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RESEARCH ON TASK PERFORMANCE

DEPARTMENT OF ADMINISTRATIVE SCIENCES
YALE UNIVERSITY

TOWARD UNDERSTANDING THE ROLE OF TASKS IN BEHAVIORAL RESEARCH

J. Richard Hackman

Scientific Interim Report
August, 1968

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Effects of Task Characteristics on Performance
Air Force Office of Scientific Research
Research Grant AFOSR-68-1600
J. Richard Hackman, *Principal Investigator*

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Abstract

Tasks play an important role in much research on human behavior, and differences in tasks and task characteristics have been shown to mediate differences in individual and social behavior. Thus, it is unfortunate that we know relatively little about the nature of tasks and their behavioral implications. This paper attempts to lay the ground work for furthering our understanding of the differences among tasks and the ways in which tasks influence behavior. Three general "problem areas" are reviewed and evaluated in the paper: (a) problems in defining the concept "task"--i.e., what are the components and characteristics of an adequate task definition; (b) problems relevant to the description of tasks--i.e., what are the most useful and appropriate bases for making task descriptions and comparisons; and (c) problems relevant to understanding task effects--i.e., how do task factors make differences in the ways people think and act.

After evaluating several issues relevant to the problems of task definition and description, one working definition of the concept is proposed, and one general approach to task description is suggested as likely to be most useful in understanding the behavioral impact of tasks. Finally, a framework is proposed which outlines the diversity of effects which may be attributable to task factors in a performance situation, and suggests how these effects may be conceptualized and related.

Toward Understanding the Role of Tasks in Behavioral Research[1]

J. Richard Hackman

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Tasks are pervasive in the methodologies of nearly all major areas of behavioral research. It seems that no matter what the specific field of study, researchers almost routinely "give the subjects a task to do" while some "substantive" variables are being studied. Thus, we have"problem solving" tasks serving as vehicles for the investigation of the problem solving process; we have "group tasks" for the study of social interaction; we have "learning" tasks, "creativity" tasks, and "concept-formation" tasks.

The substantial impact of tasks and task characteristics in behavioral research situations is gradually becoming well documented. For example, Hackman (1968) found that differences among three "types" of tasks account for up to 50 per cent of the variance of certain aspects of group output. A parallel study (Morris, 1966) of task effects on group interaction yielded data nearly as strong. Longnecker (1962) found that stress conditions interact with subjects' anxiety and motivation in determining performance effectiveness and concludes that his data point "to the need to include the task and situational variables as a crucial factor in formulating a comprehensive theory of motivation" (p. 221). Golembiewski (1962), reviewing literature on leadership, concludes that "task characteristics

are intimately related to the results obtained in experiments, as in producing behavioral change" (p. 203). Finally Weick (1965), discussing tasks in the context of laboratory experimentation on organizations, suggests that "it is probable that more uncontrolled sources of variation exist in tasks than in any other components of experiments" (p.244).

Weick's statement is not overly strong. Tasks do make important differences in behavioral research data, differences which for the most part are not presently understood. Yet, despite the ubiquity and importance of tasks in behavioral research, the task domain remains mostly uncharted, as numerous reviewers have pointed out with lament.[2] Ferguson (1965, p. 130) notes that learning theorists have "tended to restrict themselves to a range of learning tasks of low-order generality. No satisfactory methodology has emerged for describing particular learning tasks, or indicating how one task differs from another, other than by a process of simple inspection." Breer & Locke (1965, p. 266), in their conclusion of a report on how job and task variables affect subjects' attitudes, make a similar point for the job description area: "The major stumbling block to the systematic study of job experience as source of beliefs, values, and preferences is the lack of a suitable instrument or series of instruments for measuring differences in job experience." Davis (1966, p. 36) speaks to the problem solving area: "Research in human problem solving has a well-earned

reputation for being the most chaotic of all identifiable categories of human learning. The outstanding quality which leads to this conclusion is the diversity of experimental procedures called 'problem solving' tasks."

This paper is an evaluative summary and assessment of the present state of knowledge about tasks and how they influence people's actions and interactions. First, some issues relevant to the definition of the concept "task" are discussed, and four means of describing and differentiating among tasks are reviewed and evaluated. Then, a new working definition of the concept is suggested, and a general framework for analyzing task effects on behavior is proposed. Hopefully this framework can help pave the way toward asking what is probably the most important question of all about tasks: just how is it that differences in tasks interact with differences in people to mediate the substantial "task effects" which are observed with such regularity?

Some Definitional Problems

Instead of attempting to list and compare the large number of definitions of the concept "task" which have been proposed, we will focus on two issues which seem particularly useful in differentiating among the various definitions. These are: (a) the degree to which "task" is conceptually distinguished from the general situation which confronts an individual; and (b)

whether tasks are viewed as entities external to the performer and imposed on him, or are seen as being internal to the performer and defined by him.[3]

Task and Situation

One of the widest ranging definitions of "task" which his writer has come across is that of Hare (1962, pp. 248-249). Hare suggests that:

> "Since the task is, in the most pertinent sense, what the group members subjectively define it to be as they respond to the situation in which they find themselves, all of the internal features of the social system are likely sooner or later to become relevant to task specification. The task should not be narrowly viewed in terms of what the experimenter intends, or what some objective sense of the situation apparently demands.
>
> "In its broadest sense, then, the definition of the task is the definition of the situation, and differences in behavior which appear between situations are the most general indication of differences in tasks."

Thus, for Hare, the task in effect is the situation. Hare feels that since all aspects of the situation work in concert with the task which is imposed on the subjects, there is little usefulness in differentiating between some set of "situational" determinants and presumably more molecular and closely-defined "task-based" determinants.

A similar point of view is represented by the two approaches to the definition of group tasks suggested by McGrath & Altman (1966, p. 75):

> "Task is an artificial construct. What is 'task' and what is 'group' tend to shade together in many specific instances (e.g., actions toward organizing a division of labor in the group). It is probably useful to conceptualize all groups as having tasks--hence equating tasks with 'shared goals.' In this view, the task of a group such as a family may be entirely that of maintaining the group's existence and well-being.
>
> "Task can also be defined to include all factors impinging on the group and its members whose origins are not properly attributable to members or to the group. This kind of definition tends to equate task and environmental effects, as the total situation."

There is considerable merit and potential elegance resident in such broad-based approaches to understanding tasks and task effects. Tasks certainly are a part of the situation which confronts a performer in either an experimental or a real-life situation; if a general theory of how "situations" influence behavior were available, "task influences" undoubtedly would be included as part of the theory.

Unfortunately, very little is known about how situations determine behavior. If tasks are equated with situations, the development of a systematic theory of task effects must await the development of a theory of situational effects--and such a general theory does not seem to be in the offing at present. Thus, instead of setting out to attack the general situational problem at this time, it may be more fruitful to deal seperately with those more closely-defined aspects of the situation for which we now have relatively adequate conceptual and methodological "tools" available.

