

A discriminant analysis was applied to the time-series results in an attempt to determine which variables best predict membership into groups defined by significant ($p < .05$) level change and significant drift change using the Statistical Package for the Social Sciences (SPSS) (Nie, Hull, Jenkins, Steinbrenner, and Bent, 1975). The discriminant analysis used both independent and dependent variables (response measures) as classified by the original design as variables which might be combined to identify a single dimension along which the groups might be best differentiated.

Six separate discriminant analyses were executed, differentiating the level change and drift change groups for the subjects who worked for points, those who worked for money, and the total sample. The Wilks method of stepwise selection was used. In the stepwise selection, a single variable is chosen which maximizes the F ratio and minimizes Wilks' lambda, a measure of group discrimination. Each of the other variables are paired with the first variable to meet the above criterion, and so on until all variables are selected or no additional variables provide a minimum level of improvement.

The results of the six discriminant analyses are provided in Appendix B. In addition to the lists of variables in their order of inclusion, values are provided for appropriate eigenvalues, canonical correlations, Wilks' lambdas, and predicted group membership. Also indicated are those variables whose means, in an analysis of variance, were found to be significantly ($p < .05$) different for the two groups defined in each analysis.

The discriminant analysis was used to indicate those variables which best predicted membership in the groups defined by level change and drift change. Therefore only the first few variables in each analysis were of interest, in particular those which also exhibited significantly ($p < .05$) different values for the group defined by the analysis as indicated by an analysis of variance. A standard use of the discriminant analyses for the subsamples with 32 subjects each was not acceptable since the number of variables used in the analyses exceeded the number of observations. The perfect fit for these analyses is therefore not only not surprising but is indeed predictable.

The discriminant analyses are of value in showing that different variables accounted for the effects of level and drift change depending on the type of reinforcer used. The discriminant analyses and analysis of variance indicate that the presence of feedback or not is the single best predictor of level change at the point of intervention for the total sample. The analyses for the two subsamples show feedback again to be indicated as the most potent variable for the money subsample but not the points subsample. The points subsample has two variables which are good predictors of group membership: VALGAM1, a pre-experimental measure of gambling valence, and ABLTYE, an ability measure using the error, or effort, units.

The discriminant analyses for drift change are somewhat more consistent in that need for achievement (NACH) appears as a good predictor of group membership in all three analyses, while being the best variable for the total sample and the points subsample. Instrumentality is indicated as a strong variable for the total sample. The ABLTYE measure is the best predictor of drift change for the money subsample.

Multivariate Analysis of Variance (MANOVA)

Table 9 presents the results of a multivariate analysis of variance performed using all 8 measures of performance, including the ability measures to check for differences in subjects in ability not accounted for in random assignment to cells. The main effects of points or money, feedback,

Table 9. Multivariate Analysis of Variance for the 2×2×2 Factorial Design

Source	Criteria	Mean Square	F	df	p less than
A (Points or Money)	Multivariate Lambda		1.330	8,49	.251
	AbltyA	62.016	.860	1,56	.358
	AbltyE	588.062	.282	1,56	.597
	ANSCRF	2822.266	1.033	1,56	.321
	ANSTOT	6123.063	.793	1,56	.377
	ANSVR2	631.266	.462	1,56	.500
	ERRCRF	23370.766	.385	1,56	.537
	ERRTOT	17556.250	.083	1,56	.775
	ERRVR2	420.250	.007	1,56	.933
B (Feedback)	Multivariate Lambda		1.517	8,49	.176
	AbltyA	34.516	.479	1,56	.492
	AbltyE	798.063	.383	1,56	.538
	ANSCRF	3378.516	1.201	1,56	.278
	ANSTOT	18632.250	2.412	1,56	.126
	AMSVR2	6142.641	4.491	1,56	.039*
	ERRCRF	12460.141	.205	1,56	.652
	ERRTOT	54522.250	.257	1,56	.614
	ERRVR2	14823.063	.253	1,56	.617
C (Instructions)	Multivariate Lambda		.379	8,49	.927
	AbltyA	34.516	.479	1,56	.492
	AbltyE	1056.250	.507	1,56	.479
	ANSCRF	2127.616	.756	1,56	.388
	ANSTOT	3937.563	.510	1,56	.478
	ANSVR2	276.391	.202	1,56	.655
	ERRCRF	72159.391	1.189	1,56	.657
	ERRTOT	304428.063	1.437	1,56	.379
	ERRVR2	80089.000	1.367	1,56	.223

Table 9 (Continued). Multivariate Analysis of Variance for the 2×2×2 Factorial Design

Source	Criteria	Mean Square	F	df	p less than
A × B	Multivariate Lambda		1.312	8,49	.260
	AbltyA	1.891	.026	1,56	.872
	AbltyE	2997.563	1.429	1,56	.235
	ANSCRF	2364.391	.840	1,56	.363
	ANSTOT	6765.062	.876	1,56	.353
	ANSVR2	1130.641	.827	1,56	.367
	ERRCRF	12127.516	.200	1,56	.657
	ERRTOT	166872.250	.788	1,56	.379
	ERRVR2	89102.250	1.521	1,56	.223
A × C	Multivariate Lambda		1.370	8,49	.233
	AbltyA	8.266	.115	1,56	.736
	AbltyE	576.000	.277	1,56	.601
	ANSCRF	2036.266	.724	1,56	.399
	ANSTOT	3540.250	.458	1,56	.501
	ANSVR2	206.641	.151	1,56	.699
	ERRCRF	235831.641	3.885	1,56	.054
	ERRTOT	337851.562	1.595	1,56	.212
	ERRVR2	9168.062	.157	1,56	.694
B × C	Multivariate Lambda		1.214	8,49	.311
	AbltyA	6.891	.096	1,56	.758
	AbltyE	1024.000	.492	1,56	.486
	ANSCRF	489.516	.175	1,56	.678
	ANSTOT	2889.062	.374	1,56	.543
	ANSVR2	1000.141	.731	1,56	.396
	ERRCRF	129150.391	2.128	1,56	.150
	ERRTOT	248253.062	1.172	1,56	.284
	ERRVR2	19321.000	.330	1,56	.568

Table 9 (Concluded). Multivariate Analysis of Variance for the 2×2×2 Factorial Design

Source	Criteria	Mean Square	F	df	p less than
A × B × C	Multivariate Lambda		.657	8,49	.726
	AbltyA	178.891	2.480	1,56	.121
	AbltyE	7656.250	3.676	1,56	.060
	ANSCRF	5274.391	1.875	1,56	.176
	ANSTOT	10609.000	1.373	1,56	.246
	ANSVR2	922.641	.675	1,56	.415
	ERRCRF	86068.891	1.418	1,56	.239
	ERRTOT	356110.563	1.681	1,56	.200
	ERRVR2	91960.563	1.570	1,56	.215

and instructions provide a 2×2×2 factorial design with 8 dependent variables. Cramer's (1967, 1973) MANOVA program was used to perform the analysis on the Cyber 74 computer. An alpha level of .05 was chosen for tests of significance. Only one test proved to be significant ($F_{1,56} = 4.491$, $p < .05$) out of the 48 univariate tests, indicating that those subjects who received feedback performed at a lower rate during the VR2 schedule than did those subjects who received no feedback, an effect also shown by the time-series analysis. This result may be due to the drop in response rate at the point of intervention as suggested by the time-series analysis, an effect which evidently could not be compensated for by a quick recovery. As reported earlier, this result does not seem to be due to a "novelty" effect. A reanalysis using the ability measures as covariates produced no changes for significance at the .05 level.

Correlational Analysis

Table 10 gives the correlations between the independent variables of the design. Table 11 gives the correlations between the independent variables and each of the six dependent variables. Also provided are combinations of variables suggested in the expectancy literature and their correlations with the dependent variables.

Due to the large number of correlations presented in these two tables, the probability of making a Type I error is probably unity. Using conventional methods for testing for significance of correlations at the .05 alpha level, probability would suggest the chance of making a Type I error 5 times for every 100 correlations tested. As the number of correlations becomes substantial, as is the case here, one becomes hesitant about rejecting a null hypothesis based on the data alone. Using a Monte Carlo method, Harris (1967) and Larzelere (1975) have confirmed that the empirical estimate of the probability of making at least one Type I error in a family of tests increases substantially as the number of component tests increases.

To attempt to minimize this problem, the correlation indices were tested for significance using the Multistage Bonferroni Procedure, described by Larzelere and Mulaik (1977). This procedure is a modification of the Bonferroni Procedure and satisfies Tukey's criterion of defining the familywise error rate as the maximum value it can attain under all possible sets of true component null hypotheses (Ryan, 1959).

The first step of the multistep Bonferroni procedure requires the specification of the familywise significance level, such as .05, which when divided by the number of tests, $\underline{m}$, determines the nominal significance level (α_T) for each individual test. Each of the individual tests was evaluated at this level of significance. If none of the tests in the family of tests is significant, the procedure stops and none of the null hypotheses is rejected. However, if k tests

Table 10. Correlation Matrix for Independent Variables for the Total Sample (N = 64)

1.	Equity[a]	1.0																									
2.	Effort	-04	1.0																								
3.	Expcty	-18	-01	1.0																							
4.	Insty	14	04	42[b]	1.0																						
5.	IVa	26[b]	19	12	13																						
6.	IVb	-04	11	07	12	31[b]	1.0																				
7.	nAch	02	13	-15	11	00	-04	1.0																			
8.	Valmon1	06	14	-15	-14	-14	-10	-05	1.0																		
9.	Valmon2	16	04	-17	-10	-03	-01	13	82[c]	1.0																	
10.	Sex	-24	-11	-02	-10	03	00	-31[b]	-18	-19	1.0																
11.	Class	-19	06	-24	-11	-02	09	-33[b]	02	-08	24	1.0															
12.	Valgam1	20	16	-06	-09	-11	09	01	67[c]	51[c]	-32[b]	02	1.0														
13.	Valgam2	22	04	-21	-15	-19	08	-07	46[d]	42[b]	-11	04	65[c]	1.0													
14.	AbltyA	22	19	-13	14	-06	-14	30[b]	13	05	-38[b]	06	27[b]	21	1.0												
15.	AbltyE	27[b]	05	-24	11	-08	-18	19	19	14	-27[b]	04	40[b]	30[b]	84[c]	1.0											
16.	Age	-28[b]	05	-25[b]	-18	-07	15	29[b]	-02	01	04	83[c]	00	03	01	-04	1.0										
17.	GPA	40[b]	-08	-07	05	07	01	05	-20	-18	12	17	-12	08	06	05	04	1.0									
18.	Support	10	06	-01	06	-20	-11	35[b]	13	11	-20	17	10	07	-01	-08	23	-16	1.0								
19.	PTORMON	--	16	17	12	04	-10	19	02	-09	00	05	-14	-28[b]	12	-07	-05	-13	-06	1.0							
20.	Instr	-09	05	03	11	-02	-14	09	19	07	09	-08	04	08	09	09	-09	07	23	00	1.0						
21.	Fdback	-16	02	-06	35[b]	11	07	19	-05	05	09	23	-06	06	09	08	10	11	-03	00	00	1.0					
22.	LevChg	05	00	16	18	04	00	-08	-09	-07	24	16	-15	-09	-13	-13	00	09	03	04	-18	33[b]	1.0				
23.	DrChg	-03	03	08	-26[b]	-03	02	-28[b]	-13	-17	05	-13	-13	04	-15	-18	00	13	-23	-09	-03	-22	02	1.0			
24.	SumIV1	15	09	04	37[b]	-13	10	-12	56[c]	47[d]	-26	-16	51[c]	40[b]	02	08	-09	-11	04	03	13	17	-12	-24	1.0		
25.	SumIV2	22	04	00	36[b]	-15	12	-17	49[d]	55[c]	-27	-18	43[b]	40[b]	00	09	08	-12	04	04	10	13	-13	-27[b]	93[c]	1.0	
26.	Valpts	--	17	20	06	14	-07	15	05	02	-07	01	-03	-28[b]	-01	-19	-08	-05	-05	76[c]	-08	-04	-04	-20	07	05	1.0
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26

[a]Scores obtained for money subsample only (N = 32).

[b]Borderline significance: $P_T < .05$.

[c]$P_{FW} < .01$.

[d]$P_{FW} < .05$.

Table 11. Correlations of Independent and Dependent Variables for the Total Sample

	ANSVR2	ERRVR2	ANSCRF	ERRCRF	ANSTOT	ERRTOT
Effort	17	13	29[b]	19	25[b]	17
Equity (N=32)	51[b]	33	46[b]	38[b]	49[b]	39[b]
Expcty	05	00	-10	-17	-04	-10
Insty	30	20	17	16	23	19
IV_a	-02	-03	-06	-12	-04	-08
IV_b	04	02	-06	-03	-02	-01
nAch	19	07	25[b]	10	23	09
Valmon1	03	06	09	14	07	11
Valmon2	05	07	03	10	04	09
Sex	-26	-09	-32[b]	-13	-30[b]	-12
Class	08	01	10	13	10	07
Valgam1	21	11	31[b]	28[b]	27[b]	21
Valgam2	22	21	24	20	24	22
AbltyA	57*	40[b]	77*	60*	71*	53*
AbltyE	50*	39[b]	70*	66*	63*	56*
Age	08	04	10	12	09	09
GPA	15	-01	07	-09	11	-06
Support	-03	-12	-03	-10	-03	-12
PTORMON	09	-01	13	08	11	04
Instr	06	15	11	14	09	15
Fdback	27[b]	06	14	06	20	06
LevChg	13	-05	-02	-01	04	-03
DrChg	-12	-02	-14	-08	-14	-06
SumIV1	14	13	10	15	12	16
SumIV2	16	16	11	17	14	17

[1] Valences for class credit (V_p) are used.

[2] Valences for money (V_m) are used.

*$P_{FW} < .01$.

