An Empirical Investigation of the Motivational Determinants of Task Performance: Interactive Effects between Instrumentality-Valence and Motivation-Ability

by

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Abstract

The present study was designed to operationalize and test two components of a motivational model thought to be useful in the explanation of productivity variations among operative workers. Vroom (1964) has suggested that performance can be thought of as a multiplicative function of motivation and ability \( p = f(M^*A) \). Motivation to perform a task can be postulated to vary with the valences \( V \) of outcomes associated with the performance of that task and the instrumentality \( I \) of performance for attainment of these desirable outcomes or for avoidance of undesirable outcomes. Thirty-two operative workers completed questionnaires designed to operationalize the concepts of valence and instrumentality and to test the interactive effects of \( V \) and \( I \) as well as \( M \) and \( A \). A modified analysis of variance procedure, utilizing a "dummy variable" technique and step-wise multiple regression procedure, yielded support for the hypothesized interactive effects. Results are interpreted in terms of the Vroom model as well as other recent research yielding \( M^*A \) effects.
The major purpose of the research reported in this paper is to illustrate an operationalization of a model for the explanation of productivity differences observed among operative workers. The need for such attention was brought out recently by Dubin.

"All the studies of human relations and supervision tell little about how much productivity is affected by individual supervisory practices... The Western Electric and other researchers showed that fellow workers influence the individual's output. Advances in technology produce steady increases in man-hour productivity. There has never been a proper analysis of variance to assay that relative importance of simultaneous factors affecting individual output. It is certainly time to turn empirical attention to just this kind of problem." (Dubin, 1964, p. 50.)

The vehicle chosen to start such an analysis is a model of motivation suggested by Vroom (1964). The model will be briefly reviewed and interpreted in terms of the operative worker's organizational role. Following the conceptualization, the model will be operationalized by specifying the measuring instruments, presenting a sample selection strategy, and by illustrating a statistical technique for the analysis of the data.

The Motivation Model

The model of motivation is based upon a definition of motivation as "a process governing choices made by persons or lower organisms among alternative forms of voluntary activity." (Vroom, 1964, p. 6.) The individual whose
decision or choice process is being studied is depicted as a role occupant faced with a set of alternative voluntary behaviors. Associated with the set of alternatives is a set of outcomes. The situation can be represented schematically as in Figure One.

![Figure 1: Schematic Representation of a Choice Situation](image)

The problem to which motivation theory addresses itself is to explain why the role occupant will choose one of the alternatives and reject the other. Approaches to the explanation of this choice process have reflected the influence of the principle of hedonism. The hedonistic doctrine is based upon the assumption that behavior is directed toward pleasure and away from pain. The history of inquiry into this problem has been one of trying to put some empirical content into the hedonistic calculus. One of the primary
impediments has been the difficulty of determining a priori which outcomes are pleasurable and which are painful. Any behavior could be explained, after the fact, by noting the probable sources of pleasure and pain. One of the contributions of the Vroom model is that it allows the prediction of which outcomes are pleasurable and which are painful and links the concepts with empirically observable events.

The Vroom model attempts to predict which outcomes are pleasurable and which are painful by introducing the notion of second level outcomes. The situation is depicted schematically in Figure Two. The second level outcomes

$$I_{jk} = \text{instrumentality of outcome } j \text{ for the attainment of outcome } k.$$
are viewed as events to which the first level outcomes are expected to lead. In other words the first level outcomes are viewed as means to the second level outcomes. Now in order to predict which behavior the role occupant will select, one needs to know which first level outcome is preferred. Preferences for first level outcomes are determined by their expected relationship to the second level outcomes. The precise method of determining preferences for first level outcomes makes use of two concepts -- valence and instrumentality. The concept of valence assumes that people have preferences for alternative states of nature. Valence then refers to the strength of the person's desire for an outcome or state of nature (Lewin, 1938).