This more modest approach could have a dual payoff. First, experience gained in working with aspects of the situation such as, say, "tasks" or "ecology" could help substantially in developing the methodologies and conceptual approaches which will be needed for dealing with broader situational influences. Secondly, dealing with the "small problems" first should have the rather important result of increasing knowledge about just these problems. The comments of researchers reported earlier in this paper suggest that there is a strong need <u>now</u> for better knowledge about tasks and their effects. Dealing with these tasks by identifying them with situations does not seem to be a judicious strategy for gaining such knowledge at the present time.

Later in this paper a definition of "task" will be proposed which explicitly differentiates this concept from the general performance situation. The proposed definition is, however, sufficiently broad to allow identification and comparison of those aspects of tasks which are common to most research situations, and hopefully it can facilitate the development of general dimensions for describing and differentiating among a heterogeneity of particular tasks.

<u>Task Redefinition</u>

A second issue which pervades many discussions of task definition has to do with the degree to which tasks imposed on subjects are subjectively redefined by them. Many of these discussions imply that definitions and descriptions of "externally imposed" tasks may be of limited use because of the pervasiveness

and importance of the "redefinition" process. Pepinsky & Pepinsky (1961, pp. 219-220) discuss the question especially cogently:

> ". . . we can anticipate the necessity of distinguishing between the task as defined by (a) the actor to whom it is assigned, and (b) by the setter who assigns it. . . . Therefore, we may define the task, in the latter view, as the confronting of an actor with a designated stimulus situation in which he is required to follow stipulated rules of procedure in responding to the situation, and in which he must attempt to satisfy specified criteria by which the amount of success of his acts is judged. . . . The task setter is assumed to be operating for the social system, both in stipulating the actor's rules of procedure and in judging the extent to which the actor satisfies the task setter's criteria of success. This is called the official task--to distinguish it from the actor's private task or problem, the actor's definition of a stimulus situation that he feels impelled to modify so as to realize some personally desired outcomes. Thus, an actor may or may not respond to the assigned, official task as if it were a problem to him . . . ."

The previously discussed definition of Hare (1962, pp. 248-249) reflects, at the group level, the Pepinsky conception of a "private" task. Hare emphasizes that the task is, in fact, "what the group members subjectively define it to be," and that it should <u>not</u> be treated in terms of "what the experimenter intends, or what some objective sense of the situation apparently demands." Thus, for Hare, analyses of task demands or descriptions of task characteristics would most appropriately be based on the percpetions and previous experience of the performer(s) rather than on any "external" qualities of the task.

A contrasting definition, somewhat similar to the "official" task proposed by Pepinsky and Pepinsky, is proposed by Thibaut & Kelley (1959, p. 150):

> "We mean by a <u>task</u> pretty much what the common sense definition conveys: a problem, assignment, or stimulus-complex to which the individual or group responds by performing various overt or covert operations which lead to various outcomes."

Certainly Thibaut and Kelley would not deny that performers do in fact "redefine" tasks in accord with their own needs, values, and goals. But the question which their definition raises is whether or not the redefinition process should be accounted for in definitions of the concept. If so, it appears that virtually the whole problem of human motivation would be introduced into attempts to define and deal with tasks. For example, in order to develop descriptive task "dimensions," it would be necessary to specify the psychological characteristics of the performers for whom the tasks were intended, since such characteristics are critical in determining how particular tasks are redefined by particular performers--and thus what the value of the tasks would be on the descriptive dimensions. It is the view of this writer that such a course would effectively negate the possibility of developing a general "theory of tasks" toward which so many researchers have claimed we should aspire.

Nevertheless, it is clear that task redefinition (and often rather strong and idiosyncratic redefinition) occurs when people work on tasks, and that the process affects both the way tasks are dealt with and the outcomes which are produced. Ignoring this (probably sizable) portion of the behavioral variance in dealing with tasks would seem indefensible..

The solution to this dilemma may lie in recognizing that, while the objective and redefined tasks occupy different temporal positions in the performance sequence, they both are still tasks and therefore can be described and differentiated on the same dimensions. Thus, the redefinition process can be viewed as that sequence of (mostly covert) behavior which occurs between the time a performer receives the task and the time he begins actual "work" on it, and the problem of redefinition can be discussed in substantive rather than in definitional terms.

This is the general strategy which will be followed here. Later in the paper, a definition of the concept will be introduced and a framework for analyzing task effects on behavior will be proposed, both of which view task redefinition as a part of the performance process itself.

Some Problems in Describing Tasks

In this section, four approaches to the systematic description and differentation of tasks will be reviewed and evaluated. Then, in the next section, one of the approaches will be adopted as the basis for a new conception of how tasks might be usefully defined and compared.

Approaches to Task Description[4]

Task qua task. As described by McGrath & Altman (1966, p. 75), this approach asks "What pattern of stimuli is impinging on the subjects?" In this view, task qua task properties are "real world" dimensions--the physical nature of the task, its subject matter, the characteristics of the stimulus materials

involved. Thus, many task qua task characteristics would be what Roby & Lanzetta (1958) term "objective" properties of tasks--i.e., those for which an experimenter can specify a single, definite value by suitable measurement and control.

It should be emphasized that while many task qua task characteristics refer primarily to the physical nature of the stimuli which confront a performer (e.g., "stimulus input rate"), the term legitimately applies to any aspect of the actual task materials which are presented to a subject or group. Thus, Shaw's (1963) dimensions of "goal clarity" and "population familiarity" or dimensions describing the actual instructions given to performers also are task qua task characteristics.

Task as behavior requirement. As used by McGrath & Altman (1966), this approach asks the general question, "What responses should the subjects emit, given the stimulus situation, to achieve some criterion of success?" Steiner's (1966) discussion of "task demands" would be characteristic of the approach:

> "Task demands specify the kinds and amounts of resources that are needed, and the utilization pattern that is required if maximum productivity is to be obtained" (p. 274).

Similarly, Roby & Lanzetta (1958) make heavy use of the "behavior requirement" approach. They suggest that:

> ". . . we may expect that the most useful method of classifying group tasks will be with reference to those aspects of group behavior or procedures which these tasks bring to the foreground. In other words, we would expect that the distinctive features of particular tasks will be the degree to which they require certain group behaviors for adequate performance. Such behavioral requirements will be referred to as 'critical demands'" (p. 95).

Examples of critical demands given by Roby and Lanzetta include "orientation" (determining the condition of variables in the task environment or determining the group's standing with respect to those variables), "mapping" (the process by which a group anticipates or learns the consequences of various action alternatives under various environmental conditions), and "jurisdiction" (processes whereby response actions are chosen and decisions implemented.)