[b] Borderline significance: $P_T < .05$

Table 11 (Continued). Correlations of Independent and Dependent Variables for the Total Sample

	ANSVR2	ERRVR2	ANSCRF	ERRCRF	ANSTOT	ERRTOT
ValPts	02	-01	-02	-11	00	-12
$E\ (IV_m)$	12	09	-05	-03	02	03
$IV_a+IV_b+E+I+V_m$	16	12	09	10	12	12
$IV_b+E(IV_b+(IV_m))$	11	09	-05	-03	02	03
$E(\Sigma IV)$	03	06	-07	-03	-03	02
POINTS[1]						
$E(IV_p)$	13	12	-14	13	-02	10
$IV_a+IV_b+E+I+V_p$	17	-15	-14	-17	-01	-16
$IV_b+E(IV_b+(IV_p))$	12	-03	-15	-04	-04	-05
MONEY[2]						
$E(IV_m)$	11	07	04	03	07	06
$IV_a+IV_b+E+I+V$	37[b]	17	36[b]	23	37[b]	21
$IV_b+E(IV_b+(IV_m))$	11	07	04	03	07	05

indicate rejection of the null hypotheses, then a second stage is begun on the m-k remaining tests. The significance level becomes $\alpha_T = \alpha_{FW}/(m-k)$ and the remaining null hypotheses not rejected are tested. This process of testing and elimination continues until no tests suggest rejection of the null hypotheses. Larzelere (1975) has proven that this procedure assures that the probability of making one or more Type I errors on any subset of test is no larger than α_{FW}.

The multistage Bonferroni procedure was used to test the correlations in Tables 10 and 11 for significance at both the .05 and .01 levels of significance. These tables contain 526 correlations, 24 of which were significant at the .05 level. Also noted are those correlations in which the null hypotheses would have been rejected using conventional procedures and are noted as borderline. It is also suggested that although they do not provide conclusive evidence themselves, they may be useful in providing such evidence when considered with similar results from other samples (Larzelere and Mulaik, 1977). It should also be noted that some of the variables are not independent in their components, such as INSTY and SUMIV1, SUMIV2 for example, which could produce correlations spuriously high. Some of the correlations can also be used as indications of test-retest reliability, as in the case of SUMIV1 with SUMIV2 and VALMON1 with VALMON2, with a lag of approximately one hour between tests.

Few correlations in Table 10 show significance nor provide much in the way of analyses when the test-retest and non-independent correlations are ignored. The high correlation between VALPTS, or the value of receiving course credit, and PTORMON, the groups receiving points (course credit) or money, is not surprising since receiving course credit had little meaning as a possible outcome to the subjects working for money. The high correlation between ABLTYA and ABLTYE may be questioned as being too high in a period of testing during the first five minutes when the largest amount of "errors" might be expected without a concomitant number of answers. Correlations between the valences of money and gambling could also be expected due to the phrasing of the gambling question in terms of potential monetary gain or loss. It is of interest that those who value money most would be most willing to gamble on an all-or-nothing basis.

Table 10 provides some information of more value when comparisons are made between independent and dependent variables. Responses to the question of equity of payment prove to be a good reflection of past performance for those individuals who worked for money. Yet these correlations would not be predicted by most interpretations of equity theory. Instead the correlations should be zero since the equity function is U-shaped, predicting poorest performance for both those individuals who feel underpaid <u>and</u> overpaid.

Expectancy theory variables prove to be poor predictors of performance, both individually and in "traditional" combinations. Instrumentality is the best correlate with performance for the total sample, particularly during the VR2 schedule. In terms of expectancy theory, an additive model of $IV_a + IV_b + E + I + V$ (Berger et al., 1975) is a moderately good predictor of performance (but not effort) when applied only to the money subsample with the appropriate valence for money is used. The increased correlation over the total sample is also partially due to the shrinkage in sample size.

By far the best predictor of performance is measured answers and errors during the five minutes of unreinforced practice at the beginning of the session (ABLTYA and ABLTYE). These measures are conceptualized as ability measures collected before reinforcement is applied. Both indices predict answer totals but not error, or effort, totals at later stages, with the correlations decreasing as the session progresses in regard to performance. The ability measures correlate poorly with the effort measures during CRF, yet become moderately good predictors for effort during the VR2 schedule. Tables 12 and 13 provide the same correlations for the money subsample. The pattern of correlations remain stable in most cases.

Table 14 addresses Vroom's conceptualization of performance being a multiplicative function of motivation and ability. Using the expectancy models suggested by the literature as indices of motivation, comparisons are shown of the

Table 12. Correlation Matrix of Independent Variables for the Money Subsample (N = 32).

1.	Equity	1.0																							
2.	Effort	-04	1.0																						
3.	Expcty	-18	03	1.0																					
4.	Insty	14	08	54^{b}	1.0																				
5.	IVa	26	15	02	10	1.0																			
6.	IVb	-04	39^{b}	15	01	40^{b}	1.0																		
7.	nAch	02	23	-22	08	02	-13	1.0																	
8.	Valmon1	06	26	-13	06	-11	-02	21	1.0																
9.	Valmon2	16	14	-30	08	-04	04	07	74**	1.0															
10.	Sex	-24	-03	17	-05	-01	02	-40^{b}	-45^{b}	-29	1.0														
11.	Class	-19	12	-28	-25	-13	06	30	00	02	15	1.0													
12.	Valgam1	21	30	12	20	05	25	20	63**	37^{b}	-54^{b}	05	1.0												
13.	Valgam2	22	40^{b}	02	20	05	23	27	31	27	-42^{b}	10	69**	1.0											
14.	AbltyA	22	25	-08	34	26	-16	38^{b}	43^{b}	22	-44^{b}	10	43^{b}	33	1.0										
15.	AbltyE	27	09	-21	28	17	-34	33	39^{b}	28	-38^{b}	03	43^{b}	33	87**	1.0									
16.	Age	-28	07	-30	-34	-13	13	33	02	07	06	89**	-02	-01	-02	-14	1.0								
17.	GPA	40^{b}	-10	-04	07	05	-02	-08	-10	-04	-05	18	-06	19	-01	03	14	1.0							
18.	Support	-10	18	10	23	-29	00	38^{b}	30	18	-22	20	24	23	-06	-13	23	-10	1.0						
19.	Instr	-09	00	21	21	00	-19	27	16	-03	-09	-19	-10	-11	13	02	-11	06	38^{b}	1.0					
20.	FdBack	-16	-11	07	50^{b}	04	-06	20	00	23	09	23	02	09	11	21	17	06	08	00	1.0				
21.	LevChg	05	03	06	31	-12	19	-25	11	14	25	16	17	04	01	10	04	10	09	-29	43^{b}	1.0			
22.	DrChg	-03	-06	05	-23	03	15	-20	-18	-17	36^{b}	-06	-31	-16	-32	-41^{b}	03	34	-31	06	-19	-04	1.0		
23.	SumIV1	15	08	31	54^{b}	-08	11	12	35^{b}	33	-53^{b}	-29	51^{b}	42^{b}	17	09	-14	05	36^{b}	16	19	14	-30	1.0	
24.	SumIV2	22	03	14	47^{b}	-13	10	07	24	43^{b}	-55^{b}	-25	42^{b}	49^{b}	09	08	-12	12	30	06	23	09	-32	92**	1.0
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

$^{*}p_{FW} < .05$

$^{**}p_{FW} < .01$

^{b}Borderline significance: $p_T < .05$.

Table 13. Correlations of Independent and Dependent Variables for the Money Subsample

	ANSVR2	ERRVR2	ANSCRF	ERRCRF	ANSTOT	ERRTOT
Effort	24	17	33	21	30	20
Equity	51^b	34	46^b	38^b	49^b	39^b
Expcty	-01	06	-09	-09	-06	-01
Insty	27	10	19	16	23	14
IV_a	11	02	16	00	14	01
IV_b	-10	-17	-16	-24	-14	-22
nAch	22	09	35^b	18	31	14
Valmon1	35^b	18	41^b	30	40^b	25
Valmon2	27	17	24	24	26	22
Sex	-26	-06	-39^b	-11	-35^b	-09
Class	15	-02	18	-15	18	06
Valgam1	39^b	09	49^b	31	46^b	21
Valgam2	42^b	23	44^b	19	44^b	23
AbltyA	63**	48^b	81***	69***	75***	62**
AbltyE	60*	39^b	75***	69***	70***	57^b
Age	09	-01	09	08	09	04
GPA	36^b	12	17	01	25	06
Support	10	-07	07	-03	09	-05
Instr	01	09	00	-11	00	-01
Fdback	15	-08	02	00	08	-04
LevChg	31	-05	10	19	18	07
DrChg	-10	06	-27	-17	-20	-05
SumIV1	23	04	17	00	20	02
SumIV2	20	03	13	-02	16	00

*$P_{FW} < .10$.

**$P_{FW} < .05$.

***$P_{FW} < .01$.

[b]Borderline Significance: $P_T < .05$.

Table 14. Performance = Motivation × Ability?

IF $Mot1 = E(IV_m)$[1]

$Mot2 = IV_a + IV_b + E + I + V_m$

$Mot3 = IV_b + E(IV_a + (IV_m))$

$Mot4 = E(\Sigma\ IV)$

D.V.	with	I.V.	r	
ANSVR2		AbltyA	.5714	(.6321)
		Mot1*AbltyA	.3992	
		Mot2*AbltyA	.5611	
		Mot3*AbltyA	.4014	
		Mot4*AbltyA	.1321	
		Equity*AbltyA	.7208	
ANSCRF		AbltyA	.7740	(.8087)
		Mot1*AbltyA	.3230	
		Mot2*AbltyA	.7171	
		Mot3*AbltyA	.3258	
		Mot4*AbltyA	.0721	
		Equity*AbltyA	.8441	
ANSTOT		AbltyA	.7081	(.7529)
		Mot1*AbltyA	.3636	
		Mot2*AbltyA	.6695	
		Mot3*AbltyA	.3661	
		Mot4*AbltyA	.0994	
		Equity*AbltyA	.8108	
ERRVR2		AbltyE	.3878	(.3892)
		Mot1*AbltyE	.2769	
		Mot2*AbltyE	.3970	
		Mot3*AbltyE	.2780	
		Mot4*AbltyE	.1286	
		Equity*AbltyA	.5573	
ERRCRF		AbltyE	.6588	(.6867)
		Mot1*AbltyE	.2438	
		Mot2*AbltyE	.6077	
		Mot3*AbltyE	.2444	
		Mot4*AbltyE	.0630	
ERRTOT		AbltyE	.5603	(.5695)
		Mot1*AbltyE	.2764	
		Mot2*AbltyE	.5371	
		Mot3*AbltyE	.2773	
		Mot4*AbltyE	.1010	

[1] V_m = Valence for money.

multiplicative functions as predictors of performance as compared to the ability measures alone. Only in one case did the multiplication improve prediction, very modestly at that (from .39 to .40 ERRVR2). Where equity was inserted for a measure of motivation, prediction of performance can be improved, in this case most noticeably for measures during the VR2 schedule which is actually more removed in time from the time of ability measurement than ANSCRF and ERRCRF. Correlations in parentheses are the ability measures for the money subsample only correlated with the "dependent" variables, being slightly larger due to the smaller sample size. This is important since equity can only be calculated for the money subsample (N = 32).

CHAPTER V

DISCUSSION

Adequacy of the Questionnaire Measures

The reliability coefficients for the questionnaire data appear to be in an acceptable range, .55 to .93, when instrumentality and subjective estimates of the probability of reinforcement are not included. The reliability estimate of .55 for expectancy is comparable or better than reliabilities reported for this variable in other studies (Lawler, 1968; Schwab and Dyer, 1974; Sheridan et al., 1973). Expectancy is also a value which might be expected to fluctuate as one becomes more familiar and proficient at the task. The median reliability coefficient obtained for valence measures (.91) is substantially larger than those reliabilities reported earlier (Schwab and Dyer, 1973; Sheridan et al., 1973).

The reliability coefficients for instrumentality (.04) and subjective estimates of reinforcement frequency (-.57) certainly do not seem acceptable in the standard use of such measures. In this case, both these variables depend on the experimental manipulation itself. There was no way to guarantee that the objective probability of reinforcement remained constant over sessions due to the use of a probability generator, and the negative correlation could reflect actual change in probability, or more likely, changes in perceptions as experience increases. Instrumentality is the variable which the design was aimed at modifying, and whose estimates were hopefully under a state of flux as the probability of reinforcement changed. The results reported for the entire study also suggest that the values reported for these two variables may indeed have been random. The test-retest measures were obtained from a sample of subjects which did not work for money but under conditions like that used for the point subsample in the F-NI condition. If these subjects reacted similarly to the larger sample, it may be that the feedback information, which should have been used to form the judgments of instrumentality and probability of reinforcement, actually had only secondary value as a source of information. Fluctuations in expectancy and instrumentality both can be tolerated, and perhaps even expected, although such fluctuations can provide problems for the researcher who uses a longitudinal design.

An Interpretation of the Research Results

The conclusion that the point subsample did not react to the manipulations, specifically the feedback, is founded on the reports of instrumentality, amount of reward earned, and estimates of the probability of reinforcement. The feedback significantly reduced the instrumentality reports for the money subsample, an effect largely due to the very low instrumentality reports for the F-I group. No differences were found for instrumentality in any of the conditions in which nonredeemable points were the "reward." It appears that feedback is the more potent of the two types of information concerning reinforcement schedule as it relates to the present design. Instrumentality perceptions for the money subsample would support the role of feedback and instructions in reducing instrumentality perceptions except the case where those subjects receiving no feedback of any kind reported a lower mean instrumentality than those subjects who received instructions only. The subjects receiving no information would be predicted to report high instrumentalities. The lowered instrumentalities may be due to the fact that all subjects received reports or verification of how many points or cents they had earned before filling out the questionnaire. Thus the NF-NI subjects did receive feedback in a lumped-together form which most likely altered their perceptions based on what they thought they had earned or thought they should have earned. Of course, it should also be noted that the mean instrumentality for the NF-NI is not significantly different from the NF-I or F-NI groups in the money subsample, and therefore discussing such trends in the data may be unnecessary or unwarranted.