Instrumentality refers to the individual's perception of the relationship between the first level outcome and the second level outcome. The manner in which the first level outcome acquires a valence is stated by the proposition:

The valence of an outcome to a person is a monotonically increasing function of the algebraic sum of the products of the valences of all other outcomes and his conceptions of its instrumentality for the attainment of these other outcomes (Vroom, 1964, p. 17). Thus,

\[ V_j = f_j \left( \sum_{k=1}^{n} V_k \cdot I_{jk} \right) \quad j = 1, 2, \ldots, n \quad (1) \]

\[ \sum_{e} V_e \geq 0 \]

\[ \sum_{j} I_{jk} \geq 0 \]
\[ V_j = \text{Valence of outcome } j \]
\[ V_k = \text{Valence of outcome } k \]
\[ I_{jk} = \text{Perceived instrumentality of outcome } j \text{ for the attainment of outcome } k \]
\[ 1 \leq I_{jk} \leq I \]

The use of equation (1) for explaining choices among alternative levels of task-related effort requires an addition to the model. All of the variance in the valence of an outcome cannot be explained by viewing the outcome as a means to other ends. Some outcomes are sought as ends in themselves. This may be the case with job performance. Some employees will sometimes seek to do well even when no externally-mediated rewards are forthcoming. Following Slater, this phenomena will be a type of internalized motivation called ego-involvement (Slater, 1959).

Motivation is defined as internalized to the extent that it is independent of externally-mediated sanctions and is hypothesized to occur to the extent that role performance is relevant to the maintenance of an individual's self-identity (Vroom, 1962, p. 161).

If one can determine the extent to which an individual is ego-involved with respect to a particular dimension of role performance, it can be predicted a priori which outcomes are positively valent and which are negatively valent.
Following the above definition, it is assumed that the valence acquired through internalized motivation is independent of the valence of externally-mediated rewards and penalties. Independence then implies that the two kinds of valence are additive. The modified form of the Vroom model is the separable function listed below.

\[ V_j = f_0(V_o) + \sum_{k=1}^{n} f_j(V_k, I_{jk}) \quad j = 1, 2, \ldots m \]  

\[ \frac{\delta f}{\delta v_o} > 0 \]

\[ V_o = \text{valence acquired through internalized motivation} \]

The other terms remain as defined in equation (1).

**Choice and Efficiency**

A decision-making or choice approach to understanding the behavior of operative production workers may not be obvious. The usefulness of the choice approach stems from the fact that all voluntary behavior is the result of a conscious or unconscious selection of particular actions out of all those which are physically possible. This does not imply any conscious or deliberate process. It simply refers to the fact that if an individual follows one particular course of action, there are other courses of action that he foregoes. Thus for the production worker there are, at any moment, a multitude of physically possible alternative behaviors, any one of which may be undertaken. Then by some process, these numerous alternatives are narrowed down to the one which is actually acted out.
Most production organizations undertake job design activities to define the task so as to restrict considerably the behavioral alternatives with which the worker is faced. However, the specification of a program of behavior does not completely determine the forthcoming behavior of the operative worker. For many technologies, it leaves some discretion to the worker concerning the decision to produce. Instead, the program establishes a minimum level of performance which is needed by the organization.

The Vroom model provides a vehicle for explaining the choice situation and predicting which alternative behavior will be selected. Since organizations vary in the activities determined by formal authority, the Vroom model will not always be useful in explaining productivity variations among operative workers. It will only be useful when the operative worker has a choice among alternative levels of task related effort and is able to act out his choice. For this to be possible, there must exist a range of possible performance outcomes which are acceptable to the organization. The range is bounded on the low side by the minimum amount of production which is necessary in order to remain in the organization. The range is bounded on the high side by the abilities of the worker and the constraints of the technology. When this range exists, the employee's performance is hypothesized to be at its average level because the man chooses to perform at that level. Under these conditions a choice model should be useful in explaining the existing productivity variations if the variables which influence his choice can be identified. It is to this set of variables which we now turn.
Extrinsic and Intrinsic Factors

The above discussion has conceptualized a choice situation for the operative worker. He has before him a set of alternatives representing differing amounts of task related effort. Associated with these alternatives are expected outcomes. For operatives there usually exists a dimension on which these outcomes can be measured (units/day, rejects/day). Manufacturing firms with tangible goals are thus able to measure an individual's contribution to these goals. There is another dimension on which these outcomes are measured and that is in terms of their relative attractiveness for the worker. He may prefer producing 300/day to producing 200/day. Alternatively, he may prefer 200 to 300 units or he may be indifferent depending on the valences of the performance outcomes. The performance outcomes are actually the first level outcomes mentioned in the Vroom model. The first level outcome acquires a valence by its expected relationship to the second level outcomes over which the worker has preferences. The second level outcomes are rewards and penalties which are given on the basis of performance. Equation (2) can be used to explain how they affect the valence of the performance outcomes. If the worker can influence the amount of task related effort devoted to the dimension of productivity monitored by the organization, then variations in productivity should be explainable in terms of variations in valence of the performance outcomes.