Another example of a group task classification scheme which relies on the "behavior requirement" approach is that of Altman (1966). Altman's system is based primarily on a system of interaction classification which he has developed simultaneously with the task classification scheme. Tasks are coded and classified in terms of the kinds of interactions which are required to complete the task successfully and, additionally, in terms of several participant relationship dimensions (e.g., "status relationships") which serve as modifiers of the interaction properties.

Finally, much of the work with tasks carried out in the context of "systems analyses" falls within the "task as behavior requirement" rubric. Typically, systems analysts specify in considerable detail the behaviors required for adequate performance of specific system tasks. For example, Miller (1962) gives an example of the requirements of one particular task such as might have been developed in a military systems analysis:

> "Must run one mile in ten minutes on a straight, level, and smooth concrete roadway, with no wind blowing on a

> sunny day at 70° F., carrying 30-pound load in addition to wearing 2 pounds of summer clothing and 2 1/2 pounds of normal GI boots" (p. 197).

Miller points out that describing task requirements in this manner could result in "huge volumes of documents of description," and suggests that many tasks might more profitably be analyzed in terms of their general behavior requirements (as opposed to the more physically descriptive data contained in "task descriptions" such as the above example).

A system for task description which does rely heavily on "general behavior requirements" has been developed by Gagné (1964). Drawing on Miller's work, Gagné proposes that tasks can be usefully described by identifying (a) the operationally distinct kinds of behavior which the task requires, (b) the stimulus situation in which performance takes place, and (c) the object which is acted upon by the performer. For example, Gagné (p.12) gives an example of how the task "sets up electronic equipment" would be described using this approach:

> "Using a pictorial diagram [stimulus situation], identifies [behavior] the location of pluggable components in an equipment system [object]."

Gagné suggests that, when descriptions are made in these terms, they provide specific and easily understandable information regarding what the task requires, and that descriptions such as these can be readily translated into items for evaluation of individuals' performance on the job.

Task as behavior description. In this approach, the focus

is on the responses which the performer actually does emit, given the stimulus conditions. This contrasts with the "task as behavior requirement" approach which describes the responses which the subject should emit, to achieve some performance criterion. Roby & Lanzetta's (1958) description of "modal" properties of tasks as the "typical" behavior of individuals is roughly congruent with the task as behavior description approach.

The behavior description approach has been a dominant one in research on jobs and job characteristics by industrial psychologists. For example, McCormick (1965), who has done considerable work toward the development of "job dimensions," suggests that there are two kinds of variables which can be used in describing job behaviors:

> "[A researcher] can describe work activities either in terms of the technological processes or operations that are carried out, or in terms of the human behaviors that are involved. One could, for example, describe job activities in terms of painting, recording, galvanizing, baking, or cleaning, thus describing what end-result is accomplished by the work. These we might refer to as job-oriented variables. On the other hand, one could characterize work activities in terms of specific human behaviors such as making visual discriminations, making decisions, moving objects by hand, or verbal communications. These we might refer to as worker-oriented variables" (pp. 1-2).

Although McCormick suggests that the "job-oriented" approach focuses on "end-results," in fact both the "job-oriented" and the "worker-oriented" approaches describe what people do on the job, and both therefore fit our category of "task as behavior description."

McCormick and his associates have attempted to derive dimensions of jobs by factor analyzing specific aspects of job behavior. For example, in one of his more recent studies, McCormick (1965) reports on two factor analyses of some 119 descriptive items, which yielded seven interpretable factors (four of which were comparable across analyses). The dimensions were: (a) decision-making and communications activities, (b) hierarchical person-to-person interaction, (c) skilled physical activities, (d) mental vs. physical activities, (e) responsible personal contact, (f) general physical activities, and (g) pleasant vs. unpleasant working conditions.[5]

Dunnette (1966) has made a comprehensive review of attempts to define the jobs of managers, which further points up the heavy reliance of industrial and organizational psychologists on the "behavior description" approach. Dunnette examines three related approaches to the definition of managers' jobs: (a) direct observation and recording of managers' behavior (e.g., Carlson, 1951; Kelly, 1964); (b) the "critical incident" technique of Flanagan (1954); and (c) factor analysis of managers' behaviors to develop major "clusters" or categories of managerial behavior (e.g., Fleishman, 1953; Hemphill, 1959).

Dunnette feels that there is much to be gained from a "dimensional" approach to job description, and suggests a general procedure by which dimensions of managerial jobs might be developed. He notes, however, that determining the appropriate

"level of abstraction" for analysis is a major problem associated with this approach. Derived dimensions can be either so concrete and organization- or technology-specific as to lose all generality, or so abstract as to lose their relevance to the description of actual jobs and tasks. The literature which Dunnette reviews indicates that this general problem has by no means been overcome by researchers interested in describing managers' jobs.

Task as ability requirement. A fourth approach to the description of tasks involves specification of the patterns of personal abilities or characteristics which are required for successful task completion. Ferguson (1965, p. 130) in a discussion of some methodological problems relevant to research on learning suggests the potential of such an approach. After lamenting the fact that learning theorists have developed no satisfactory methodology for describing and comparing learning tasks, Ferguson notes that:

> "The ability theorists have, however, developed descriptive classificatory systems, which, regardless of their many faults do have some degree of generality in relation to many forms of human behavior. Since abilities are clearly involved in the learning process, it follows that particular learning tasks can, at different stages of learning, be described in terms of particular ability patterns. We have, then, a method for describing particular learning tasks and differentiating them one from another."

A similar point is made by Hare (1962, p. 251):

> ". . . from the point of view of abilities required, the same abilities that can be differentiated from each other by individual testing will also be useful in the description of group tasks."

Although the above authors do not suggest it, the work of

Guilford (e.g., 1956) on the "structure of the intellect" might provide a highly useful set of "ready-made" categories from which an attempt to classify tasks in terms of ability requirements might begin. Indeed, Guilford has constructed tests of his different types of mental abilities (e.g., "unusual uses," "consequences") which have been used as tasks in certain kinds of experimental situations (e.g., Bass, et al., 1962; Anderson & Fiedler, 1964). Similarly, it would seem that different types of motor tasks could be constructed and described on the basis of the factors of psychomotor skill which have been identified by Fleishman (1954).

The "task as ability requirement" approach also has been popular in descriptions of industrial jobs and tasks. Lytle (1946), tracing the history of "job evaluation" procedures, found heavy reliance on worker abilities and characteristics as the basis for job descriptions. Similarly, Ghiselli & Brown (1955) suggest that it is possible to specify the personal characteristics of workers which are necessary for particular jobs by a procedure which they call "worker analysis." Worker analysis yields information about the physical, psychological, and background characteristics which are necessary for successful job performance. These kinds of data should make possible the comparison and classification of jobs on the basis of similarities

in the personal characteristics which they require. Orr (1960) has performed a study which does just this, using a profile similarity technique to develop "clusters" of jobs in terms of the various worker "aptitudes" which they require. McCormick, Finn & Scheips (1957) utilize factor analysis to achieve much the same end. In this study, a heterogeneity of personal characteristics were intercorrelated and several meaningful factors were obtained, although once again the items analyzed were "mixed" in type and included some "behavior requirements" and some "behavior descriptions" as well as the main body of "personal characteristics."