The instrumentality data by itself can present a case for concluding that the subjects who worked for nonredeemable points either ignored the information as manipulated in the experimental design or at best placed little value in it. The case becomes stronger when larger discrepencies are noted for the points subsample between the number of points reported as earned and the number actually earned as well as between estimates of reinforcement probability and actual reinforcement frequency as compared to the money subsample.

It would be possible to attempt to attribute significant intervention effects such as a depression of response rate to a motivation decrement which the expectancy model would predict in its present interpretation. The data analysis suggests a more parsimonious interpretation which attributes the response decrement to a loss of information.

Very little support for expectancy theory was generated by either inspection of the response curves or the correlational analysis. Only one subject (223) exhibited a response curve which was originally conceptualized as being strong evidence for a decrement in motivation as predicted by the expectancy model (Mahinney and Behling, 1973). While a total of 20 subjects (31%) showed a response decrement at the point of changeover from continuous reinforcement to a variable ratio schedule, 17 of these subjects were able to recover to a point where their response totals were close to or better than performance under continuous reinforcement.

Correlations between expectancy models and response measures are similarly of little support. The complete model predicts performance more poorly than any other independent variable or combination tested for the total sample. It should be noted that only one instrumentality value was obtained, while in a strict interpretation of a within-subjects design such as this, an instrumentality perception should be obtained for each possible outcome. The list of possible outcomes was also generated by the experimenter, with some outcomes perhaps being unrealistic or meaningless. Yet when the appropriate valences for the actual outcomes (receiving money of class credit) and the appropriate instrumentality measure are combined in a multiplicative model for each subsample, the correlations are only marginally improved (median $r = .11$).

No positive correlation between expectancy composite models and response measures exceed .16 except for an additive model suggested by Berger et al. (1975), applied to the money subsample, which accounts for approximately 14% of the variance for all three performance measures. Error rates, or effort, are not accounted for as well, although the model is designed to predict effort (Vroom, 1964). The correlations between the Berger model and the response measures can be attributed largely to the valence component, which is the best predictor of performance of all the expectancy components and models. The additive model has little logical appeal since any component could go to zero without having the equation go to zero, which should be predicted. This additive model does include measures of intrinsic values for the task, which should be considered, although they contribute little in the present study. It is of interest to note no difference ($t = -.34$, $p > .05$) in intrinsic value perceptions for the two subsamples. A greater difference might have been predicted by some researchers (Deci, 1971, 1972a, 1972b).

One observation on the composite expectancy model is that the expectancy and instrumentality measures reported here are not independent ($r = .42$), with independence being a requirement for the multiplicative model. A definite possibility, at least in this case, is that the correlation represents a high degree of method variance. Expectancy and instrumentality perceptions were obtained as probabilities, with those questions being the only two of that kind on the questionnaire. The distinction between effort-performance and performance-outcome probabilities may also have been difficult. While this study, along with many others, suggest a limited usefulness for the composite model, the problems in the measurement of its components should be investigated before the model is discarded or modified. The findings that the manipulation of schedules did affect instrumentality perceptions for some subjects suggests that this variable may function in a manner which we may not yet understand.

Another measurement consideration in the use of motivation models such as those examined here concerns the dimensionality of each of the components. For example, an additive model should require that each of the component variables represent the same dimension of measurement. In a multiplicative model, the variables which form the multiplicand and multiplier might be measured in different dimensions, but this difference should be reflected in the dimensions of measurement applied to the product. The measurement of motivational variables as attempted here needs to be refined and investigated to a point where it can be determined if such refinement is possible, and if so, what dimensions are appropriate. Such rigor is of central importance in the physical sciences, and this rigor may be applicable to the behavioral sciences.

The central role that feedback plays as a determinant of performance was indicated by the time-series analysis, the discriminant analysis, and the analysis of variance. The analysis of variance simply showed that individuals who received feedback in the form of a counter and buzzer showed a slower response rate (answers) during the variable ratio schedule than those subjects who received no such feedback. The time-series analysis and discriminant analysis showed that this effect was due largely to an abrupt change in the level of the response curve at the point of intervention. This effect was most pronounced for those subjects who worked for money and received feedback but no instructions.

While there might be a small motivational basis for such an effect, as suggested by expectancy models, the data did not support such an interpretation. Even though instructions which inform the subject that the probability of reinforcement has been reduced should reduce instrumentality perceptions, only five out of 32 (15%) subjects who received instructions showed the level change. In addition, out of the group of subjects which reported the lowest instrumentalities, i.e., F-I money, only one out of eight showed the significant level change. While the data suggest that the "F-I money" subjects were the only subjects who reacted to the manipulation by reporting reduced instrumentalities, a corresponding decrement in responding as predicted by the expectancy model was not found for these subjects.

While the discriminant analysis showed feedback to be the variable which best determined level change, for the entire sample, the effect was largely confined to the money subsample. Level change for the points subsample was best predicted by a pre-experimental measure of gambling valence and a response measure. The role of valence for gambling has been suggested by other researchers (Yukl and Latham, 1975) as being of some importance in these types of studies.

Feedback and instructions were provided to indicate to the subjects the presence of rewards as determined by the design. If the money and points did indeed serve as reinforcers, the feedback should have acted as a signal and reinforcer itself. As a potential reinforcer, the feedback also provided a source of information (Estes, 1971; Bandura, 1971). One possible function of this information could have been to signal the successful completion of a problem while simultaneously indicating the presentation of a new problem. When the reinforcement schedule was changed from continuous reinforcement to a variable ratio schedule, such information would become unreliable and should lead to a decrement in performance until the subject finds a suitable replacement for this information. Such an effect was indicated by the data for the subjects who received money as the reinforcer while not in the points subsample. This leads to the conclusion that the information provided by the feedback was of more importance to the subjects who worked for money, perhaps because it acted as a reinforcer while the points had little if any reinforcing value. The feedback was probably of extraneous value to the subjects who worked for non-redeemable points. Such a conclusion is supported by less accurate reports of point totals and frequencies as well as the data showing no effect on reported perceptions of instrumentality.

As reported earlier, level changes exhibited for the points subsample were indicated best by the valence for gambling in the discriminant analysis. The problems involved with studies in which variable ratio schedules mimick gambling situations and thus influence moral judgments from the subjects are discussed by Yukl and Latham (1975). These types of perceptions might help explain the level changes if the subjects with low gambling valences were those subjects who demonstrated the level change effect. Yet an opposite result was found. It was the subjects with high gambling valences who exhibited the effect. This result could be interpreted by simply extrapolating from the previous discussion of the informative role of the feedback which was differentially attended to by the two subsamples. It may be possible that the feedback was of little or no consequence to the subjects receiving non-redeemable points until the VR2 schedule was imposed, at which time the subjects who found this feedback to be attractive in a gambling sense redirected their attention toward the feedback, which would in turn cause a decrement in performance. The feedback again is an unreliable indicator of successful completion of a problem under the VR2 schedule while under CRF it could augment the information provided by the machine itself.

One additional note concerning expectancy theory is its application specifically as a predictor of effort, not performance. Some researchers have used a very simple task as a criterion in an attempt to remove ability as a moderator of effort and performance (Graen, 1969; Jorgenson, Dunnette, and Pritchard, 1973; Arvey, 1972; Motowidlo et al., 1972; Dachler and Mobley, 1973). In the present study, an attempt was made to differentiate between effort and performance measures. The Complex Coordinator reports an "error" each time the lights are matched for a limb of the body. Therefore a minimum of four errors is required before one "answer" is recorded, with no limit on how many errors can be made before the answer is given. Making errors requires little skill and was defined as a measure of effort. This measure of effort did not correlate as well with expectancy variables and combinations as did the performance measure, or answers. The effort counts did not correlate well with self-reports of effort (median r = .17). Although one may argue with the conceptualization and measurement of effort, the results reported here do not support its usefulness as a motivational measure.

By far the best predictors of performance were the ability measures, defined as total answers and errors during five minutes of unreinforced responding at the beginning of the experiment. In operant terminology, the best predictor of performance was past performance. A close rival for predictive value were measures of equity, or perceived fairness of pay, for those subjects who received money as the reinforcer. Equity, as presented by Adams (1963, 1965) is a motivational variable based on cognitive dissonance and social comparison processes. Although equity was not actively manipulated here, its correlation with performance measures is interesting but should not be strictly predictable. According to the Adams conceptualization, subjects who are underpaid under an incentive system should produce more quantity and lower quality as a means of reducing inequity while those individuals who are overpaid should produce fewer items of higher quality. While no measure of quality was possible here, the theory would suggest a curvilinear, or inverted U-shaped relationship between equity feelings and performance instead of the linear relationships indicated by the high correlations. The most probable explanation for the relatively high positive correlations is that the threshold for underpayment is lower than for overpayment (Levanthal, Weiss, and Long, 1969) and that the overpaid subjects found it acceptable to receive overpayment for such a short period of time.

Since the data suggest equity as a possible determinant of motivation, the possibility of using the equity and ability measures in Vroom's equation, Performance = Motivation × Ability, became of interest. As Table 13 indicates, substituting equity perceptions for motivation and ability as measured in answers for the ability variable, correlations with four performance measures (ANSCRF, ANSVR2, ANSTOT, and ERRVR2) were substantially improved over correlations using either the ability or equity measures alone.

The drift change data was analyzed using a discriminant analysis (Appendix B) to indicate what variables accounted for responding being maintained or decelerating after intervention. The finding that drift change occurred frequently "spontaneously" as in the NF-NI condition where no intervention was used makes this result very difficult to interpret in a meaningful way. Need for achievement is an important variable for both subsamples, while a ceiling effect for the money subsample may also be indicated by the response measure (ABLTYE) which is the best predictor of drift change. The role of nACH in all research using human subjects needs further investigation.

Implications for Future Research

Future attempts to improve on the research reported here should be based on an awareness of the limitations and implications of this study in terms of both internal and external validity. Where time and resources would permit, it might be desirable to extend the number and lengths of observations. This would allow the subjects to reach a less variable level of responding before intervention is attempted to allow for easier interpretation of the results. Some design modifications might also be implemented to aid in the explanation of results, such as a return to continuous reinforcement after the variable ratio sessions. Using a group of subjects who received an opposite order of treatments, i.e., administering VR2 first and then CRF, while also increasing the size of the ratios might also give insight into the role of schedules of reinforcement and the issues in question.

If the practical problems of expense, time, and subject participation can be set aside, such longitudinal study can still present some substantive problems relating directly to expectancy theory. Both the reliability data reported in this study and common sense indicated the fluctuations in perceptions of instrumentality and, to some extent, expectancy. Constant monitoring of instrumentality would be bothersome, of questionable value in terms of independence of measurements and could easily influence the results of the experiment by influencing the subjects' perceptions of the experimental situation. In addition, the number of measurements becomes impractical if instrumentalities are to be generated for all possible outcomes, as is suggested for a true within-subject design. It is also conceivable that the list of possible outcomes might change as time has its effect on the perception of the work environment.

While the present study is not flawless in design, using a single, relatively brief experimental session in a controlled setting seems to be optimal for investigation expectancy theories. The naive subject can be expected to remain unaware of the purpose of the study when inquiries as to his/her perceptions are limited to a single report. The number of realistic outcomes are limited, are made known to the subject "a priori," and are easily measured for valence. There are no social factors which can obviously influence the subject, such as group norms and co-worker influences.

Generalizations to a real work environment were naturally limited as controls were added to the situation. In some ways generalizations to a work environment were knowingly sacrificed. For obvious reasons, it is unlikely that a manipulation of pay schedules such as those used here could ever be attempted in a field study. In addition, no base pay was given to those subjects who worked for money, a situation also rarely found in the field. Yet not giving base pay seems to be a requirement for studies in motivation such as the one reported here.

The task used in this study appears to have some applicability to some work settings which require eye-hand-foot coordination. A "work" situation was created by making pay dependent on performance. Yet it would take a vivid imagination to say that a single one hour session constitutes a realistic work setting. One possible implication for the work setting could spring from the actual decremental effect the feedback had, particularly under the VR2 schedule. Providing immediate feedback of a similar nature as described here under an intermittent schedule might detract from attention to the task at hand, resulting in less than optimum performance.

In order to attempt to answer the questions which formed the basis for this study, the emphasis becomes more on experimentation than on generalization. It is suggested here that, if a model such as the expectancy model cannot be supported in a controlled situation in which many relevant perceptions can be accounted for, the possibility of finding support for the model are limited by method, measurement, and past research.

While the emphasis of this thesis is in the area of industrial-organizational psychology, implications of the results as applied to past and future experimentation using human subjects should be considered. Appropriately the question is one of motivation. Participation in psychological studies is usually rewarded by class credit, pay dependent on performance, performance-independent pay, or a combination of these. It is safe to say that these things are of different value from individual to individual. It is almost equally safe to say that these "valences" are seldom measured. The assumption is that the individual would not participate if the reward was not of some value to him/her. Yet the interpretation of the results of this study suggests that, while few group differences were indicated by the analysis of variance, the groups differed greatly in regard to both their reactions to the experimental manipulations and to the variables which determined their performance. These differences can be at least partially attributed to the reinforcers offered and their effect on the perception of the experimental environment.

CHAPTER VI

CONCLUSIONS

An experiment was reported in which 64 students performed a complex coordination task under continuous reinforcement and intermittent (variable ratio) reinforcement successively with the primary goal of determining whether decrements in performance under intermittent reinforcement predicted by expectancy theory were actually found. Manipulated variables included type of reinforcer (money or non-redeemable points), performance feedback, and instruction concerning schedule of reinforcement, providing a 2×2×2 factorial design. Performance criteria included number of problems correctly "answered" and errors, with errors being conceptualized as an effort measure. Questionnaires solicited responses to perceptions of experimental manipulations, expectancy variables, and demographic data. Analyses were selected with special reference to detecting and explaining changes in performance at the point of intervention (changing from continuous to intermittent reinforcement) as well as attempting to account for response variance. An interpretation of the results has led to the following conclusions:

1. A response decrement at the point of intervention was attributed to a loss of information rather than having a motivational basis as predicted by expectancy theory.