The variations in valences, with which the variations in productivity are hypothesized to be correlated, are to result from differences in the worker's preferences for second level outcomes and differences in the
cognized instrumentality of performance outcomes for the attainment of the second level outcomes. The second level outcomes associated with performance can be conceived as rewards and penalties deriving from those groups with whom the worker is interdependent. In other words, individuals can attain few of their goals solely by their own efforts -- hence they become depend-ent on others. In similar fashion, the worker, in the performance of his work, can affect the goals desired by others thereby creating a situation of interdependence. If this scheme is useful, the valence of performance outcomes should be explainable in terms of groups which have both a stake in the individual's performance and an ability to supply rewards and penalties. The Vroom model would interpret variation in the valence of the performance outcomes in terms of the individual's preference for the rewards and the group's success in communicating the instrumentality of performance for the attainment of the rewards. For the operative worker, those who would have an interest in his performance and ability to supply rewards would be the organization, his immediate supervisor, and his peers.

The above-mentioned rewards are defined as extrinsic rewards since they bear no inherent relationship to the behavior itself. They are artificially selected to influence the behavior but are not a natural consequence of the behavior. Now it is entirely possible that the performance outcome can be rewarding independent of any externally mediated rewards. Such rewards are defined as intrinsic rewards. From the point of view of the individual, intrinsic rewards bear an expected relationship
to the behavior and are a natural consequence of that behavior. Thus, for some workers high productivity is a reward in itself. On this basis, a fourth source of rewards is the task itself.

Incorporating the Role Variables into the Model

Each of the variables can be cast into the model presented earlier. For each group a reward can be specified which carries a valence and will have a perceived instrumentality. For the organization, the usual rewards are wages, fringe benefits and promotions. Performance will vary directly with the product of the valence of the reward and the perceived instrumentality of performance for the attainment of the reward. Variations in individual productivity should be explainable in terms of variations in instrumentality and/or valence.

Variations in valence will primarily be due to individual differences across occupants of the work roles. The variations in instrumentality will be primarily determined by characteristics of the work roles themselves. For example, the instrumentality of money will vary from one to zero for a wage incentive system versus a union negotiated contract. Of course it is possible for perceived instrumentality to be different from objective instrumentality. For the variable to influence performance both valence and instrumentality need to be positive. These are necessary conditions. The available evidence concerning the above statement is best illustrated by Georeopulos, Mahoney, and Jones (1957) and is summarized in Vroom (1964).
A second source of extrinsic rewards results from the interdependence between the worker and his immediate supervisor. It has been found that the ability of the supervisor to exercise influence over the workers depends on his ability to satisfy their goals. Supervisory behaviors which satisfy subordinate's goals have been variously described as supportive, employee-centered, and considerate. There is evidence that the satisfaction of subordinates is positively related to the subordinate's perception of the supportiveness of the supervisor's behavior (Fleishman, Harris and Burtt, 1955, and Halper and Winer, 1957). Therefore it may be said that the supervisor's behavior can be rewarding and has a valence. In terms of the model, the supportiveness of the supervisor can only influence performance if given on the basis of performance. This is to communicate a positive instrumentality. Stated more formally, performance will vary directly with the product of the valence of supportive behavior and the perceived instrumentality of performance for the attainment of supportiveness.

The above hypothesis was suggested in Vroom (1964, p. 220). It differs from most of the studies relating performance and supportiveness. Previous research usually correlates supportiveness with performance but ignores instrumentality. The above hypothesis states that supportiveness must be contingent upon performance if the supervisor is to influence performance through the supportiveness of his behavior. If supportiveness is exhibited regardless of performance then the supervisor probably exerts little predictable influence upon operative workers' performance.
A third source of extrinsic rewards is the work group. While there have been many research studies concerning the work group, our interest is only in the influence of the work group on the worker's choice of levels of performance. Such influence was hypothesized to arise out of the interdependence between the worker and the people with whom he works. The nature of the interdependence is assumed to vary with the interest of the work group in the individual's performance and the individual's preference for group acceptance. Actually what will influence the worker's choice is his perception of the group's interest in his performance or perceived instrumentality and the valence of group acceptance. Group acceptance can be rewarding if membership in the group is instrumental to the attainment of the worker's goals. As with the previous rewards, performance will vary directly with the product of the valence of group acceptance and the instrumentality of performance for the attainment of acceptance.