Evaluation of the Approaches

Any evaluation of a scheme for describing tasks, depends, of course, on the ultimate use to which the description is expected to be relevant. Thus, it should be made explicit at this point that the thrust of this paper is toward gaining insight into the general problem of how tasks and task factors affect behavior. The evaluative discussion below, therefore, will reflect this particular orientation, and some approaches to task description which will be viewed as not particularly useful for this purpose may well be quite appropriate for some other kinds of problems.

The usefulness of the task qua task approach recently has been questioned by some psychologists on both a priori and "feasibility" grounds. For example, McGrath & Altman (1966, p. 75) suggest that "It can be argued that, as psychologists, we do

not care about the . . . stimulus properties of the task, as such." The implication is that psychologists would be better advised to focus on variables which are more directly relevant to behavior. Altman, in a later paper, amplifies on this point. First, Altman (1966, p. 210) holds, even if it were possible to systematically describe and compare tasks in task qua task terms,. . ." the question 'so what?' rears its ugly head." Task qua task properties, by their nature are "distant" from behavior, and what is to be gained by having a sophisticated understanding of the stimulus characteristics of task if it is difficult or impossible to use this information for making statements or hypotheses about behavior? Thus, although the logic of beginning with task qua task properties may not be incorrect, the feasibility of such an approach is subject to real question. Altman asks:

> "What rules exist to bridge this large inferential gap [between task qua task properties and behavior]? How does one know when the bridge is complete or even legitimately crossed?"

As an alternative, Altman suggests that it would be better to begin with behavior, and only later (after general and specific behavior requirements are understood) to attempt to identify those task qua task characteristics which may be of behavioral relevance.

A similar position is taken by Ferguson (1956, p. 130) in a discussion of tasks in learning theory. Ferguson feels that it may be advantageous to use actual behaviors or responses as the primary data for task description and differentiation, consistent with the "task as behavior description" point of view. Szalay

(1962) goes further. While agreeing with Altman and Ferguson that responses rather than task qua task properties are the appropriate basis for the study of tasks and task differences, Szalay holds that reliance on behavior alone will not provide sufficient data for complete description. In addition, Szalay suggests, the cognitive and affective reactions of performers to tasks should be used in identifying task clusters and dimensions.

The position of the writers cited above is not an uncontroversial one. For example, Arnoult (1963), in a discussion of the nature of "social stimuli," offers a markedly different point of view. Arnoult (p. 21) holds that: "A genuine science of behavior consists in determining the relations between stimuli, described in the language of physical measurement, and responses, described in the same language." Arnoult is quick to point out that he is not advocating a return to an "oversimplified Watsonian behaviorism"; rather, he says, steps should be taken to insure that "the intervening processes which we adopt [are] securely anchored to the external, observable events which can be described independently of the behavior which is being explained" (p. 21). Only then, Arnoult feels, can we ever hope to use stimulus terms as real independent variables. And only as we develop the ability to generalize across samples of stimuli (as we now generalize across samples of subjects) can we ever hope to develop a truly objective science of behavior.

Arnoult is not alone in his plea for the development of objectively defined stimulus material. Sells (1963), for example,

has taken a similar position:

> "Measurement of situational variables should be based on objective observation of the stimulus situation external to the participating individual. The individual's perception of the situation is considered to be reflected in the measure of his behavior. However, if important interaction effects, between individual and situational factors, are to be studied, the situational measures must be obtained independently of the individual's perception of them" (pp. 7-8).

Finally, Barker & Gump (1964) make much the same point in quite a different context:

> "The naturally occurring life space deserves investigation, but it is not the ecological environment, and the latter cannot be discovered by using the person's behavior as the sole reference point. This is true, not because it is impossible to see all the behavior that occurs, but because the ecological environment comprises a different class of phenomenon, and can only be identified and understood independently of the behavior with which it is linked" (p.6).

It is difficult to refute the arguments made by the writers cited above. The task qua task approach has the considerable advantage of precise operational specification, and in addition is a task property which is measurable completely independently of the behavior to which it is expected to be related. The main argument <u>against</u> describing tasks in task qua task terms seems to be that it may not be feasible to do so, because of the almost limitless number of possible descriptive dimensions which are available. The feasibility problem is a real one, as Arnoult himself admits. But until data become available which document the impossibility or impracticality of describing tasks in task qua task terms, arguments of feasibility should not

inhibit work toward this goal.

Let us now turn to the other three approaches to task description which were presented earlier in this seciton. It is the position of this writer that the "task as behavior description" approach, in which tasks are described and grouped in terms of the kinds of behaviors which people exhibit when performing them, will not prove useful in understanding the dynamics of task effects on behavior. It will be recalled that much of the work relevant to the description and classification of jobs in industrial and organizational settings was based on a "behavior description" approach. It seems that researchers concerned with job and task descriptions in organizational settings have circumvented the (admittedly difficult) problem of making task descriptions in terms of the tasks themselves simply by substituting a dependent variable class for what should have been an independent variable class. That is, if we are interested in the effects of tasks and task characteristics on behavior, it is essential that we develop some means of describing and classifying our independent variables (tasks) other than in terms of the dependent variables to which we ultimately wish to predict. The task qua task approach offers this possibility; the behavior description approach logically cannot. Because of this basic difficulty, the "task as behavior description" approach will not play a very large role in the task definition and description scheme to be presented in the next section of this paper.

Those who would describe tasks in terms of the "ability requirements" which are necessary for successful task performance are, it seems to this writer, in a similar, if slightly less precarious, position. This approach also circumvents the problem of defining tasks in task terms. Its only difference from the "task as behavior description" position is that it elects relatively enduring aspects of the performer as the basis of description, rather than aspects of the performance itself. It would appear that this position, too, is not a defensible one if we are in fact ultimately interested in analysis of the behavioral impact of tasks and task characteristics.

The "task as behavior requirement" approach appears to hold considerable promise for furthering understanding of tasks and task effects. "Behavior requirements" were described earlier in this paper as specifying those behaviors which must be emitted by a performer for adequate or successful performance on a task. Since the nature of these behaviors will differ from task to task and will depend only on what the task "demands," behavior requirements can legitimately be viewed as characteristics of <u>tasks</u> (rather than characteristics of the performer, as was the case with the two approaches discussed above). Thus, such requirements appear to represent a good basis for making differentiations among tasks.