The effect was largely transitory in nature in that subjects would typically recover from the reduction in response rate.

2. Information provided for the subjects according to the design (i.e., feedback and instructions) was of less importance to the subjects who worked for nonredeemable points as compared to those who worked for money. Therefore the experimental manipulations should be examined for their effects in regard only to the money subsample when generalizing to other settings.
3. Different variables were most effective in predicting level change and drift change at the point of intervention depending on the type of reinforcer used.
4. Expectancy variables and composite equations did not satisfactorily account for response variance regardless of whether performance or effort measures were used as the criterion.
5. Self-reports of effort as a criterion are not satisfactory. They do not correlate well with objective measures of effort. High correlations with expectancy variables may be attributable largely to method variance.
6. The best single predictor of performance was an ability measure defined as five minutes of unreinforced responding at the beginning of the experiment. The predictive power of this measure was increased by multiplying it by perceptions of equity of payment for the money subsample.

7. Feedback indicating reinforcement was a potent variable causing reduced performance under intermittent reinforcement for subjects who worked for money most often when the feedback was not paired with instructions concerning reinforcement schedule. This effect was not due to a novelty or Hawthorne effect.
8. The present state of the measurement of expectancy variables needs considerable study in terms of identifying what the concepts are measuring as well as defining the dimensionalities of the components and composite equations.
9. Under the conditions specified here, expectancy theory does not show promise as a motivational model. Equity perceptions appear to hold more promise as a motivational construct.
10. All experiments using human subjects should evaluate the effects of various reinforcers on their results. Individual differences in valences for such rewards can affect the interpretation and generalizability of a study.

APPENDIX A

PRE- AND POST-EXPERIMENTAL QUESTIONNAIRES

You will be working on a task for approximately the next hour which requires concentration but is not especially demanding of physical exertion. Below are some possible outcomes following completion of the hour. Rate them as to how you would value each one from -6 to +6 as follows:

-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
Extremely Bad		Very Bad		Bad		Neutral		Good		Very Good		Extremely Good

Write the number of your choice in the space before each outcome. Remember to include the plus (+) and minus (-) signs!!

_____ 60 minutes of experimental credit (course credit)

_____ one dollar

_____ an "A" in your easiest course

_____ 25% (1 in 4) chance to win twelve dollars (or nothing)

_____ three dollars

_____ nothing

_____ 50% chance (1 in 2) to win six dollars (or nothing)

_____ fifty cents

_____ get your name in the Technique saying you did well

_____ get your name in the Technique saying you did poorly

_____ five dollars

_____ a personal "thank you" from your instructor

_____ an "A" in your hardest course

This questionaire section consists of a number of pairs of statements about things that you may or may not like. Here is an example:

A I like to talk about myself to others.

B I like to work toward some goal that I have set for myself.

Which of these two statements is more characteristic of what you like? You may like both A and B. In this case, you would have to choose between the two and you should choose the one you like better. If you dislike both A and B, then you should choose the one that you dislike less.

The following pairs of statements are similar to the above example. Read each pair of statements and pick out the one staement that better describes what you like. For each numbered item draw a circle around A or B to indicate the statement you have chosen.

1. A I would like to accomplish something of great significance.

   B I like to find out what great men have thought about various problems in which I am interested.

2. A I would like to be a recognized authority in some job, profession, or field of specialization.

   B Any written work that I do I like to have precise, neat, and well organized.

3. A I would like to write a great novel or play.

   B I like to tell amusing stories and jokes at parties.

4. A I like to be able to come and go as I want to.

   B I like to be able to say that I have done a difficult job well.

5. A I like to solve puzzles and problems that other people have difficulty with.

   B I like to follow instructions and do what is expected of me.

6. A I like to attack points of view that are contrary to mine.

   B I like my friends to confide in me and to tell me their troubles.

7. A I like to have my work organized and planned before beginning it.

   B I would like to be a recognized authority in some job, profession, or field of specialization.

8. A I like to tell amusing stories and jokes at parties.

   B I like to be able to do things better than other people can.

9. A I like to be able to come and go as I want to.

   B I like to accomplish tasks that others recognize as requiring skill and effort.

10. A I like to avoid being interrupted while at my work.

    B I like to criticize people who are in a position of authority.

11. A I like to form new friendships.

    B I like to be successful in things undertaken.

12. A I like to solbe puzzles and problems that other people have difficulty with.

    B I like to judge people by why they do something - not by what they actually do.

13. A I like my friends to encourage me when I meet failure.

    B I like to accomplish tasks that others recognize as requiring skill and effort.

14. A When serving on a committee, I like to be appointed or elected chairman.

    B I would like to write a great novel or play.

15. A I feel quilty whenever I have done something I know is wrong.

    B I would like to be a recognized authority in some job, profession, or field of specialization.

16. A I like to help other people who are less fortunate than I am.

    B I like to do my very best in whatever I undertake.

17. A I like to eat in new and strange restaurants.

    B I like to be able to do things better than other people can.

18. A I like to work hard at any job I undertake.

    B I like to be able to say that I have done a difficult job well.

19. A I like to kiss attractive persons of the opposite sex.

    B I would like to accomplish something of great significance.

20. A I like to attack points of view that are contrary to mine.

    B I would like to write a great novel or play.

21. A I like to do my very best at whatever I undertake.

    B I like to be loyal to my friends.

22. A I like to be able to say that I have done a difficult job well.

    B I like to observe how another individual feels in a given situation.

23. A I like my friends to encourage me when I meet with failure.

    B I like to be successful in things undertaken.

24. A I like to be one of the leaders in the organizations and groups to which I belong.

    B I like to be able to do things better than other people can.

25. A I like to solve puzzles and problems that other people have difficulty with.

    B When things go wrong for me, I feel that I am more to blame than anyone else.

26. A I like to help my friends when they are in trouble.

    B I like to do my very best in whatever I undertake.

27. A I like to accomplish tasks that others recognize as requiring skill and effort.

    B I like to travel and see the country.

28. A I would like to accomplish something of great significance.

    B I like to work hard at any job I undertake.

29. A I like to be successful in things undertaken.

    B I like to go out with attractive persons of the opposite sex.

30. A I like to read newspaper accounts of murders and other forms of violence.

    B I would like to write a great novel or play.

Below are some possible outcomes for the task which you have just completed. Rate them as to how you would value each one from -6 to +6 as follows:

-6	-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6
Extremely Bad		Very bad		Bad		Neutral		Good		Very Good		Extremely Good

Write the number of your choice in the space before the outcome. <u>Remember to include the plus (+) and minus (-) signs!!</u>

______ five dollars

______ a personal "thank you" from your instructor

______ get your name in the Technique saying you did poorly

______ get your name in the Technique saying you did well

______ fifty cents

______ 50% chance (1 in 2) to win six dollars (or nothing)

______ nothing

______ three dollars

______ 25% chance (1 in 4) to win twelve dollars (or nothing)

______ an "A" in your hardest course

______ one dollar

______ 60 minutes of experimental credit (course credit)

______ an "A" in your easiest class

Subject No. ________ Amt. Received ______

Please answer the following questions as best you can.

1. Considering the amount of effort and time spent, the pay I received was: (Circle one number)

1	2	3	4	5	6	7
Not fair at all			Fair			Much too much

2. The amount of effort I expended overall was: (Circle one)

1	2	3	4	5	6	7
As little as I could			Medium			As much as I could

3. During the last two 10-minute sessions, how often did you receive a penny for every 10 correct answers (on the average)?

About _____ pennies for every 10 correct answers.

4. What did you feel the chances were that if you increased your effort it would lead to better performance (more matches)? (Think of it as a probability from 0 to 10).

_____ out of 10

5. What did you feel the chances were that an increase in performance would lead to earning more money?

_____ out of 10

6. Of what value do you feel learning to do this task was to you? (Circle one)

1	2	3	4	5	6	7
No Value			Some Value			Great Value

7. Of what value was doing well on the task regardless of the pay? (Circle one)

1	2	3	4	5	6	7
No Value			Some Value			Great Value

8. Did you use the information about your performance (on the counter) to set goals for yourself for improvement as you went along? (Circle one)

Yes No

If Yes, please explain what you did and how often.

9. Did you believe that the experimenter was really going to pay you?

1	2	3	4	5	6	7
No		Had some doubts				Yes

The following questionsare to be answered voluntarily. Your assistance would be greatly appreciated. The answers will be in no way connected to your name. They are solely for research purposes. If you don't know an answer, place a question mark (?) in that space. Thank you.

Sex: Male Female (Circle one)

Age: _____

Year in school: Frosh Soph Jr Sr Graduate

Married? Yes No

Major: ________________

Grade point average (approx.): __________

Are you on some form of scholastic aid? Yes No

Approximately what percentage of your schooling do you pay for?

________ %

APPENDIX B

DISCRIMINANT ANALYSIS PRINTOUTS

T

- - - DISCRIMINANT - - - **Drift Change**

SUBFILE MONEY POINTS (Total sample)

GROUP COUNTS

	GROUP 1	GROUP 2	TOTAL
NUMBER	29.	35.	64.

ALL ELIGIBLE VARIABLES INCLUDED

SUMMARY TABLE

VARIABLE	F	WILKS LAMBDA	SIG.	V CHANGE	SIG.
NACH	5.17342	.92298	.026	5.17342	.023
SUMIV2	7.96215	.81642	.002	8.76795	.003
VALGAM2	2.04017	.78957	.003	2.58222	.108
SEX	2.05827	.76296	.003	2.73937	.098
ABLTYE	2.70871	.72891	.002	3.79513	.051
SUPPORT	2.45300	.69884	.002	3.66048	.056
INSTR	1.12346	.68509	.002	1.77985	.182
AGE	1.17226	.67080	.003	1.92888	.165
CLASS	2.82519	.63745	.002	4.83564	.028
ERRCRF	1.31908	.62197	.003	2.42072	.120
IVA	1.27630	.60707	.003	2.44665	.118
EFFORT	1.00292	.59536	.004	2.00841	.156
ANSCRF	1.10131	.58253	.005	2.29378	.130
INSTY	1.03530	.57048	.006	2.24877	.134
LEVCHG	.43892	.56531	.009	.99379	.319
GPA	.56218	.55862	.013	1.31184	.252
EXPCTY	.38517	.55399	.019	.92933	.335
-ABLTYE	.00062	.55399	.011	-.00151	1.000
VALGAM1	.51924	.54781	.016	1.26328	.261
SUMIV1	.63829	.54015	.021	1.60534	.205
-INSTY	.00106	.54016	.013	-.00269	1.000
ANSTOT	.18726	.53792	.019	.47763	.489
ERRTOT	.30068	.53427	.028	.78764	.375
VALMON2	.05250	.53362	.042	.14169	.707
VALMON1	.16586	.53152	.058	.45884	.498
ABLTYE	.07455	.53056	.082	.21211	.645
ABLTYA	.05605	.52981	.112	.16374	.686
-ANSCRF	.00015	.52982	.081	-.00044	1.000

NUMBER	EIGENVALUE	CAN. CORR.	P TRACE	WILKS	SIG.
0	.88745	.68570	100.0	.52982	.061

1 FUNCTIONS WILL BE USED IN REMAINING ANALYSES

STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS

	1
EFFORT	-.40175
EXPCTY	-.27799
IVA	.33511
NACH	.54743

VALMON1	-.28553
VALMON2	.29389
SEX	.56757
CLASS	.82738
VALGAM1	.42995
VALGAM2	-.62954
ABLTYA	.14077
ABLTYE	-.19587
AGE	-1.14160
GPA	-.19446
SUPPORT	.64902
INSTR	-.31720
LEVCHG	-.23694
SUMIV1	-.30943
SUMIV2	1.18718
ANSTOT	.69103
ERRCRF	.33203
ERRTOT	-.86999

CENTROIDS OF GROUPS IN REDUCED SPACE

GROUP 1	1.01862
GROUP 2	-.84400

PREDICTION RESULTS -

ACTUAL GROUP NAME	CODE	N OF CASES	PREDICTED GROUP MEMBERSHIP GROUP 1	GROUP 2
GROUP 1	1	29	23. 79.3P	6. 20.7P
GROUP 2	2	35	5. 14.3P	30. 85.7P

82.8 PERCENT OF KNOWN CASES CORRECTLY CLASSIFIED

CHI-SQUARE = 27.563 SIGNIFICANCE = .000
AUTO-MODE - RETURNED FROM SPSS.
?

200.00S EACH
? EXECUTE
ENTERING SPSS.
T

- - - DISCRIMINANT - - -

SUBFILE MONEY

GROUP COUNTS

	GROUP 1	GROUP 2	TOTAL
NUMBER	13.	19.	32.