The proposition can be interpreted, as have the previous ones, in terms of the multiplicative interaction between valence and instrumentality. Performance will be high when the individual desires group acceptance and believes that high performance is a behavior necessary for acceptance. Performance will be low when the worker desires acceptance and believes that low performance is a behavior necessary for acceptance. Similar statements could be made for negatively valent group acceptance. Performance should be unaffected if the worker is indifferent to acceptance and/or if the work group neither rewards nor punishes on the basis of an individual's performance.
The present discussion began by postulating that the higher the valence of a performance outcome the higher will be the performance. Thus the variables postulated can be more explicitly put forth in the Vroom model as follows:

\[ V = V_I^m + V_I^f + V_I^p + V_I^s + V_I^g \]  

where:

- \( V \) = valence of high performance
- \( V_m \) = valence of money
- \( V_f \) = valence of fringe benefits
- \( V_p \) = valence of promotion
- \( V_s \) = valence of supportive behavior
- \( V_g \) = valence of group acceptance
- \( I_{pm} \) = perceived instrumentality of performance for money
- \( I_{pf} \) = perceived instrumentality of performance for fringe benefits
- \( I_{pp} \) = perceived instrumentality of performance for promotion
- \( I_{ps} \) = perceived instrumentality of performance for supportiveness
- \( I_{pg} \) = perceived instrumentality of performance for group acceptance

An individual's performance cannot be completely explained in terms of extrinsic rewards alone. That is, performance is not always viewed as a means to other ends but quite possibly can be perceived as an end itself. The rewards which result as a natural consequence of the behavior were earlier defined as intrinsic rewards. Individuals receiving such rewards are said to have internalized motivation. Basically, task performance is important for the maintenance of a positive self-concept for such an
individual. The self is involved to the degree that performance requires abilities possessed by the individual and valued by the individual (Vroom, 1964, p. 249-250). If the individual's self-concept incorporates his performance, this performance will vary directly with the amount of ego-involvement in the task. The complete model can now be presented,

\[ V = V_e + V_I \text{ pm} + V_I \text{ pf} + V_I \text{ pp} + V_I \text{ ps} + V_I \text{ pg} \]  

(5)

where: \( V_e \) = valence due to ego-involvement.

**Role of Ability**

The above reasoning postulates that performance is some function of the valence of the performance outcomes. Performance is also a function of an individual's ability. Any realistic model for explaining variation in job performance must account for variation in individual abilities. Vroom has hypothesized that motivation and ability are multiplicative in determining performance. Recent evidence tends to support the hypothesis (Lawler, 1966). This relationship can be presented as:

\[ P = f(M \times A). \]  

(6)

Equations (5) and (6) make up the model for which an empirical test will now be illustrated. The presentation will proceed from sample selection to measurements to the statistical tests of results.
Research Design

The subjects used in the research were thirty-two operative workers in a large, heavy equipment manufacturer located in a south-central Indiana city. The subjects selected were those for whom there were objective measures of production and held jobs where they controlled the pace of work. In other words, the sample was selected so as to provide independent, objective measures of performance and to provide workers who were faced with a range of alternative levels of performance. One further constraint was that in order to obtain cooperation of both the company and the union, participation in the research was to be voluntary. This will not affect the validity of the test but will introduce a constant error factor which restricts the generalizability of the results. It will, however, have the advantage of eliminating subjects who are unwilling and who may have given erroneous answers if forced to participate.

The primary concern of the research design, other than operationalizing the concepts, is to eliminate alternative explanations of results brought about by implicit assumptions in the statement of the propositions. The control over these alternative explanations begins in the sample selection and continues throughout the research. The assumption needing control by sample selection is that the propositions equate a worker's preference for a performance outcome with actual attainment of that outcome. The implication is that preference equals choice and choice equals attainment. Let us discuss each of these implications in turn.
The model presented earlier, specifically equation (3), would predict that choice may be different from preference when expectancy does not equal one. Expectancy was a concept applying to an action-outcome relationship. It is then reasonable to assume that expectancy equals one if there are no non-controllable, intervening influences between action (exertion of productive effort) and the performance outcome. In order to assume that expectancy equals one, the selected subjects were those performing independent tasks. They were dependent on no one other than themselves in achieving a performance outcome. The interdependence referred to earlier arises after a performance outcome is attained and therefore affects instrumentality not expectancy.