Further, the concept of "behavior requirement" readily can be broadened to be even more useful in understanding the

differences among tasks and their effects on behavior. In previous research, "task success" and "adequate performance" invariably have been the outcome states for which behavior requirements have been determined. Thus, behavior requirements are conceptualized as mediating between behavior and the attainment of these states; certain behaviors lead to successful performance, other behaviors do not. There is no a priori reason why the behaviors which lead to the attainment of other kinds of outcome states (e.g., personal learning, group cohesiveness, frustration, etc.) for a particular task or class of tasks could not be identified as well. That is, there are many possible task-determined "links" between what a performer does and what outcomes result from that behavior; we need not restrict ourselves only to those links which involve task success.

Consider, for example, an experimental game which requires subjects to allocate materials (e.g., money) among several areas (e.g., advertising media) so as to maximize their "payoffs" (e.g., total sales). The particular outcome which will be obtained for any given trial is determined wholly by the mathematical structure of the payoff function. This payoff function, then, translates behaviors or responses into outcomes, and the experimenter (assuming he knows the operating characteristics of his payoff function) can specify precisely what the "behavior requirements" are for any of a wide variety of outcomes (e.g., maximization of sales for a given sum of money spent).

As another example, assume a subject is given a concept-formation task consisting of a series of stimulus cards, for each of which the subject is to indicate whether or not the particular stimulus is an "instance" of the concept. If the concept "rule" is that a stimulus is an instance only if it contains curved lines, this rule represents a behavior-outcome link (or behavior requirement) in the same sense as the payoff function in the previous example. That is, the rule mediates between the actual behavior of the subject (i.e., saying "instance" or "not an instance") and his outcome (i.e., the experimenter's response of "correct" or "incorrect").

When the links between what a performer does (that is, his behavioral process in working on the task) and the outcomes he receives are determined by the task, as in the two examples above, we will refer to them as task-based "process-outcome links." Process-outcome links subsume "behavior requirements" as the term was used earlier in this paper, and represent an important way in which tasks influence task performance.

Finally, it should be noted that process-outcome links usually cannot affect a performer's behavior directly. As a person begins work on a task, he has available to him only the task materials themselves (i.e., that material which can be described by task qua task dimensions). Only as he gains experience with the task (or with similar tasks) and act-

ually learns what behaviors lead to what outcomes will the process-outcome links begin to have an effect on his behavior.[6] The ways in which these process-outcome links (and other task characteristics) influence the direction of the performance process will be discussed in more detail in a subsequent section of the paper.

A Proposed Definition of Task

The definition of task to be proposed here draws heavily on the characterization of the "external problem situation" which has been described by Gagné (1966) in a paper on human problem solving.

Gagné suggests that the external problem situation consists of three kinds of materials: stimuli, instructions, and verbal directions. Stimuli are the actual physical materials with which subjects work. Instructions, in Gagné's definition, "have the function of eliciting the mediating processes for problem solving" (p. 135). Gagné suggests that there are four major ways in which instructions operate: (a) informing the problem solver as to the nature of the solution required; (b) distinguishing relevant aspects of the stimulus situation; (c) stimulating recall of appropriate concepts or rules; and (d) guiding the thinking process in certain directions. Finally, verbal directions are seen as generally peripheral to the actual problem solving process. They are merely the means by which the individual is confronted with the problem; e.g., "look at the spots on this card." Directions, which logically

could have been viewed as a part of instructions, are distinguished from instructions mainly because they are irrelevant to the problem solving process.

Although Gagné restricts his discussion to problem solving situations, his conceptualization of the external problem situation, generalized and slightly modified, is applicable to virtually all tasks which are imposed on subjects from an external source. The definition of task which is presently proposed is based on this conceptualization, and reads as follows:

> A task may be assigned to a person (or group) by an external agent or may be self-generated. It consists of a stimulus complex and a set of instructions which specify what is to be done vis a vis the stimuli. The instructions indicate what operations are to be performed by the subject(s) with respect to the stimuli and/or what goal is to be achieved.

Let us examine this definition part by part. First, a task may be either <u>assigned</u> or <u>self</u>-<u>generated</u>. If a person decides to draw a picture of a mountain scene, a self-generated task exists; if an art instructor presents a person with a mountain scene and tells him to draw a picture of it, an assigned task exists.

Assigned tasks exist in the "real world" and thus may be described and compared in real world (e.g., task qua task) terms. Thus, it is meaningful to speak of different individuals being given the "same" assigned task, and it is possible to vary systematically the objective parameters of assigned tasks

in an experimental situation. That a subject may (and will) redefine an assigned task in terms of his own idiosyncratic needs, values, or goals is irrelevant to the problem of defining and describing tasks qua tasks. (The "redefinition" problem must, of course, be accounted for in any model which purports to deal with the ways tasks influence behavior, and will be included in the framework to be proposed in the next section.)

There are obvious and substantial difficulties associated with the objective description of self-generated tasks. In one sense, the self-generated task is redefined by the performer(s) as it is generated or "decided upon," and does not exist in objective reality at all. Nevertheless, according to the definition of task presented above, self-generated tasks (like assigned tasks)consist of a set of stimulus materials and a set of instructions. Whether an individual is told to look at a TAT card and write a story about it, or whether he decides to do it on his own, he is still dealing with the stimulus material on the TAT card, and he still must respond to the instructions "write a story." The problem is to find a means of identifying the task materials and measuring their characteristics--a problem of considerable substance, given that the task may not even exist outside the performer's "consciousness" or the group's interaction process.[7] This writer is convinced that obtaining measures of the characteristics of self-generated tasks is basically a methodological rather than a substantive problem, and that adequate measure-

ment techniques can be developed. The analysis of group interaction through existing category systems (e.g., Bales, 1950; Morris, 1966) may be useful in working with self-generated tasks of groups, and recent work on the roles of verbal reports and conscious intentions in performance (e.g., Dulany (1968) and Locke (1968)) may lead to an adequate methodology for dealing with self-generated tasks of individuals.

The second assertion of the task definition presented above is that tasks always involve some identifiable stimulus material —even if it is only a blank Rorschach card. Thus, the instruction "Think!" would not be a task, but "Think about this picture and tell me what it means" would be. If there is no identifiable stimulus material, there is no task.

Third, tasks always involve instructions. At this point we diverge a bit from the formulation of Gagné. In his conception, instructions were seen as eliciting certain processes which were proposed to be important in problem solving. Since we wish our definition of task to be applicable well beyond the problem solving area, a somewhat more general view of the functions of instructions will be required. The definition specifies two such functions, either of which (or both of which) may be present in any given task: instructions about the goals which are to be obtained (analogous to Gagné's first "function" of instructions), and instructions about what operations or actions are to be performed (subsuming Gagné's last three functions). Most tasks probably will have instructions about both goals and operations; e.g., "Minimize the wavering in the tone you hear [instructions about goals] by adjusting the four knobs on this

panel [instructions about operations]." It is possible, however, to have tasks without instructions about goals ("Watch this motion picture."), or to have tasks without instructions about operations ("Make this broken radio work again."). But some kind of instruction--either about goals or about operations--is essential to the definition of task. Merely giving a person a broken radio, for example, would not be viewed as assigning him a task.