ALL ELIGIBLE VARIABLES INCLUDED

SUMMARY TABLE

VARIABLE	F	WILKS LAMBDA	SIG.	V CHANGE	SIG.
ABLTYE	6.15863	.82968	.019	6.15863	.013
SUPPORT	5.47736	.69787	.005	6.82944	.009
GPA	2.48576	.64096	.005	3.81636	.051
SUMIV2	1.84979	.59987	.006	3.20661	.073
ANSTOT	1.72028	.56264	.008	3.30896	.069
ANSCRF	2.53929	.51076	.006	5.41580	.020
INSTR	1.45672	.48153	.008	3.56507	.059
VALGAM2	1.96797	.44358	.007	5.33071	.021
VALMON1	.94240	.42536	.011	2.89709	.089
NACH	.82076	.40936	.016	2.75652	.097
FDBACK	1.11044	.38783	.020	4.06893	.044
ABLTYA	.56761	.37658	.029	2.31091	.128
IVB	.31165	.37017	.047	1.37931	.240
ERRCRF	.21285	.36559	.073	1.01473	.314
AGE	.30789	.35869	.106	1.57905	.209
INSTY	.56482	.34567	.137	3.14935	.076
CLASS	.51074	.33351	.176	3.16610	.075
-GPA	.00003	.33351	.116	-.00018	1.000
EXPCTY	.68029	.31805	.144	4.37104	.037
VALGAM1	.66701	.30253	.177	4.83964	.028
-NACH	.00356	.30261	.116	-.02714	1.000
IVA	.31510	.29545	.161	2.40296	.121
-VALMON1	.00002	.29545	.104	-.00018	1.000
ERRTOT	.25740	.28971	.149	2.01052	.156
VALMON2	.29635	.28273	.203	2.55722	.110
VALMON1	.55075	.26925	.250	5.31263	.021
SUMIV1	.54605	.25531	.302	6.08414	.014
SEX	.37566	.24508	.374	4.90464	.027
NACH	.27571	.23692	.462	4.21871	.040

NUMBER	EIGENVALUE	CAN. CORR.	P TRACE	WILKS	SIG.
0	3.22092	.87355	100.0	.23692	.213

1 FUNCTIONS WILL BE USED IN REMAINING ANALYSES

STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS

	1
EXPCTY	1.07479
INSTY	-2.27461
IVA	1.04840
IVB	.57719
NACH	.46301

VALMON1	2.00216
VALMON2	-2.16425
SEX	.86559
CLASS	2.23824
VALGAM1	-.43269
VALGAM2	-2.12114
ABLTYA	-.14981
ABLTYE	1.92805
AGE	-2.81636
SUPPORT	2.17449
INSTR	-1.26547
FDBACK	.85963
SUMIV1	-2.94219
SUMIV2	6.09940
ANSCRF	5.17962
ANSTOT	-5.76855
ERRCRF	-5.20069
ERRTOT	4.84304

CENTROIDS OF GROUPS IN REDUCED SPACE

GROUP 1	2.10078
GROUP 2	-1.43738

PREDICTION RESULTS -

ACTUAL GROUP NAME	CODE	N OF CASES	PREDICTED GROUP MEMBERSHIP GROUP 1	GROUP 2
GROUP 1	1	13	13. 100.0P	0 0P
GROUP 2	2	19	0 0P	19. 100.0P

100.0 PERCENT OF KNOWN CASES CORRECTLY CLASSIFIED

CHI-SQUARE = 32.000 SIGNIFICANCE = .000

SUBFILE POINTS

GROUP COUNTS

	GROUP 1	GROUP 2	UNGROUPD
NUMBER	16.	16.	32.

ALL ELIGIBLE VARIABLES INCLUDED

SUMMARY TABLE

VARIABLE	F	WILKS LAMBDA	SIG.	V CHANGE	SIG.
NACH	3.88222	.88542	.058	3.88222	.049
SUMIV2	7.56168	.70230	.006	8.83470	.003
SEX	8.40357	.54018	.001	12.82052	.000
VALGAM2	3.52105	.47786	.000	7.24259	.007
VALMON2	3.35263	.42328	.000	8.09532	.004
VALMON1	8.40798	.31675	.000	23.83674	.000
ABLTYA	1.58643	.29711	.000	6.26058	.012

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ABLTYE	6.10216	.23481	.000	26.78921	.000
VALGAM1	3.55423	.20215	.000	20.64067	.000
LEVCHG	1.40897	.18944	.000	9.95688	.002
GPA	1.54675	.17584	.000	12.24712	.000
SUMIV1	2.28725	.15695	.000	20.53786	.000
INSTR	1.94277	.14166	.000	20.63053	.000
FDBACK	2.71533	.12215	.000	33.82578	.000
EXPCTY	1.14732	.11398	.000	17.61134	.000
IVB	1.13551	.10596	.000	19.92536	.000
IVA	1.39875	.09633	.000	28.28856	.000
AGE	1.70933	.08514	.000	40.94845	.000
ANSCRF	1.32170	.07669	.000	38.81114	.000
ERRTOT	.65050	.07241	.001	23.13326	.000
ERRCRF	3.03495	.05555	.001	125.74384	0
ANSTOT	2.56594	.04323	.001	153.97410	0
CLASS	.63571	.04004	.002	55.15070	.000
INSTY	.28418	.03848	.006	30.41470	.000
EFFORT	.42676	.03593	.014	55.45030	.000
-AGE	.00043	.03593	.005	-.06047	1.000
SUPPORT	.17684	.03490	.013	24.61000	.000
AGE	.08344	.03433	.034	14.34423	.000

NUMBER	EIGENVALUE	CAN. CORR.	P TRACE	WILKS	SIG.
0	28.13154	.98269	100.0	.03433	.000

1 FUNCTIONS WILL BE USED IN REMAINING ANALYSES

STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS

	1
EFFORT	-.66102
EXPCTY	1.96692
INSTY	-1.48744
IVA	1.29820
IVB	-1.32259
NACH	5.78324
VALMON1	-8.80530
VALMON2	5.93642
SEX	6.88017
CLASS	-1.00252
VALGAM1	.98326
VALGAM2	-1.72500
ABLTYA	8.43482
ABLTYE	-7.12140
AGE	.51046
GPA	-2.19461
SUPPORT	-.45587
INSTR	1.17993
FDBACK	-.29600
LEVCHG	-2.36815
SUMIV1	5.70712
SUMIV2	1.64988
ANSCRF	11.80804
ANSTOT	-13.95345
ERRCRF	-12.50364
ERRTOT	13.60948

CENTROIDS OF GROUPS IN REDUCED SPACE

GROUP 1	5.13550
GROUP 2	-5.13550

PREDICTION RESULTS -

```
  ACTUAL GROUP           N OF    PREDICTED GROUP MEMBERSHIP
NAME          CODE      CASES    GROUP  1    GROUP  2
---------------------   -----    --------    --------

GROUP  1        1          16       16.          0
                                  100.0P         0P

GROUP  2        2          16         0        16.
                                     0P      100.0P

100.0 PERCENT OF KNOWN CASES CORRECTLY CLASSIFIED

CHI-SQUARE =      32.000   SIGNIFICANCE =  .000
AUTO-MODE - RETURNED FROM SPSS.
?
```

```
  200.005 ALL
? 210.005 GROUPS=LEVCHG(1,2)/
?
```

```
 EXECUTE
ENTERING SPSS.
```

T

- - - DISCRIMINANT - - - **Level Change**

SUBFILE MONEY POINTS **(total Sample)**

GROUP COUNTS

	GROUP 1	GROUP 2	TOTAL
NUMBER	15.	49.	64.

ALL ELIGIBLE VARIABLES INCLUDED

SUMMARY TABLE

VARIABLE	F	WILKS LAMBDA	SIG.	V CHANGE	SIG.
FDBACK	7.67890	.89980	.007	7.67890	.006
SEX	3.19063	.84557	.006	3.64459	.056
INSTR	3.08526	.80421	.004	3.77036	.052
EXPCTY	2.68651	.76919	.003	3.51039	.061
SUPPORT	1.55570	.74910	.004	2.16200	.141
ANSTOT	.83468	.73829	.007	1.21199	.271
ANSCRF	1.56841	.71817	.007	2.35201	.125
GPA	1.29877	.70160	.009	2.03861	.153
SUMIV2	1.39137	.68398	.010	2.27693	.131
NACH	1.34853	.66701	.011	2.30639	.129
INSTY	.40973	.66180	.016	.73241	.392
VALMON1	.88432	.65052	.021	1.62446	.202
VALMON2	.58633	.64298	.028	1.11766	.290
-EXPCTY	.00000	.64298	.017	-.00000	1.000
SUMIV1	1.43918	.62499	.017	2.77551	.096
DRCHG	.33911	.62069	.026	.68653	.407
IVB	.21094	.61797	.038	.43897	.508
CLASS	.19585	.61541	.054	.41806	.518
AGE	1.33416	.59806	.055	2.92199	.087
ABLTYA	.22799	.59505	.075	.52523	.469
VALGAM1	.04698	.59442	.105	.11124	.739
EFFORT	.03470	.59394	.143	.08418	.772
ERRTOT	.04246	.59334	.189	.10552	.745
ERRCRF	1.39108	.57387	.181	3.54535	.060
-SUMIV2	.00040	.57387	.136	-.00104	1.000
VALGAM2	.08762	.57265	.177	.23090	.631
SUMIV2	.01074	.57249	.229	.02908	.865

NUMBER	EIGENVALUE	CAN. CORR.	P TRACE	WILKS	SIG.
0	.74675	.65384	100.0	.57249	.190

1 FUNCTIONS WILL BE USED IN REMAINING ANALYSES

STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS

	1
EFFORT	-.09209
INSTY	.35485
IVB	-.06069
NACH	-.34620
VALMON1	.65402
VALMON2	-.28272
SEX	.15957

```
CLASS            .69613
VALGAM1         -.29134
VALGAM2          .12417
ABLTYA          -.45522
AGE             -.65102
GPA             -.41945
SUPPORT          .24135
INSTR           -.33484
FDBACK           .38222
DRCHG            .25318
SUMIV1          -.41013
SUMIV2          -.11030
ANSCRF         -2.54417
ANSTOT          3.49962
ERRCRF          2.21904
ERRTOT         -2.45918

CENTROIDS OF GROUPS IN REDUCED SPACE

GROUP  1       -1.53725
GROUP  2         .47059

PREDICTION RESULTS -


  ACTUAL GROUP           N OF    PREDICTED GROUP MEMBERSHIP
NAME         CODE        CASES   GROUP  1    GROUP  2
-------------            -----   --------    --------

GROUP  1       1          15       14.          1.
                                   93.3P        6.7P

GROUP  2       2          49        9.         40.
                                   18.4P       81.6P


 84.4 PERCENT OF KNOWN CASES CORRECTLY CLASSIFIED


CHI-SQUARE =      30.250   SIGNIFICANCE =  .000
AUTO-MODE - RETURNED FROM SPSS.
?



  200.005 EACH
? EXECUTE



ENTERING SPSS.
```

T

- - - DISCRIMINANT - - -

SUBFILE MONEY

GROUP COUNTS

	GROUP 1	GROUP 2	TOTAL
NUMBER	8.	24.	32.

ALL ELIGIBLE VARIABLES INCLUDED

SUMMARY TABLE

VARIABLE	F	WILKS LAMBDA	SIG.	V CHANGE	SIG.
FDBACK	6.92308	.81250	.013	6.92308	.009
NACH	5.06130	.69177	.005	6.44410	.011
GPA	4.71206	.59212	.002	7.29817	.007
ANSTOT	3.60964	.52229	.001	6.77347	.009
ANSCRF	8.62290	.39222	.000	19.04959	.000
VALGAM1	2.87450	.35177	.000	8.79464	.003
SUMIV2	2.54014	.31810	.000	9.02629	.003
EXPCTY	1.61452	.29724	.000	6.62019	.010
VALMON2	2.86753	.26296	.000	13.15539	.000
VALMON1	3.82834	.22242	.000	20.79789	.000
INSTY	1.73993	.20461	.000	11.73436	.001
CLASS	1.28931	.19161	.000	9.94921	.002
INSTR	.68429	.18459	.000	5.95202	.015
SEX	.61555	.17814	.001	5.88456	.015
ABLTYE	.57125	.17200	.001	6.01256	.014
IVB	1.15612	.15969	.002	13.44303	.000
ERRCRF	.83482	.15071	.003	11.20200	.001
ERRTOT	2.67321	.12500	.002	40.93308	.000
-VALGAM1	.00049	.12501	.001	-.00910	1.000
IVA	3.99116	.09564	.001	73.67816	.000
SUMIV1	2.28003	.08037	.001	59.59681	.000
-CLASS	.00092	.08038	.000	-.02857	1.000
EFFORT	.67022	.07613	.000	20.84571	.000
VALGAM1	.14179	.07516	.001	5.07956	.024
VALGAM2	.39035	.07233	.003	15.58098	.000
ABLTYA	.17536	.07095	.007	8.08088	.004
SUPPORT	.92218	.06362	.011	48.73933	.000
AGE	.27825	.06119	.024	18.74413	.000

NUMBER	EIGENVALUE	CAN. CORR.	P TRACE	WILKS	SIG.
0	15.34338	.96892	100.0	.06119	.001

1 FUNCTIONS WILL BE USED IN REMAINING ANALYSES

STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS

	1
EFFORT	1.50354
EXPCTY	1.95712
INSTY	-2.35962
IVA	2.02355
IVB	-2.30973

NACH	2.35181
VALMON1	-.92629
VALMON2	.36006
SEX	.10621
VALGAM1	1.98647
VALGAM2	-2.28877
ABLTYA	3.35672
ABLTYE	-1.40805
AGE	-.54442
GPA	2.39338
SUPPORT	1.45615
INSTR	-.91520
FDBACK	-.61810
SUMIV1	-5.15582
SUMIV2	6.25932
ANSCRF	4.34018
ANSTOT	-9.03740
ERRCRF	-11.86648
ERRTOT	12.20116

CENTROIDS OF GROUPS IN REDUCED SPACE

GROUP 1	6.56911
GROUP 2	-2.18970

PREDICTION RESULTS -

ACTUAL GROUP NAME	CODE	N OF CASES	PREDICTED GROUP MEMBERSHIP GROUP 1	GROUP 2
GROUP 1	1	8	8. 100.0P	0 0P
GROUP 2	2	24	0 0P	24. 100.0P

100.0 PERCENT OF KNOWN CASES CORRECTLY CLASSIFIED

CHI-SQUARE = 32.000 SIGNIFICANCE = .000

SUBFILE POINTS

GROUP COUNTS

	GROUP 1	GROUP 2	UNGROUPD
NUMBER	7.	25.	32.