While the worker does not depend on others in his task performance (after the machine is set up and materials are available), there are other non-controllable intervening variables. Examples are machine breakdown, inferior quality of materials, non-availability of materials, etc. The assumption is still justified on the basis of the accounting system for work performance. There are three categories of time which are of concern here. The worker can be setting up a machine, involved in run-time of the job, or he can report off-standard conditions. The off-standard conditions are reported and do not influence the measurement of his performance. An off-standard condition is when a factor arises which slows the worker's performance and is not attributable to the worker. These conditions falls into nine categories at the plant in question. When such a condition arises, the worker notifies the foreman who authorizes the reporting of the non-standard condition. The foreman is responsible for the amount of
off-standard time since it reduces the capacity utilization of his department. Since the off-standard conditions represent non-controllable influences and do not affect the worker's measured performance, it is reasonable to assume that his expectancy is approximately equal to one.

The second part of the assumption, to be controlled by sample selection, requires that there be no barriers to translating choice into attainment. The selection of subjects can eliminate some of the technological barriers to the translation but not the non-technical. In order for the worker to translate his choice of a performance outcome into attainment of that outcome, he must have control over his pace of work. Under this condition the worker's choice of the amount of effort he will put forth will determine his output and therefore the performance measure. It must also be pointed out that work cannot be classified into the simple dichotomy of man-paced or machine-paced. The flow of work can be man-paced but the individual work cycles of a job may be predominantly machine-paced. The worker may simply load, observe, and unload. The subjects were also selected from those departments where the man controlled during the work cycle as well as in the flow of work. On the basis of the above discussion, the assumptions seem reasonable for the subjects constituting the sample.

Measurements

The variables which require measurement are productivity, valence, instrumentality and ego-involvement.
The productivity variable of importance in the present study was the individual operative's output record. The company maintains work standards and makes daily performance measurements on individuals in several departments. These performance measures were used in this research. The variation to be explained by the motivational variables will be the variation about the production standards. The approach used was to use one month's performance since data in this form is available from the company. The individual productivity data used in this research was output divided by a standard yielding a percentage figure which is averaged over the month prior to the completion of the questionnaire used to measure the other variables.

The second set of measures, those for instrumentalities and valences, were obtained from questionnaires completed by the workers constituting the sample.

Previous research provides little guidance for measuring instrumentality. Most studies have relied upon instructions to communicate instrumentality or varied the objective instrumentality. The variable of interest in this research is the perceived instrumentality. It was measured directly by the following method. The subjects were presented with the following for each instrumentality:

To what degree does your receiving a promotion depend on your performance?

Indicate your answer by drawing a line from promotion-performance to a point on the scale which best describes your feeling.
I feel that the more I produce, the better are my chances for a promotion.

I feel that my production is important but management looks at other things too.

I don't think my chances for a promotion are affected one way or another by the amount of my production.

I feel that large amounts of production could hurt my chances for a promotion.

I feel that large amounts of production would definitely hurt my chances for a promotion.

The graphic rating technique used above, and also to be used for valence, has been shown to be effective in developing criteria for defense system design (Eckenrode, 1965).

The measurement of valence took place in two stages. The outcomes hypothesized as being related to performance outcomes were identified. Then the subjects were asked to rank them in order of preference. After completing the ranking, the subjects were asked to indicate the relative degree of liking or disliking by drawing lines from the ranked outcomes to the rating scale. The subjects were presented with the following:

Listed below are several things which you could receive in connection with your job.

a) You could be popular and accepted by the men with whom you work.

b) You could receive an increase in pay.

c) You could receive the support and consideration of your immediate supervisor.
d) You could receive a promotion.

e) You could receive greater fringe benefits, vacation time, pensions, etc.

f) You could be given a reduced work load resulting in more free time.

1. Rank the above items in the order which you would prefer them. Rank them by placing the underlined word in the spaces provided.

2. Draw lines from the word to the scale indicating how much you prefer these outcomes.

[Scale with numbers 1 to 10 and descriptions: extremely desirable, very desirable, desirable, does not matter whether I receive it or not, undesirable, very undesirable, extremely undesirable]

The next concept requiring measurement is that of ego-involvement. The measure used was taken directly from some prior studies. The measure was originated by Slater (1959) and used by Vroom (1962) in a study of job performance. The subjects were presented with the following:
If a problem comes up in your work and it isn't all settled by the time you go home, how likely is it that you will find yourself thinking about it after work?

- I always think about it.
- Most of the time I think about it.
- There's a pretty good chance I'll think about it.
- Every once in a while I'll think about it.
- I very seldom think about it.
- I probably won't think about it.
- I'm sure I won't think about it.

Atkinson (1953) has reported a study of the relation between achievement motivation and the recall of interrupted vs. completed tasks utilizing a similar measure.