We have seen that tasks, as defined here, consist of three main parts: stimuli, instructions about operations, and/or instructions about goals. It may be that identification of these separately analyzable aspects of tasks will facilitate the organization and interpretation of the diversity of "task dimensions" which have been proposed or utilized in previous research. As a first step in this direction, a sample of task dimensions is presented below, grouped on the basis of the three "task aspects" specified by the definition.

Dimensions relevant to the stimulus material. McGrath & Altman (1966) include five dimensions under the heading "stimulus properties of the task" in their coding of small group research variables. These are: (a) differences of subject matter, (b) familiarity of object, (c) clarity of stimulus, (d) nature of stimulus, and (e) relevancy of task information. Morris (1966) and Hackman (1968) have specified three categories of task "contents" which characterize the kinds of stimulus materials with which subjects deal in "discussion" situations: (a) ideas or images, (b) issues, and (c) action-plans or im-

plementations. Fleishman (e.g., 1967, p. 6) has utilized a number of dimensions relevant to the stimulus situation (as well as other types of dimensions) in his research on skilled performance. Examples are the degree of rotation of display panels relative to response panels and the predictability or non-predictability of the target course. Other examples of dimensions relevant to the stimulus include: intensity, novelty, complexity, temporal change, surprisingness, and incongruity (summarized by Wohlwill, 1966); and task load (Lanzetta & Roby, 1956).

Dimensions relevant to instructions about operations. Hare's (1962) very general dimension "rules which must be followed" is probably the most inclusive example of this set of dimensions. Several of the dimensions of group tasks proposed by Shaw (1963) also fall in this category: cooperation requirements and goal path multiplicity (to the extent that these are made known to the subjects), intellectual vs. manipulative requirements, and operational requirements. Also dealing with group situations, Steiner (1966) specifies five ways in which members can combine the resources they bring to a task situation: additively, disjunctively, conjunctively, compensatorily, and complementarily. Again to the extent that subjects are told that they should (or must) work together in one of these ways, these modes of resource combination would represent different "types" of instructions or specifications about how they are to operate. Other kinds of dimensions

relevant to instructions about operations include: deductive vs. inductive procedures (Faucheaux & Mackenzie, 1966); instructions about the time available to work on the task (roughly analogous to the differentiation between "short run" vs. "long run" tasks made by Breer & Locke, 1965); amount of planning called for (Breer & Locke, 1965); decision-making vs. creative tasks (Hoffman & Smith, 1960); and activities of "presentation," "evaluation," and "instruction" (Hackman, 1968).

Dimensions relevant to instructions about goals. Hare (1962) again provides a general indication of the kinds of dimensions which are appropriate for this category, this time two in number: the "kind of goal" and the "criteria for task completion." Krech & Crutchfield (1958) distinguish three types of creative problem-solving situations distinguishable in terms of different instructions about goals:

> "In explanation, the goal is to seek an understanding of why a specified event has occurred. In prediction, certain conditions are given and the goal is to understand the consequences of these conditions, to anticipate an event that has not yet happened. In invention the goal is to create a novel set of conditions that will result in a specified event" (p. 372).

Other dimensions relevant to this category include: the frequency with which decisions are called for (Breer & Locke, 1965); goal clarity (Shaw, 1963); and solution multiplicity (to the extent that this is made known to the subjects) (Shaw, 1963).

Dimensions relevant to more than one aspect of the task. Several proposed task dimensions (or "types") draw on more than one of the bases for description discussed above. Prominent

among these is difficulty, which has been a very popular and productive task dimension. Difficulty can refer either to the operations which are to be performed in pursuit of some goal, or to the goal itself. It would seem that there might be important differences between tasks which are hard to do and those for which it is hard to succeed, but these different bases of difficulty have not been recognized or studied. A similar state of affairs exists with respect to "ambiguity," another popular task dimension. Ambiguity can have three bases: the stimulus material, the instructions about operations, and the instructions about goals. Shaw's (1963) dimensions of "intrinsic interest" and "population familiarity" have two possible bases: the operations and the stimulus materials. Finally, the several "types" of tasks identified by Carter and his associates (e.g., Carter et. al., 1951; Carter & Nixon, 1949; Carter, Haythorn & Howell, 1950) seem to be differentiated on more than one basis. For example, in the Carter, Haythorn & Howell (1950) paper, seven "types" of tasks were identified: reasoning, intellectual, construction, clerical, discussion, motor coordination, and mechanical assembly. The tasks obviously differ in terms of the kinds of instructions about operations which they imply, but they differ as well in terms of the kinds of stimulus material with which subjects deal. It would seem worthwhile to attempt to determine the extent to which the large behavioral differences obtained among the seven types of tasks were a function of differences in stimulus material as opposed to differences in instructions about operations.

Clearly, there is a wide diversity of possible task dimensions relevant to each of the proposed definitional "bases."

Undoubtedly there are "clusters" or "types" of dimensions within each of the categories which have been suggested in this section; work toward the organization of the heterogeneity of task dimensions within the rubric proposed here would seem to be a logical "next step" for developing the implications of the definition.

A Framework for Analyzing Task Effects

Thus far, several ways of analyzing and comparing tasks and task characteristics have been reviewed, and a definition of the concept has been proposed which makes explicit the differences between the stimuli and the instructions which together comprise the task. In this section a tentative framework is proposed within which it may be possible (a) to trace out some of the effects attributable to tasks (and task characteristics), and (b) to identify some points in the task performance process at which "personal" factors have important interactions with task-based factors.

The basic framework is presented in Figure 1. A few characteristics of the performer which seem especially likely to be important in understanding task behavior are grouped near the bottom of the page. The locus of their interactions with the main performance sequence is not indicated in the figure, but will be pointed out as the framework is described in the text. The framework will be described in time-sequence; that is, by reading from left to right across the page.