ALL ELIGIBLE VARIABLES INCLUDED

SUMMARY TABLE

VARIABLE	F	WILKS LAMBDA	SIG.	V CHANGE	SIG.
VALGAM1	9.92642	.75138	.004	9.92642	.002
ABLTYE	3.08884	.67905	.004	4.25263	.039
VALGAM2	2.68006	.61974	.003	4.22866	.040
IVB	2.65855	.56418	.003	4.76646	.029
CLASS	2.66789	.51168	.003	5.45626	.020
EXPCTY	2.63507	.46289	.002	6.17982	.013

ERRTOT	1.75985	.43127	.002	4.75235	.029
INSTY	3.15108	.37930	.002	9.53030	.002
SUPPORT	1.28966	.35830	.002	4.63651	.031
NACH	1.24474	.33825	.003	4.96294	.026
GPA	1.58057	.31347	.004	7.00924	.008
EFFORT	.40717	.30690	.007	2.05090	.152
FDBACK	.62223	.29664	.011	3.37915	.066
ABLTYA	.48202	.28846	.017	2.86752	.090
VALMON2	.28025	.28350	.029	1.82164	.177
VALMON1	.56199	.27326	.042	3.96466	.046
DRCHG	.74168	.25951	.056	5.81608	.016
SUMIV1	.60256	.24802	.077	5.35820	.021
SEX	1.33836	.22313	.082	13.49062	.000
INSTR	.98426	.20481	.098	12.03041	.001
-FDBACK	.00124	.20483	.058	-.01650	1.000
ERRCRF	.89617	.18940	.073	11.93241	.001
ANSTOT	.71397	.17678	.097	11.30910	.001
ANSCRF	3.79518	.12434	.052	71.56273	.000
IVA	2.62026	.09366	.040	79.02342	.000
AGE	.48365	.08761	.067	22.12989	.000
SUMIV2	.04599	.08694	.126	2.62470	.105
FDBACK	.02871	.08645	.221	1.98126	.159

NUMBER	EIGENVALUE	CAN. CORR.	P TRACE	WILKS	SIG.
0	10.56759	.95580	100.0	.08645	.015

1 FUNCTIONS WILL BE USED IN REMAINING ANALYSES

STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS

	1
EFFORT	-1.29481
EXPCTY	2.83700
INSTY	-2.33516
IVA	1.22381
IVB	-1.82237
NACH	4.93859
VALMON1	-8.03184
VALMON2	5.81805
SEX	5.51684
CLASS	-.45331
VALGAM1	-.96586
VALGAM2	-.67791
ABLTYA	5.80236
ABLTYE	-6.52226
AGE	.85951
GPA	-1.91016
SUPPORT	-.81241
INSTR	.69321
FDBACK	-.17039
DRCHG	3.86383
SUMIV1	7.32453
SUMIV2	-.83128
ANSCRF	18.95783
ANSTOT	-19.40280
ERRCRF	-13.10000
ERRTOT	14.23382

CENTROIDS OF GROUPS IN REDUCED SPACE

GROUP 1	-5.94832
GROUP 2	1.66553

PREDICTION RESULTS -

ACTUAL GROUP NAME	CODE	N OF CASES	PREDICTED GROUP MEMBERSHIP GROUP 1	GROUP 2
GROUP 1	1	7	7. 100.0P	0 0P
GROUP 2	2	25	0 0P	25. 100.0P

100.0 PERCENT OF KNOWN CASES CORRECTLY CLASSIFIED

CHI-SQUARE = 32.000 SIGNIFICANCE = .000
AUTO-MODE - RETURNED FROM SPSS.
?

APPENDIX C

MEAN RESPONSE CURVES

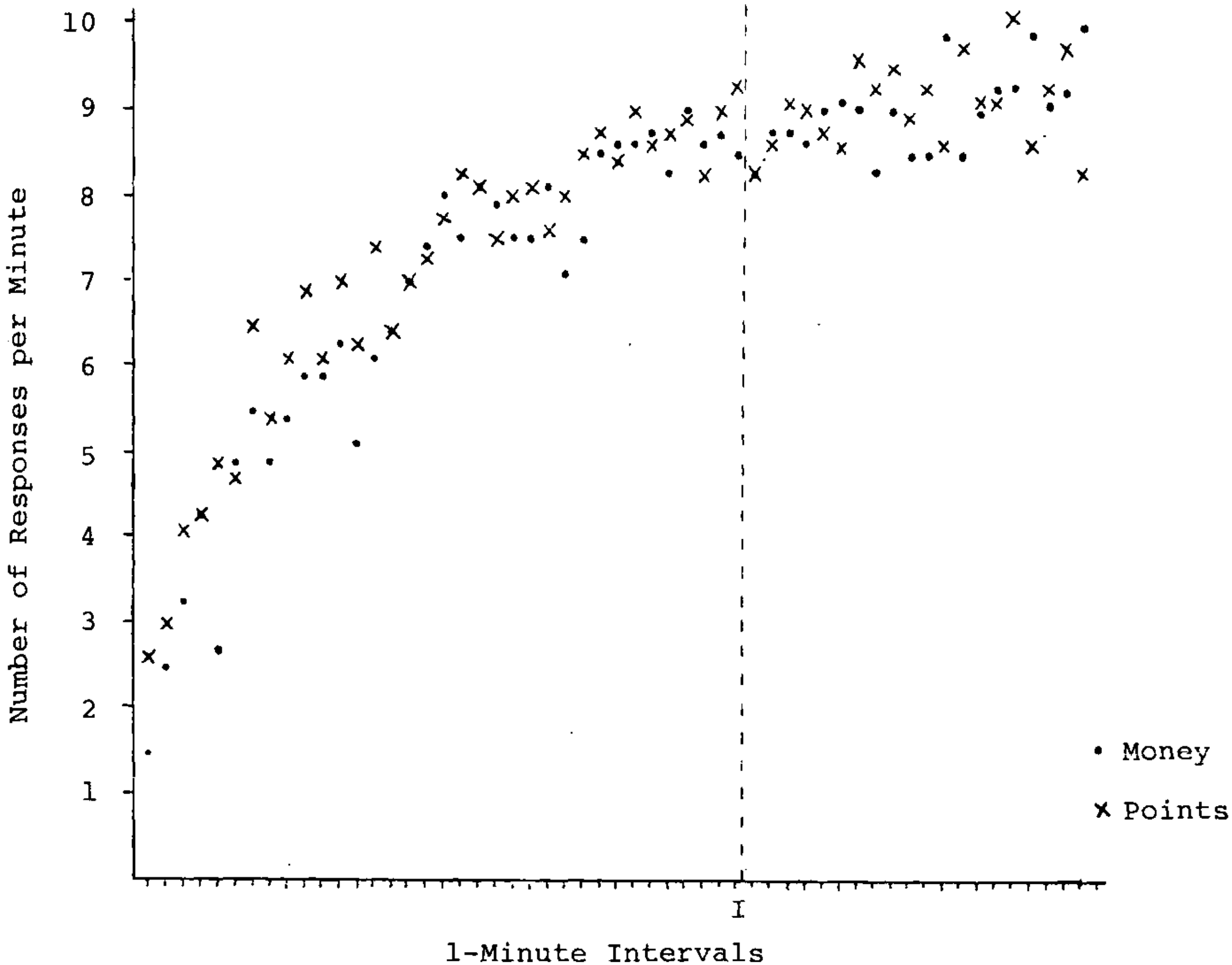

Figure 6. Mean Performance Curves for F-I Subjects

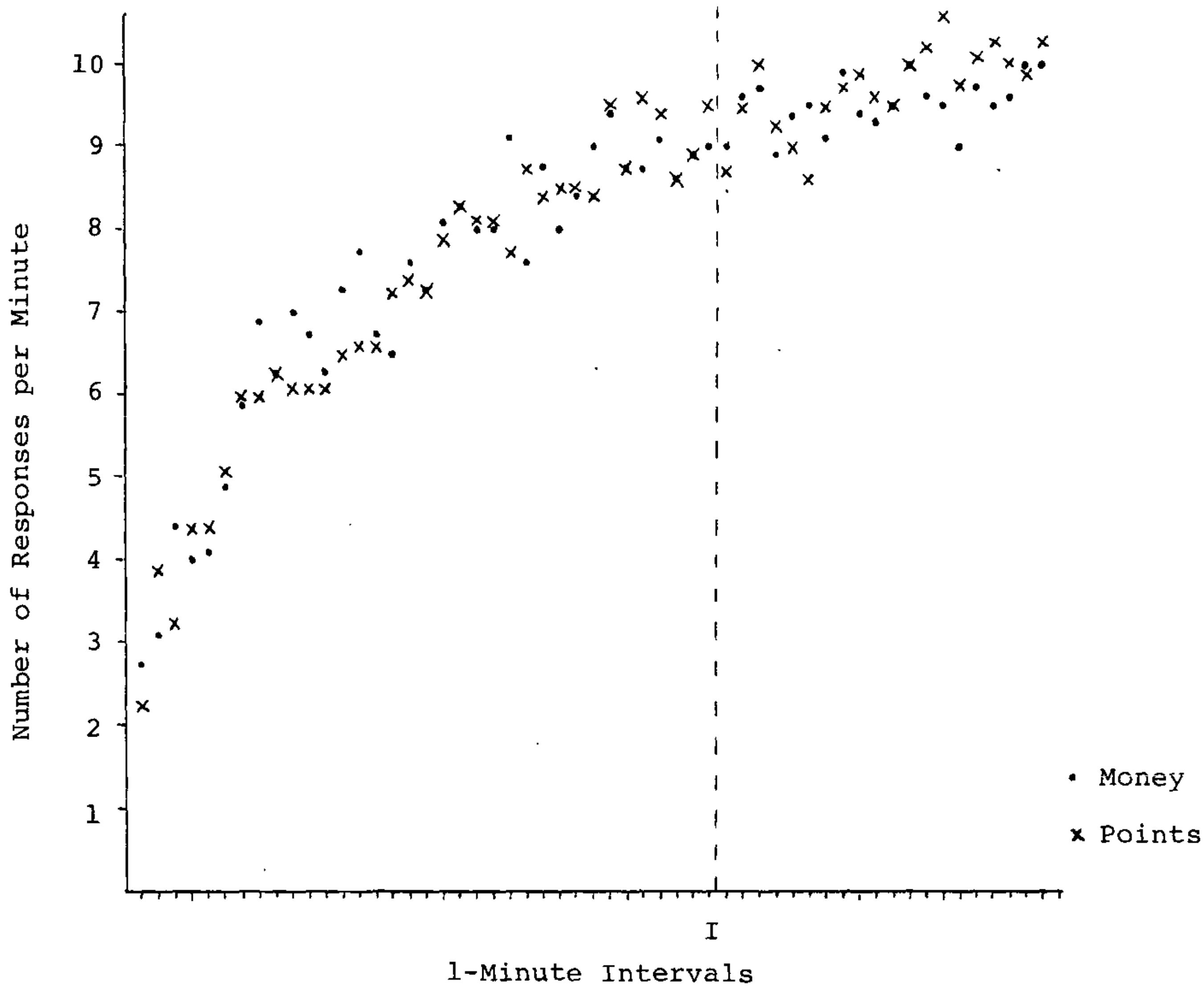

Figure 7. Mean Performance Curves for NF-I Subjects.