The measures were pretested using Indiana University staff personnel. The application of the instrument served as a pretest for discovering inadequacies in the questionnaire and as a test-retest for purposes of reliability measurement. The test was administered at one month intervals. A total of eight usable questionnaires resulted for valences and nine for instrumentality. The six valences and eight questionnaires combined to give 48 observations of valence. While not strictly independent observations, they give an overall picture of the valence instrument. Likewise 45 observations of instrumentality were used. Valences were measures on a scale from -10 to 10 unit intervals while instrumentality was measured on a scale from -1 to 1 using 0.1 intervals. The reliability coefficients for the instrument were as follows:
Valence  $r = .50 \ (n = 48)$
Instrumentality  $r = .80 \ (n = 45)$
Ego-Involvement  $r = .81 \ (n = 8)$

**Statistical Tests**

The task remaining is to devise the necessary statistical tests for the above hypotheses and also to assess their relative importance. The approach taken is to test each variable (money, promotion, etc.) individually to determine whether valence alone, instrumentality alone, the two in additive combination, or the interaction of the two is the best predictor. A second series of tests is to control for ability while analyzing each variable individually. This will allow an assessment of the predictive ability of valence, instrumentality, and ability and whether they combine in an additive or the hypothesized interactive fashion. The last two analyses will involve a relative assessment of each variable by a multivariate analysis first without ability, then controlling for ability.

The testing of effects of variables and interactions immediately suggests the analysis of variance. In order to perform the test, all valences, instrumentalities, and ability were dichotomized. For valence any observation given a value of five or greater was called high. For instrumentality, any observation having a value of 0.5 or greater was called high. For ability, those subjects holding their present job for greater than six months were classed as high ability. This method of dichotomizing generates unequal cell frequencies. There is also no guarantee that all
cells will be filled when all variables are considered simultaneously. To combat this problem the linear statistical model is formulated as a least squares regression rather than the classical analysis of variance model. The independent variables still will have zero-one values indicating low-high conditions. The reason for the regression formulation is that unequal cell frequencies eliminate the simple partitioning of the sums of squares. The computation needed to generate the test statistics now involves matrix inversion used in least squares regression. However, from the point of view of hypothesis testing the two techniques are equivalent (Goldberger, 1964, p. 230).

The operationalizing of zero-one regression models has been performed by econometricians under the name of dummy variable regression (Johnston, 1963; Goldberger, 1964). Here a dummy variable is the standard analysis of variance zero-one variable. The first analysis involved a test for each variable (money, supportiveness, etc.). Let us demonstrate for one variable since the remaining formulations will be similar. Let us consider the relationship between performance and wages. The hypothesis was that performance varied directly with the valence of money and perceived instrumentality of performance for the attainment of money. Performance will be a function of zero-one variables. Thus:

$$ P = a + b_1X_1 + b_2X_2 + b_3X_1X_2 $$ (7)

where: 

- \( X_1 = 0 \) when valence is low
- \( X_1 = 1 \) when valence is high
\[ X_2 = 0 \text{ when instrumentality is low} \]
\[ X_2 = 1 \text{ when instrumentality is high} \]

The last term \((X_1 X_2)\) picks up the hypothesized interaction between valence and instrumentality. It takes on a value of one only when both instrumentality and valence equal one. The b's are then estimated using least squares. Depending on the significance of the coefficients, the nature of the relationship can be determined. If all the b's equal zero, there is no relationship. If \(b_1\), \(b_2\), or \(b_1\) and \(b_2\) are significant then the relevant variable is significant and exerts an effect independent of the other. If, however, \(b_3\) is significant, then the effect of valence depends upon the value of instrumentality. According to Vroom's model this is the effect which is hypothesized to be significant.

When ability is introduced the number of interactions increases. Let us dichotomize the population as being high and low in ability. Thus:

\[ P = a + b_1 X_1 + b_2 X_2 + b_3 X_1 X_2 + b_4 X_3 + b_5 X_1 X_3 + b_6 X_2 X_3 + b_7 X_1 X_2 X_3 \] (8)

where:
\[ X_3 = 0 \text{ when ability is low} \]
\[ X_3 = 1 \text{ when ability is high} \]
\[ X_1, X_2 \text{ are as defined in (7).} \]

Now if valence and instrumentality interact but motivation and ability exert independent effects, then \(b_3\) and \(b_4\) will be significantly different from zero. If ability and motivation interact then \(b_7\) will be significant. These are only two of many possible interpretations.
The formulation for each variable can be extended to simultaneously considering all variables and running a multiple regression to assess the relative importance of the simultaneously acting factors. There will be a total of sixteen variables in the equation -- three for each of five extrinsic reward and one for ego-involvement. When controlling for ability there are thirty-eight -- seven for each extrinsic reward and three for ego-involvement.