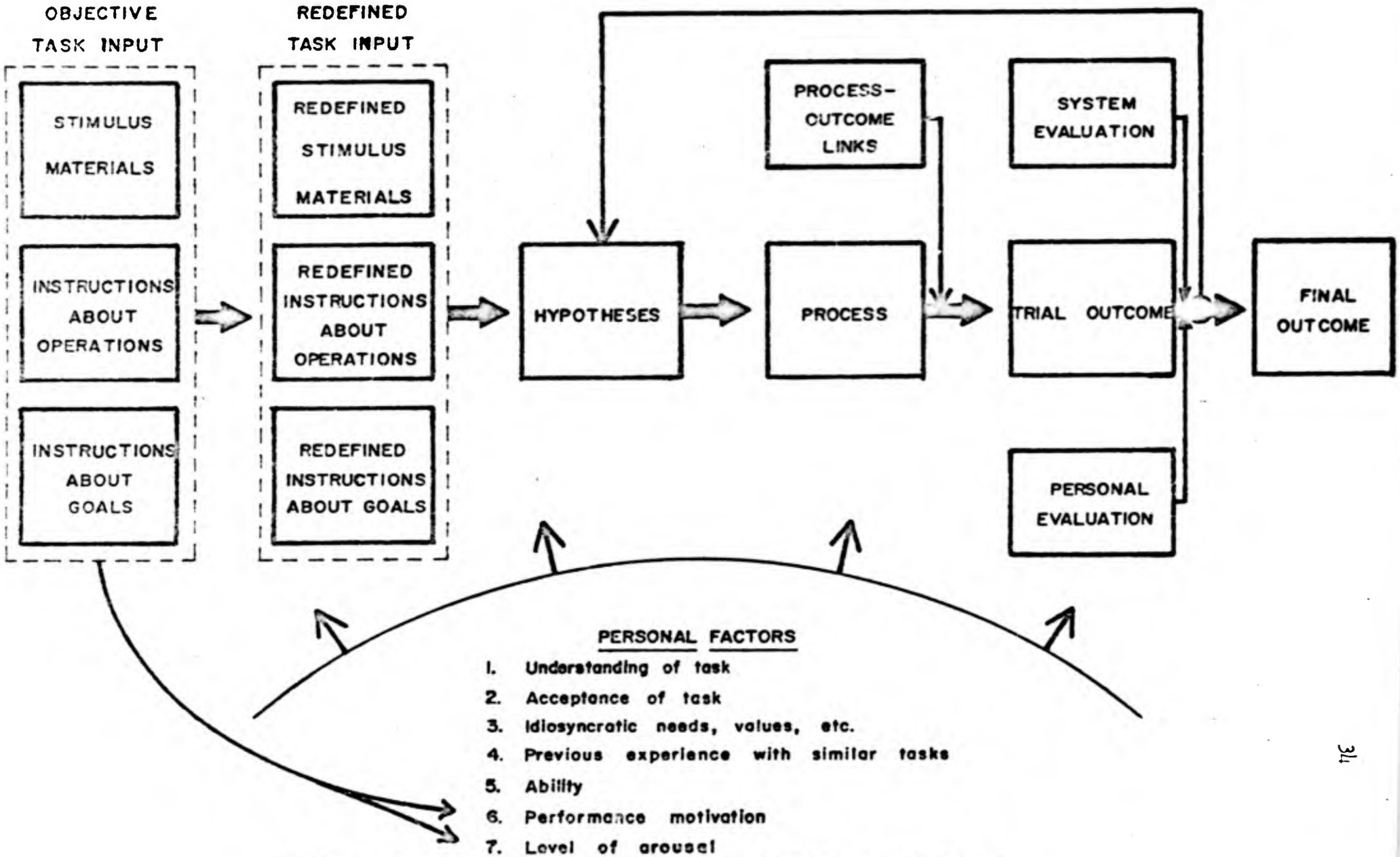

Fig. 1. A Framework for Analyzing the Effects of Tasks

The box furthest to the left represents the objective task as it is presented to the performer(s). Consistent with the definition which has been proposed, the task is seen as having three components: stimulus material, instructions about operations, and/or instructions about goals. As was discussed earlier in this paper, the "objective" task is not the one actually dealt with by any given performer(s), because of the process of "task redefinition." Since the information included in the objective statement of the task must be perceived and coded by the subject before it becomes useful to him, all of the factors which affect the dynamics of perception (e.g., needs, values, etc.) potentially will contribute to task redefinition. Breer & Locke (1965, p.12) characterize this process as follows:

> "Initially, the individual responds by cognitively descriminating among objects in his task environment 'locating and characterizing' each in terms of its relevance to the satisfaction of needs which he has brought to the situation."

Virtually all of the factors which affect the dynamics of perception may be relevant to the redefinition process. Four factors which seem likely to be especially important are: (a) the degree to which the performer <u>understands</u> the task (and if he misunderstands, in what ways); (b) the degree to which he <u>accepts</u> the task and is willing to cooperate with its demands; (c) the idiosyncratic needs and values which the performer brings to the task situation, and (d) the impact of his previous experience with similar tasks.

To the extent that subjects do not understand and/or do not accept the objective task, there is likely to be a considerable difference between the objective and redefined task. In this case, the impact of needs, values, and perhaps even past experience with superficially similar tasks will play a relatively large role in determining the nature of the redefined task. Thus, if the objective task is high on, say, "ambiguity" (a frequently used task dimension), and if the subjects have a divergence of needs, values and prior task experiences (which will usually be the case), considerably more performance variability--because of the redefinition process--would be expected on this task than on one which is low on ambiguity.

The framework proposes that, after a subject has cognitively redefined the task, he formulates some "hypotheses" about how he ought to perform. Breer & Locke (1965) also point out the role of "hypothesis formation" in task performance:

> "On the basis of a whole series of cognitions [about the task], [the individual] constructs an hypothesis with respect to the most effective way of performing the task at hand. However crudely formed, such hypotheses help to structure the individual's initial attempts at solving the task" (p.12)

There are at least two types of hypotheses which may be formed: hypotheses relevant to the strategy of performance (i.e., "How should I go about dealing with this task?"), and hypotheses relevant to the actual behaviors which will be performed, (i.e., "Given that I am going to approach the problem this way, just what should I do or say?").

The specific hypotheses which are generated will depend, of course, on the characteristics of the performer as well as upon the redefined task. Of particular importance in this regard may be any previous experience which the performer has had with the task or with tasks which seem to him to be similar. If in the past an individual has been given, say, highly difficult mathematical problems to solve and has found that he succeeded on these problems most frequently when he broke them into parts before starting actual work, he is very likely to hypothesize that this strategy also will be applicable in the present situation. Rotter (1955), in discussing the impact of the psychological situation, uses expectancy theory concepts to make much the same point. In essence, Rotter suggests that situation-based cues (in the present case, characteristics of tasks) are related through previous experience to expectancies about what kinds of behaviors will be reinforced.

As was the case for the redefinition process, the question of how different task characteristics affect the hypotheses which performers develop is open to empirical investigation. Testable propositions about the nature of this impact are not difficult to generate. For example, if subjects in an experimental game were told that their goal was to "beat the other players," we would predict that they would develop quite different hypotheses about behavioral strategy than if they

were told to "work together so everyone does as well as he can."

The next stage in the task performance sequence is called "process" and refers simply to the "doings" of performance. The process which occurs is seen in the framework as following directly from the hypotheses about what ought to be done. Like the other stages which have been discussed, process is moderated by personal factors. In this case, the performer's task-relevant abilities and his motivation to perform should be especially critical personal factors.