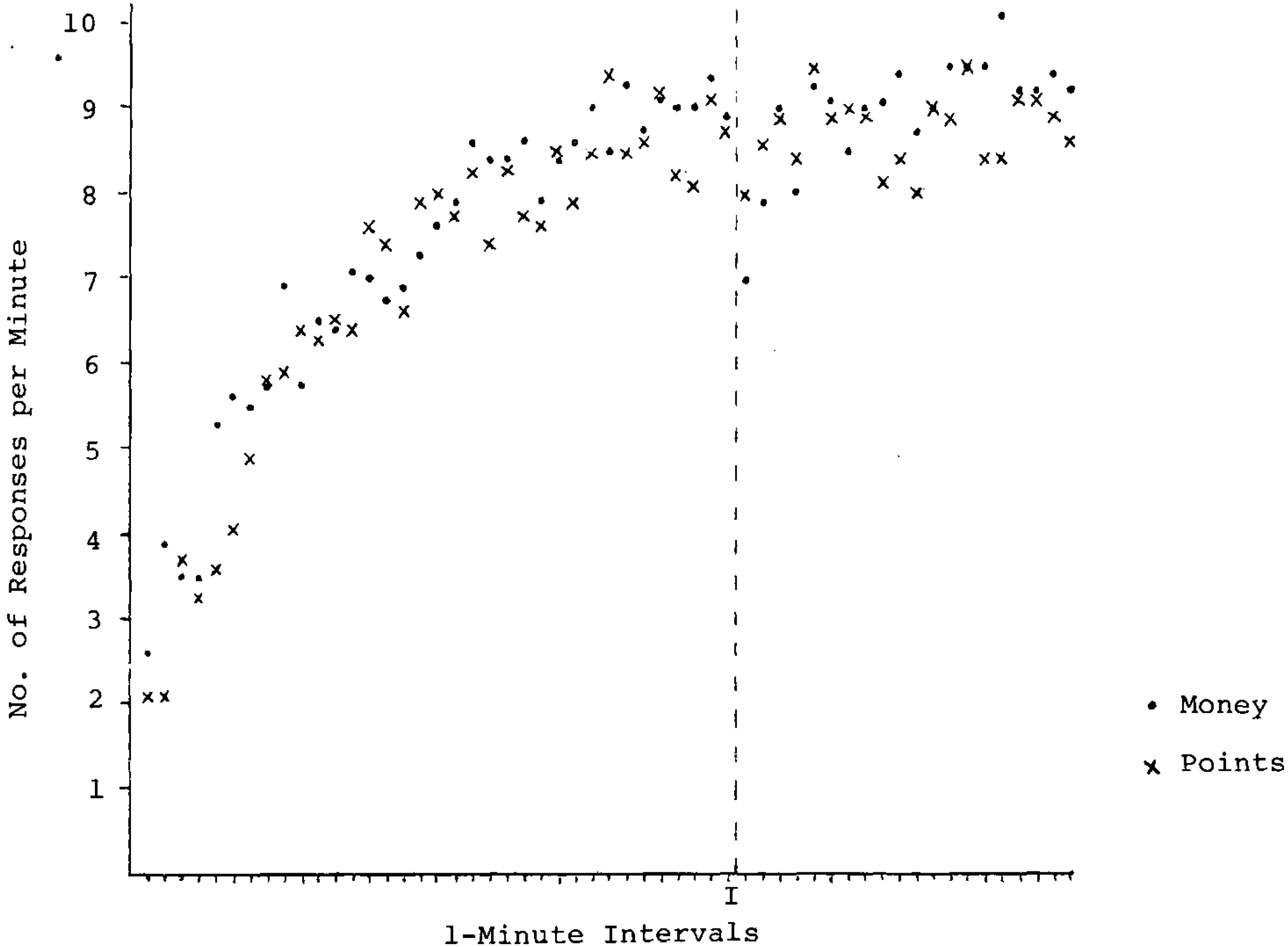

Figure 8. Mean Performance Curves for F-NI Subjects

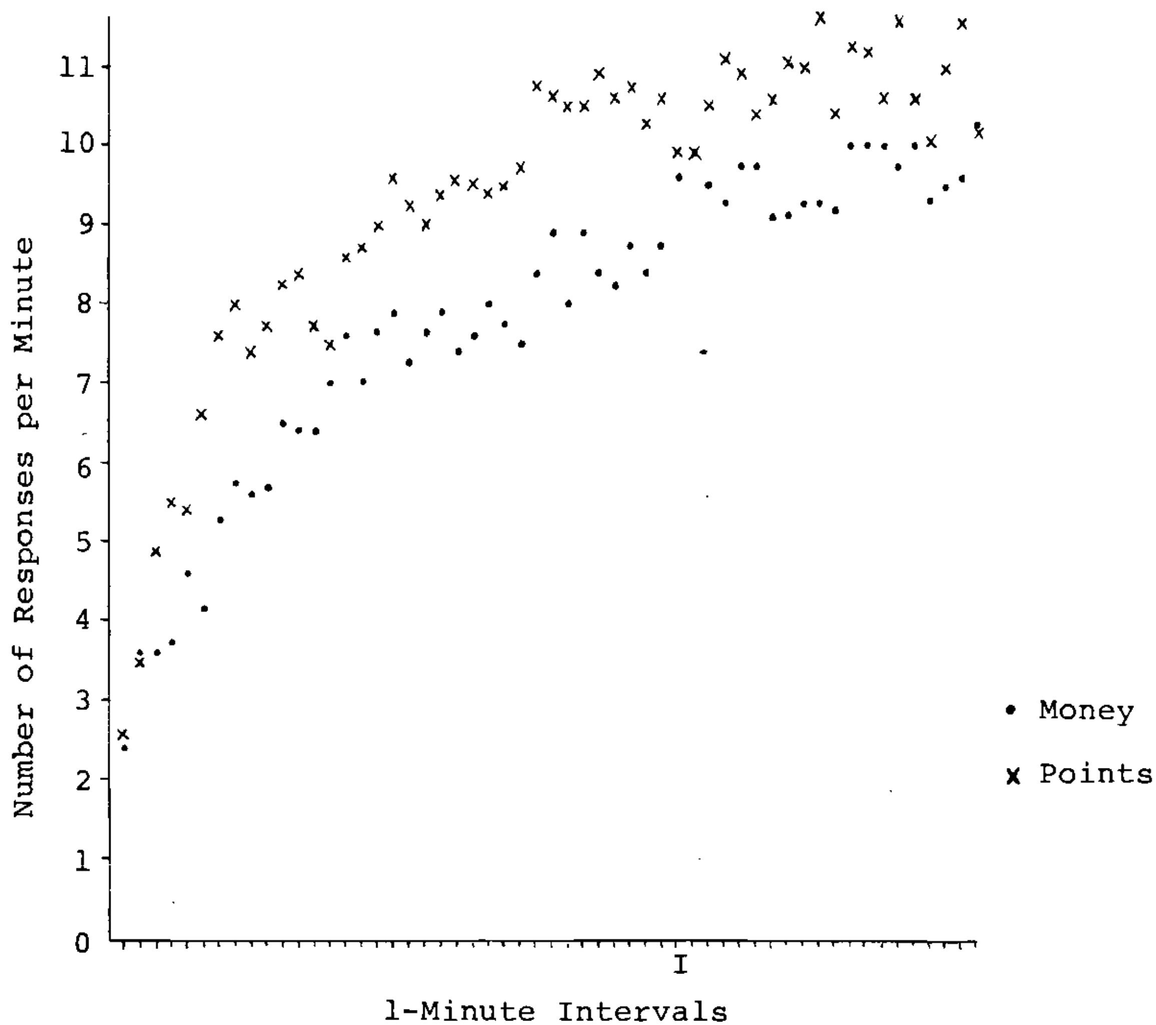

Figure 9. Mean Performance Curves for NF-NI Subjects (no intervention).

APPENDIX D

ANALYSIS OF TIME-SERIES DATA

APPENDIX D

ANALYSIS OF TIME-SERIES DATA

The present experiment utilized a "stratified Multiple Group-Single Intervention" design in which two groups were identified as receiving money or points as reinforcement. Both groups received the same intervention, the change from continuous reinforcement to a variable ratio schedule. The intervention is actually continuous in nature in that it is applied continuously over several points in time. The distinction between temporary versus continuous intervention becomes important in the interpretation of intervention effects.

The Autoregressive-Integrated-Moving-Average (ARIMA) model (Box and Jenkins, 1970) was used to describe and analyze the data. The first step is to identify the model which best describes the data after its collection. In the ARIMA model, the observed time-series is regarded as having three basic properties: 1) the observed series is stationary or non-stationary, and if the latter, there exists a degree of "differencing" of the series required to produce stationarity, 2) the order of the autoregressive component of the model, 3) the order of the moving average component of the model.

A stationary model remains in equilibrium around a constant mean level, although oscillations around this level may not be random. If the series is not stationary, successive differences are taken until the resulting series is stationary. The degree of differencing needed is determined using an autocorrelation function, and is denoted as $\underline{d}$. Box and Jenkins (1970) note that $\underline{d}$ rarely needs to exceed values other than 0, 1, or 2.

The autoregressive ($\underline{p}$) and moving average ($\underline{q}$) components are determined partly from inference and examination of the data after $\underline{d}$ has been determined. The process of specifying values for $\underline{p}$ and $\underline{q}$ is described by Glass et al. (1975). Identification of these components of the underlying model requires the calculation of a correlation coefficient called the autocorrelation from the scatterplots of various "lags." The lag 1 scatterplot pairs observations with those that are lagged by one unit of time, i.e. Z_t with Z_{t+1}. The lag 1 autocorrelation coefficient, r_i, is then plotted along with other autocorrelation coefficients, $(r_2, r_3, \ldots r_k)$ to provide what is called the correlogram. For instance, a first-order moving averages model shows the lag correlation being nonzero and the autocorrelations for lags 2 and greater will be zero, within sampling error.

The most common nonstationary ARIMA (p,d,q) model, and the model used in the present study, is ARIMA (0,1,1), which contains no autoregressive term, and the first differences contain one moving averages term. The model is suggested first by examining the data graph. The process should show nonstationarity, wandering away from a given level for long periods of time rather than oscillating around a single level. The model is also recognizable by its correlogram, which does not die out to zero exponentially or abruptly. The autocorrelations of the undifferenced data remain large for large lags. Yet the first differences of the data are stationary. The correlogram must also show the moving averages property of having the lag 1 autocorrelation be nonzero while the autocorrelations for large lags are essentially zero.

The ARIMA (0,1,1) model can be stated mathematically as:

$$Z_t = L + (1 - \theta_1) \sum_{i=1}^{t-1} a_i + a_t$$

where Z_t = observation at time t

L = true but unobserved level of the process at t=0

a_i = random shocks entering at time t=0 NID $(0,\sigma^2)$

$1-\theta$ = proportion of shocks remaining in the system indefinitely

After identification of the ARIMA model, the parameter θ_1 must be estimated from the observed time-series. It is possible to calculate

$$\underline{SS} = \hat{a}_i^2$$

where the minimum SS determines the maximum likelihood estimates of θ_1. A$(1 - \alpha)$ percent confidence region is then given by

$$SS_{(1-\alpha)}(\theta) = [SS_{\text{calculated min.}}][1 + \frac{\chi^2_\alpha(p+q)}{N}].$$

As mentioned previously, the present data was identified by an ARIMA (0,1,1) model. Yet due to the nature of the data for the present study, i.e. an aquisition curve, it became apparent that the data did not fit the assumption of no systematic, non-stochastic trends of a probabilistic nature. This assumption is implicit in having a_i being normally and independently distributed with a mean of zero. In such a case, the random variable portion of the model can be allowed to assume an expected value other than zero, taking on the form,

$$Z_t = L + (1 + \theta_1) \sum_{i=1}^{t=1} b_i + b_t,,$$

where b is a normal variable with variance σ_b^2 and mean equal to μ. The parameter μ is related to the rate of ascent or descent of the time-series. b can be thought of as μ + a. It is then possible to test for both changes in the deterministic drift as well as changes in level at the point of intervention. If the above equation is descriptive of the n_1 observations before intervention, then the n_2 observations after intervention can be described by

$$Z_t = L + (1 + \theta_1) \sum_{i=1}^{t-1} (b_i + \Delta) + (b_t + \Delta) + \partial$$

where ∂ = the change of level of the series between time n_1 and $n_1 + 1$

Δ = the change in the mean of the random errors between these two times.

Prior to intervention, the series drifts at a rate of $(1-\theta)$ units for each unit of time. After intervention, the series drifts $(1 - \theta_1)$. $(\mu + \Delta)$ units on the average for each unit of time.

Glass et al. (1975) make some suggestions which were also considered before collection and analysis of the data. They suggest that at least 50 data points be collected to identify the ARIMA model with some confidence. The large sample size does not increase the power of the tests directly but allows the dependence among the observations to be accounted for. In the present study, observations were recorded at 30 second intervals, providing a total of 110 observations, 70 prior to intervention.

Programs CORREL and TSX (Bower, Padia, and Glass,1974), were used to analyze the time-series observations from the 64 subjects used in this study. CORREL was used in the identification of the model appropriate for the time-series. The program subjects the time-series data to a correlogram and partial autocorrelation analysis. Inspection of the output and the data graphs suggested the ARIMA (0,1,1) model. To verify this choice, a random sample of time-series cases was selected and run through CORREL with the option included to provide the residuals,

$$\hat{a}_t = z_t - \hat{z}_t.$$

These residuals were in turn run through CORREL to provide the autocorrelations and correlogram. If the correct model had been identified, the residuals should be uncorrelated, indicated by a non-significant chi-square statistic. This implies that the residual are white noise and that the model was correctly fit. In all cases tested, the data indicated that the (0,1,1) model was appropriate.

Each of the 64 time-series sets was then run through TSX, a Fortran IV program which analyzes time-series data with intervention. A design matrix constructed by the program performs a standard least-squares regression of the observations onto the "independent variables" of the design matrix. The initial design matrix is multiplied by an appropriate function to construct the actual design matrix used in the regression. A complete least-squares analysis is performed for increments of .02 between +1 and -1 for θ_1. Options were used to estimate the change in the level, drift, and change in drift.

BIBLIOGRAPHY

Adams, J. S. Toward an understanding of inequity. Journal of Abnormal and Social Psychology, 1963, 67, 422-436.

Adams, J. S. Injustice in social exchange. In. L. Barkowitz (Ed.), Advances in experimental social psychology. Vol. 2, New York: Academic Press, 1965.

Ammons, R. B. Effects of knowledge of performance: a survey and tentative theoretical formulation. Journal of General Psychology, 1956, 54, 279-299.

Arvey, R. D. Task performance as a function of perceived effort-performance and performance-reward contingencies. Organizational Behavior and Human Performance, 1972, 8, 423-433.

Atkinson, J. W. Toward experimental analysis of human motivation in terms of motives, expectations, and incentives. In J. W. Atkinson (Ed.), Motives in fantasy, action, and society. Princeton: Van Nostrand, 1958.

Atkinson, J. W. and Raphelson, A. C. Individual differences in motivation and behavior in particular situations. Journal of Personality, 1956, 24, 349-363.

Atkinson, J. W. and Reitman, W. R. Performance as a function of motive strength and expectancy of goal attainment. Journal of Abnormal and Social Psychology, 1956, 53, 361-366.

Bandura, A., in R. Glaser (Ed.) The nature of reinforcement. New York: Academic Press, 1971.

Berger, C. J., Cummings, L.L. & Heneman, H. G. Expectancy theory and operant conditioning predictions of performance under variable ratio and continuous schedules of reinforcement. Organizational Behavior and Human Performance, 1975, 14, 227-243.

Bilodeau, E. A. & Bilodeau, I. M. Motor-skills learning. In Annual review of psychology, Vol. 12, Palo Alto: Annual Review, 1961.

Boren, M. C. P. Fixed-ratio and variable ratio schedules of brief stimuli in second-order schedules of matching to sample. Journal of the Experimental Analysis of Behavior, 1973, 20, 219-233.

Bower, C. P., Padia, W. L., and Glass, G. V. TMS: Two Fortran IV programs for analysis of time-series experiments. Boulder: Laboratory of Educational Research, 1974.

Box, G. F., & Jenkins, G. M. Time-series analysis: Forecasting and control. San Francisco: Holden Day, 1970.

Braunstein, D. W., Klein, G. A., & Pachla, M. Feedback expectancy and shifts in student ratings of college faculty. Journal of Applied Psychology, 1973, 58, 254-258.

Brown, J. S. Problems presented by the concept of acquired drives. In Current theory and research in motivation: A symposium. Lincoln: University of Nebraska Press, 1953.

Brown, J. S. The motivation of behavior. New York: McGraw-Hill, 1961.

Bruning, J. L. Effects of magnitude of reward and percentage of reinforcement on a lever movement response. Child Development, 1964, 35, 281-285.

Camann, C., & Lawler, F. E. III. Employee reactions to a pay incentive plan. Journal of Applied Psychology, 1973, 58, 163-172.

Campbell, H. Group incentives. Occupational Psychology, 1952, 26, 15-21.

Campbell, J. P. & Pritchard, R. D. Motivation theory in industrial and organizational psychology. In M. D. Dunnette (Ed.) Handbook of industrial and organizational psychology. Chicago: Rand McNally, 1976.