Due to the small sample size (n = 32) and the attempts to select the best predictors, a stepwise regression was used. This is an excellent technique for investigating proposed additional variables to add or delete from the regression equation. Instead of evaluating all possible sets of predictor variables, the stepwise regression selects the most significant set. The program proceeds by first regressing the dependent variable on all independent variables individually. The independent variable having the largest F-ratio is introduced. Then the residuals from the two variable regression are regressed on all the remaining candidates. The next variable having the highest F-ratio is introduced. We now have a three variable regression. Again the residuals are regressed on the remaining independent variables. The process will continue until no variable has an F-ratio greater than a specified level. For this reason an F-ratio of 1.0 was used. In other words when the regression of the residuals on outstanding variables failed to produce an F-ratio of 1.0 or greater, or if no variables in the regression dropped below 1.0 due to intercorrelations, the program stops. If a variable in the regression has an F-ratio which has fallen to less than 1.0 it is removed and the
process continues. Care should be taken not to have too many variables in the regression equation. The reason is that as the number of variables in a regression equation approaches the number of observations, all the variation in the dependent variable can be explained away even when it is independent of the set of independent variables. This is a generalization of the fact that one always gets perfect correlation in a two variable regression with two observations. Least square will fit a straight line between the two points. A demonstration with a larger number of variables has been given (Ando and Kaufman, 1964). The researcher can prevent this from occurring by setting the F-ratio at a sufficiently high level.

It is felt that the linear regression formulation using zero-one variables and a stepwise least-squares estimation technique can be very useful for behavioral field research where multiple interacting variables are present.

Results

The results of the first two analyses are present in Table 1. When the linear model given by Equation (7) was run for each variable, none of the valences alone, instrumentalities alone or the two in combination produced any significant results. The exception was supportiveness of the supervisor. The significant variable was the interaction between valence and instrumentality \( (b_3) \). Likewise when controlling for ability the only significant result was the interaction of valence, instrumentality and ability \( (b_7) \). The reason for non-significant results for the others may be
Table 1

Significant Variables from Regression
Considering Variables Alone with Ability
Both Controlled and Not Controlled
All Others Are Not Significant

Supportiveness $b_3$ (hi valence, hi instrumentality) \hspace{2cm} p < .05

Supportiveness $b_7$ (hi valence, hi instrumentality, hi ability) \hspace{2cm} p < .01

due to the insufficient discriminating power of the test, the lack of
variation at the research site, or that in fact they are not related. All
are possible but cannot be determined in this research. Therefore we will
make no attempt to generalize our results.

The results from the multiple regression considering all variables
simultaneously are shown in Tables 2 and 3. Table 2 reports results
utilizing motivational variables only. The most significant variable is

Table 2

Motivational Determinants of Job Performance

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>t value</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>$b_s = 21.1$ (supportiveness interaction)</td>
<td>2.93</td>
<td>.01</td>
</tr>
<tr>
<td>(high valence, high instrumentality)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$b_m = 20.9$ (money interaction)</td>
<td>2.32</td>
<td>.05</td>
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<tr>
<td>(high valence, high instrumentality)</td>
<td></td>
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<tr>
<td>$b_g = -41.5$ (group instrumentality)</td>
<td>-2.02</td>
<td>.10</td>
</tr>
<tr>
<td>(high instrumentality)</td>
<td></td>
<td></td>
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<tr>
<td>$b_e = -11.1$ (ego-involvement)</td>
<td>-1.57</td>
<td>.20</td>
</tr>
<tr>
<td>(high valence)</td>
<td></td>
<td></td>
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<tr>
<td>$R = .57$</td>
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</table>
the interaction between valence and instrumentality for supportive behavior on the part of the supervisor. The interaction is also significant for the money variable. The instrumentality of performance for group acceptance is the next variable. It would appear that high performance is perceived to be instrumental in attaining group rejection, implying that the norms of the group, as perceived by these operatives, establish definite upper limits on the appropriate production level for these operatives. The last variable is the amount of ego-involvement in the task. Since it is negative, it might be suggested that those who are ego-involved are motivated toward equality rather than quantity. The multiple correlation coefficient was 0.57 meaning about one-third of the variation was explained by the significant variables in the model.