Caputo, D. V., Psathas, G., & Plapp, J. M. Test-retest reliability of the EPPS. Educational and Psychological Measurement, 1966, 26, 883-886.

Cherrington, D. J. The effects of a central incentive-motivational state on measures of job satisfaction. Organizational Behavior and Human Performance, 1973, 10, 271-289.

Cramer, E. M. Revised MANOVA program. Chapel Hill: University of North Carolina Psychometric Laboratory, 1967.

Cramer, E. M. MANOVA, a computer program for univariate and multivariate analysis of variance. Chapel Hill: L. L. Thurstone Psychometric Laboratory, University of North Carolina, 1973 (mimeographed).

Dachler, H. P., & Mobley, W. H. Construct validation of an instrumentality-expectancy-task-goal model of work motivation. Journal of Applied Psychology, 1973, 58, 397-418.

Dalton, M. The industrial "rate-buster": A characterization. Applied Anthropology, 1948, 7, 15-78.

Davison, M. C. Preference for mixed-interval vs. fixed-interval schedules. Journal of the Experimental Analyses of Behavior, 1969, 12, 247-252.

Deci, E. L. The effects of externally medicated rewards on intrinsic motivation. Journal of Personality and Social Psychology, 1971, 18, 105-115.

Deci, E. L. The effects of contingent and noncontingent rewards and controls on intrinsic motivation. Organizational Behavior and Human Performance, 1972, 8, 217-229. (a)

Deci, E. L. Intrinsic motivation, extrinsic reinforcement, and inequity. Journal of Personality and Social Psychology, 1972, 22, 113-120. (b)

Dollard, J., & Miller, N. E. Personality and psychotherapy. New York: McGraw-Hill, 1950.

Edwards, A. L. Manual for the Edwards personal preference schedule. New York: Psychological Corporation, 1959.

Elliott, R. Reaction time and heart rate as function of magnitude of incentive and probability of success: a replication and extension. Journal of Experimental Research on Personality, 1966, 1, 174-178.

English, H. B., & English, C. A. A comprehensive dictionary of psychological and psychoanalytic terms. New York: McKay, 1958.

Estes, W. K. in R. Glaser (Ed.) The nature of reinforcement. New York: Academic Press, 1971.

Fantino, E. Preferences for mixed- versus fixed-ratios. Journal of the Experimental Analysis of Behavior, 1967, 10, 35-42.

Ferster, C. B. Intermittent reinforcement of a complex response in a chimpanzee. Journal of the Experimental Analysis of Behavior, 1958, 1, 163-165.

Ferster, C. B., & Skinner, B. F. Schedules of reinforcement. New York: Appleton-Century-Crofts, 1957.

Findley, J. D. An experimental outline for building and exploring multi-operant behavior repertories. Journal of the Experimental Analyses of Behavior, 1962, 5, 113-166.

French, E. G. Some characteristics of achievement motivation. Journal of Experimental Psychology, 1955, 50, 232-236.

Galbraith, J., & Cummings, L. L. An empirical investigation of the motivational determinants of task performance: Interactive effects between instrumentality-valence and motivation-ability. Organizational Behavior and Human Performance, 1967, 2, 237-257.

Glass, G. V., Willson, V. L., & Gottman, J. M. Design and analysis of time-series experiments. Boulder: Colorado Associated University Press, 1975.

Graen, G. Instrumentality theory of work motivation: Some experimental results and suggested modifications. Journal of Applied Psychology Monographs, No. 2, Part 2, 1969.

Hackman, J. R., & Porter, L. W. Expectancy theory predictions of work effectiveness. Organizational Behavior and Human Performance, 1968, 3, 417-426.

Hamner, W. C. & Harnett, D. L. Goal setting, performance, and satisfaction in an independent task. Organizational Behavior and Human Performance, 1974, 12, 217-230.

Harris, R.J. Multiple significance tests of correlation coefficients in correlation matrices (Doctoral dissertation University of Maryland, 1967). Dissertation Abstracts, 1967, 28, 11633.

Heiman, G. W. A note on "operant conditioning principles extrapolated to the theory of management." Organizational Behavior and Human Performance, 1975, 13, 165-170.

Heneman, H. G. III, & Schwab, D. P. Evaluation of research on expectancy theory predictions of employee performance. Psychological Bulletin, 1972, 78, 1-9.

Herrnstein, R. J. Aperiodicity as a factor in choice. Journal of the Experimental Analysis of Behavior, 1964, 7, 179-182.

Herzburg, F., Mausner, B., & Snyderman, B. The motivation to work. New York: Wiley, 1959.

Holland, J. G., & Skinner, B. F. The analysis of behavior. New York: McGraw-Hill, 1961.

Holmstrom, V. L., & Beach, L. R. Subjective expected utility and career preference. Organizational Behavior and Human Performance, 1973, 10, 201-207.

Horst, P., & Wright, C. E. The comparative reliability of two techniques of personality appraisal. Journal of Clinical Psychology, 1959, 15, 388-391.

House, R. J. A path goal theory of leader effectiveness. Administrative Science Quarterly, 1971, 16, 321-328.

House, R. J., Shapiro, H. J., & Wahba, M. A. Expectancy theory as a predictor of work behavior and attitude: A re-evaluation of empirical evidence. Decision Sciences, 1974, 5, 481-506.

Hundal, P. S. Knowledge of performance as an incentive in repetitive industrial work. Journal of Applied Psychology, 1969, 53, 224-226.

Ilgen, D. R., & Hamstra, B. W. Performance satisfaction as a function of the difference between expected and reported performance at five levels of reported performance. Organizational Behavior and Human Performance, 1972, 7, 359-370.

Jablonsky, S. F., & DeVries, D. L. Operant conditioning principles extrapolated to the theory of management. Organizational Behavior and Human Performance, 1972, 7, 340-358.

Jorgenson, D. O., Dunnette, M. D., & Pritchard, R. D. Effects of the manipulation of performance-reward contingency on behavior in a simulated work setting. Journal of Applied Psychology, 1973, 57, 271-280.

Kaufman, H. Task performance, expected performance, and responses to failure as functions of imbalance in the self-concept. Unpublished doctoral dissertation, Philadelphia: University of Pennsylvania Press, 1962.

Kelleher, R. T., & Gollub, L. R. A review of positive conditioned reinforcement. Journal of the Experimental Analysis of Behavior, 1962, 5, 543-597.

King, N. A clarification and evaluation of the two-factor theory of job satisfaction. Psychological Bulletin, 1970, 76, 18-31.

Klein, S. M., & Maher, J. R. Education level and satisfaction with pay. Personnel Psychology, 1966, 19, 195-208.

Larzelere, R. E. An empirical investigation of three procedures for multiple significance tests of intercorrelations. Unpublished master's thesis, Georgia Institute of Technology, 1975.

Larzelere, R. E., & Mulaik, S. A. Single-sample tests for many correlations. Psychological Bulletin, 1977, 84, 557-569.

Latham, G. P. & Kinne, S. B. Improving job performance through training in goal setting. Journal of Applied Psychology, 1974, 59, 187-191.

Lawler, E. E., III. A correlation-causal analysis of the relationship between expectancy attitudes and job performance. Journal of Applied Psychology, 1968, 52, 462-468.

Lawler, E. E., III. Pay and organizational effectiveness: A psychological view. New York: McGraw-Hill, 1971.

Lawler, E. E. & Porter, L. W. Antecedent attitudes of effective managerial performance. Organizational Behavior and Human Performance, 1967, 2, 122-142.

Leventhal, G. S., Weiss, T., and Long, G. Equity, reciprocity, and reallocating rewards in the dyad. Journal of Personality and Social Psychology, 1969, 13, 300-305.

Lewin, K. A dynamic theory of personality. New York: McGraw-Hill, 1935.

Lewin, K. The conceptual representation and measurement of psychological forces. Durham, N.C.: Duke University Press, 1938.

Lewis, D. J., & Duncan, C. P. Effects of variable magnitude of reward on a lever pulling response. Journal of Experimental Psychology, 1961, 62, 203-205.

Locke, E. A. Toward a theory of task performance and incentives. Organizational Behavior and Human Performance, 1968, 3, 157-189.

Locke, E. A., Cartledge, N., & Knerr, C. S. Studies of the relationship between satisfaction, goal setting, and performance. Organizational Behavior and Human Performance, 1970, 4, 135-158.

Lowell, E. L. The effect of need for achievement on learning and speed of performance. Journal of Psychology, 1952, 35, 31-40.

Luce, R. D. Psychological studies of risky decision making. In Strother, G. B. (Ed.), Social science approaches to business behavior. Homewood: Dorsey, 1962, 141-161.

Mann, J. H. Self-ratings and the EPPS. Journal of Applied Psychology, 1958, 42, 267-268.

Marriott, R. Size of working group and output. Occupational Psychology, 1949, 23, 47-57.

Marriott, R. Incentive Payment Systems. London: Staple Press, 1957.

Matsui, T., and Terai, T. A cross-cultural study of the validity of the expectancy theory of work motivation. Journal of Applied Psychology, 1975, 60, 263-265.

Mawhinney, T. C. Operant terms and concepts in the description of individual work behavior: Some problems of interpretation, application, and evaluation. Journal of Applied Psychology, 1975, 60, 704-712.

Mawhinney, T. C., & Behling, O. Differences in predictions of work behavior from expectancy and operant models of individual motivation. Proceedings of the Meeting of the Academy of Management, 1973, 383-388.

Mitchell, T. R. Expectancy models of job satisfaction, occupational preference, and effort: A theoretical, methodological, and empirical appraisal. Psychological Bulletin, 1974, 81, 1053-1077.

Mitchell, T. R., & Albright, D. W. Expectancy theory predictions of the satisfaction, effort, performance, and retention of naval aviation officers. Organizational Behavior and Human Performance, 1972, 8, 1-20.

Mitchell, T. R., & Nebeker, D. M. Expectancy theory predictions of academic effort and performance. Journal of Applied Psychology, 1973, 57, 61-67.

Mitchell, T. R., & Pollard, W. E. Instrumentality theory predictions of academic behavior. Journal of Social Psychology, 1973, 89, 34-45.

Motowidlo, S. J., Loehr, V., & Dunnette, M. D. The effect of goal specificity on the relationship between expectancy and task performance. Tech Rep. 4008, Minneapolis: University of Minnesota, 1972.

Nie, N. H., Hull, C. H., Jenkins, J. G., Steinbrenner, K., & Bent, D. Statistical package for the social sciences. New York: McGraw-Hill, 1975.

Opsahl, R. L., & Dunnette, B. D. The role of financial compensation in industrial motivation. Psychological Bulletin, 1966, 66, 94-118.

Porter, L. W., & Lawler, E. E., III. Managerial attitudes and performance. Homewood, Ill.: Dorsey Press, 1968.

Porter, L. W., Lawler, E. E., III, & Hackman, J. R. Behavior in organizations. New York: McGraw-Hill, 1975.

Pritchard, R. D., & Curtis, M. I. The influence of goal setting and financial incentives on task performance. Organizational Behavior and Human Performance, 1973, 10, 175-183.

Pritchard, R. D., & Sanders, M. S. The influence of valence, instrumentality, and expectancy on effort and performance. Journal of Applied Psychology, 1973, 9, 215-225.

Roethlisberger, F. J., & Dickson, W. J. Management and the worker. Cambridge: Harvard University Press, 1939.

Ronan, W. W., Latham, G. P., & Kinne, S. B., III. Effects of goal setting and supervision on worker behavior in an industrial situation. Journal of Applied Psychology, 1973, 58, 302-307.

Rotter, J. B. The role of the psychological situation in determining the direction of human behavior. In Jones, M. R. (Ed.), Nebraska Symposium on Motivation. Lincoln: University of Nebraska Press, 1955, pp. 245-268.

Ryan, T. A. Multiple comparisons in psychological research. Psychological Bulletin, 1959, 56, 26-47.

Schuster, J. R., Clark, B., & Rogers, M. Testing portions of the Porter and Lawler model regarding the motivational role of pay. Journal of Applied Psychology, 1971, 55, 187-195.

Schwab, D. P. Impact of alternative compensation systems on pay valence and instrumentality perceptions. Journal of Applied Psychology, 1973, 58, 308-312.

Schwab, D. P., & Dyer, L. D. The motivational impact of compensation system on employee performance. Organizational Behavior and Human Performance, 1973, 9, 215-225.

Sheridan, J. E., Richards, M. D., & Slocum, J. W., Jr. The descriptive power of Vroom's expectancy model of motivation. Proceedings of the Annual Meeting of the Academy of Management, 1973, 414-420.

Sidman, M. Tactics of scientific research. New York: Basic Books, 1960.

Skinner, B. F. Science and human behavior. New York: MacMillan, 1953.

Tolman, E. C. Purposive behavior in animals and men. New York: Century, 1932.

Tolman, E. C. Principles of purposive behavior. In Koch, S. (Ed.), Psychology: A study of a science. Vol. 2, New York: McGraw-Hill, 1959, pp. 92-157.

Viteles, M. S. Motivation and morale in industry. New York: Norton, 1953.

Vroom, V. H. Work and Motivation. New York: Wiley, 1964.

Vroom, V. H. Organizational Choice: A study of pre- and post-decision processes. Organizational Behavior and Human Performance, 1966, 1, 212-225.

Wahba, M. A., & House, R. J. Expectancy theory in work and motivation: Some logical and methodological issues. Human Relations, 1974, 27, 121-147.

Wyatt, S. Incentive in repetitive work: a practical experiment in a factory. (Industrial Health Research Board Report No. 69) London: His Majesty's Stationery Office, 1934, as cited in Vroom, W. H. Work and motivation, New York: Wiley, 1964.

Yukl, G. A., & Latham, G. P. Consequences of reinforcement schedules and incentive magnitudes for employee performance: problems encountered in an industrial setting. Journal of Applied Psychology, 1975, 60, 294-298.

Yukl, G. A., Wexley, K. N., & Seymore, J. D. Effectiveness of pay incentives under variable ratio and continuous reinforcement schedules. Journal of Applied Psychology, 1972, 56, 19-23.