The second regression introduced ability. Ability was measured by time on the job. Table 3 reports results utilizing both motivational and ability variables. The men constituting the sample varied from one

<table>
<thead>
<tr>
<th>Variable</th>
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<th>Significance Level</th>
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<tbody>
<tr>
<td>Supportive Behavior Interaction</td>
<td>3.70</td>
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<tr>
<td>Money Interaction</td>
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<td>.01</td>
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<td>(high valence, high instrumentality, high ability)</td>
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<td>Ego-Involvement Interaction</td>
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<tr>
<td>(high valence, high ability)</td>
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</table>

R = .68
month to five years on their present jobs. The median time period constituted six months and the sample was split at the median. While there are certainly other ability dimensions on which the subjects may vary, time on the job captures some of the substance of the ability variable. All variables are interactions between motivation and ability. For supportive behavior and money, the variable represents the three-way interaction between valence, instrumentality, and time on the job. For ego-involvement it represents the motivation and time interaction. A multiple correlation coefficient of 0.68 means that about 46% of the variation in performance is explained by the significant variables.

Discussion

The results of the tests generally support the hypothesized interaction between motivation and ability. Our findings concerning performance = \( f(\text{ability} \times \text{motivation}) \) are in general agreement with Lawler's (1966) recent study indicating that ability does play a moderating role in influencing the relationship between job-related attitudes and task performance. As Lawler notes, four studies can be interpreted as offering support for a multiplicative relationship between ability and motivation in determining performance (French, 1957; Fleishman, 1958; Vroom, 1960 and Lawler, 1966). The present results offer support for a multiplicative relationship on an operative sample utilizing a valence-instrumentality measure of motivation.
The present study also offers support for the Vroom (1964) model of the interactive effects of valence and instrumentality in determining motivation for a particular performance outcome. Data collected across a larger sample (and across samples composed of differing occupational and skill groups) are needed before statements concerning the generality of the relationship can be made. The present work does, however, suggest means through which the model can be operationalized.

Several of the present findings can be interpreted in terms of conditions prevailing at the research site. Since the receipt of promotions within the company is largely contingent upon seniority, the low instrumentality of task performance for the attainment of promotions seems reasonable. The data indicates that the use of promotion as an effective component of any organizational reward system is contingent upon the degree of perceived instrumentality between task related behavior and the receipt of a promotion (assuming significant valence is attached to promotion in the employee's preference ordering). Similar reasoning holds for the perceived instrumentality linking performance and the receipt of fringe benefits. In the organization in question, this perceived instrumentality is conditioned by the influence of union contract provisions establishing fringe levels. The changes which can and do occur in these levels are perceived by many operatives as resulting from the relative bargaining power of the union versus the company -- not from the level of performance exhibited by any given operative. The implication of the above discussion is that the independent variable (instrumentality) cannot take on a
sufficient amount of variability to influence the dependent variable (performance). Also, since instrumentality takes on a mean value near zero, the variation in valence cannot influence performance due to the interaction.

The relatively strong impact of supervisor supportiveness relative to the influence of the other dimensions of the reward system is in general agreement with much of the literature of the past decade in organizational behavior (Vroom, 1964, pp. 211-229). Given the constraints mentioned above on the possible variations in other components of the organizational reward system, the quality of supervisory behavior would appear to be one of the few organizational controllables with sufficient variability to influence operative performance over the time span of measurement used in the present study. The present study suggests that at least three conditions are necessary for a component of the organizational reward system to exert a significant and predictable impact on employee behavior; (1) the component of the reward system must be desired by the employee; i.e., it must possess positive valence in the employee's preference ordering, (2) the employee must perceive that variations in his performance level will lead to variations in the amount of reward received; i.e., perceived instrumentality must be significantly different from zero, and (3) given (1) and (2), the technology, union contract and other environmental factors constraining the effectiveness of the reward system must be such that the organization can vary the magnitude of the reward component sufficiently to evoke variations
in employee behavior. In the present study, the quality of the supervisor's behavior appeared to be the only component of the organizational reward system satisfying each of the three conditions.
REFERENCES


FOOTNOTES

1 The authors wish to thank Professor V. H. Vroom of Carnegie Institute of Technology for helpful comments on an earlier draft and Gordon Kaufman of Massachusetts Institute of Technology for helpful comments on the statistical section.

2 The measure of ability was to be supervisor ratings. However, the measure did not even correlate with performance.
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