It should be noted that the individual's performance motivation is not merely that motivation that the person "brings with him" to the performance situation. The characteristics of the task itself (especially the stimulus materials) can strongly affect the performer's level of motivation in at least two ways. For example, Scott (1966) has showed how certain task factors can increase the level of arousal of individuals in work situations through activation of the reticular formation, and Hunt (1963) reviews the role of stimulus factors in activation and motivation in more general terms. McClelland and Atkinson (e.g., McClelland et al., 1953) take a slightly different approach to the same issue. These authors suggest that stimulus materials (as well as other conditions) may serve as cues for the arousal of certain motives (e.g., achievement or affiliation) which subsequently can affect the level or direction of performance.

The actual behavior or "process" of performance results in a tentative or "trial" outcome.[8] Two general kinds of trial outcomes (and ultimately, final outcomes) are noted in the framework: objective outcomes and personal outcomes. The former are simply the "products" of the performance process (e.g., a written passage, a configuration of lights on a panel, an assembled device, physical locomotion); the latter are the performer's own reactions to the task experience (e.g., attitude change, frustration, GSR).

The means by which particular responses are translated into particular outcomes is by what we have termed "process-outcome links." These,it will be recalled, are those aspects of the task or the situation which determine what outcomes result from various behaviors on the part of the performer. The payoff matrix in the experimental game and the "rule" in the concept formation task described earlier both are examples of process-outcome links which are based in the task itself.

The framework suggests that after a trial outcome has been obtained (whether explicitly or via a covert trial and error sequence) some evaluation of this outcome is made. The source of this evaluation may be either the person, the system in which the performance is taking place, or both. Examples of system evaluation would be the appearance of the correct pattern of lights on a panel in a board wiring task, or a communication from a supervisor that one's job perfor-

mance was not adequate. Personal evaluation is merely the degree to which the performer feels that the particular trial outcome is "good enough," regardless of whether or not any system evaluation is present. If there is no system evaluation, the decision as to when any given trial output will be accepted as final output is strictly a function of the subject's evaluation. When there is system evaluation, it may be all-encompassing (e.g., no outcome is successful until all five lamps are lighted), or it may operate in conjunction with personal evaluation (e.g., when under the instruction "You may stop when you feel that you have lighted as many of the five lamps as you possibly can.")

If evaluation is negative, the task performance process is seen in the framework as recycling back to the "hypothesis" box, where the subject will presumably "try something different" to see if he can improve his trial outcome. If the evaluation is positive, the trial outcome will become the final outcome and the performance sequence will terminate.

Some implications of this framework will be discussed in the section to follow, as several general problems and opportunities associated with the use of tasks in behavioral research are reviewed.

Discussion[9]

Tasks have a variety of functions in research on human behavior. Sometimes they serve as the means by which an experimental manipulation is introduced (e.g., increasing task

ambiguity as a means of inducing stress). Sometimes they serve as a means by which performers' responses to some other experimental manipulation are assessed (e.g., use of objectively-scorable cryptogram tasks in a study of the effects of leadership style). And sometimes they serve merely as "something for the subjects to do" while other variables are being studied (e.g., asking a subject to write a story about a TAT card while the effects of room temperature on physiological indicators are being studied).

Regardless of which function tasks serve in a performance setting, there are both data and good *a priori* reasons to expect that the tasks themselves will have some influence on the behavior which takes place and the kinds of outcomes which result. In studies in which task factors are central to experimental treatments, any main behavioral effects associated with task factors are likely to be accounted for in the experimental design. But in most research situations the tasks themselves are not central to the treatment, and any task effects are frequently not accounted for by the study design or in statistical analyses.

We are on very shaky ground if we assume that since such tasks are "irrelevant" to our treatments they do not make differences in the way subjects respond to them. While we can say with confidence that the kind of task a subject deals with affects his behavior, we cannot yet say just how this

influence takes place. Thus, we can never be really sure whether the behavioral effects attributable to our tasks are working in concert with the effects due to our manipulation, whether they are tending to "wash out" the manipulated effects, or whether (as we are prone to assume) they do not interact with the treatment at all.

These considerations suggest that tasks to be used in behavioral research should no longer be considered merely "something for the subject to do" while other phenomena are being studied. For as long as this practice continues to be acceptable, important portions of the variability of subjects' reactions to experimental situations will continue to be ignored, with unfortunate consequences for both the interpretability and the generalizability of our results. It seems to this writer that a high priority research need is the development of understanding about what "types" of task dimensions have substantial behavioral impact, what the nature of this impact is, and how it interacts with various experimental treatments.

The framework proposed here may be of help in moving toward these goals by offering one conceptualization of what happens "inside" the performance process. The assumption underlying the very existence of a framework such as this one is that merely looking at "input-output" relationships is <u>not</u> an optimal strategy for furthering understanding of how

task factors affect performers' behavior and output. Rather, the framework suggests that for full understanding of tasks and task effects, we need to determine how "input-output" changes come about; that is, whether obtained results are due to particular kinds of tasks redefinitions, particular hypotheses about behavioral strategy, or to some other aspect of performers' cognitive responses to tasks. Hopefully, the framework will prove to be useful both in interpreting and comparing past research involving tasks, and in planning new empirical studies in such a way that the "why" and the "how" of the results can be ascertained.

As a specific example of how the framework might be used along the lines suggested above, consider the basic question of just how it is that "task effects" take place. The framework shows that there are at least three ways in which tasks can influence the performance process. First, tasks can influence a performer's behavior by affecting the kinds of hypotheses he generates about behavioral strategy. For example, if most performers typically generate hypotheses x and y--but not hypotheses w and z--about how they should respond to a particular task, different behaviors will be observed for performers working on that task than for a task which typically gives rise to alternative hypotheses. Secondly, tasks can influence the characteristics of the performer himself and thereby affect that individual's task behavior. For example, references were

made earlier in this paper to research that shows how task factors can influence (a) the motive states of performers, and (b) their general levels of cognitive and physiological arousal. Both of these influences should result in observable effects on task behavior. Thirdly, task effects may operate through what we have called "process-outcome links." If the task determines (or strongly influences) what outcomes result from various behaviors, a performer can observe the existence and characteristics of this "link" and adjust his behavior to take account of it. In effect, the performer is "learning the task" and how to deal with it to obtain the outcomes he desires.

Just as tasks may affect the performance process in several different ways, it may be that different aspects of the task itself will have different effects. It was proposed that tasks consist of two qualitatively different kinds of information: stimulus materials, and instructions (about operations and/or about goals). There is no a priori reason to assume that "task effects" deriving from these two aspects of the task will operate in comparable ways. Consider the dimension of "ambiguity." A performer might react quite differently to a task in which the stimulus materials were very clear and straightforward and the instructions obscure than he would to one in which the instructions about what to do were clear, but the stimulus materials themselves ambiguous.

Similar kinds of differences in reactions to changes in a "single" task dimension with respect to different aspects of the task might be obtained for other task-based inductions of experimental conditions. To the extent that it is determined empirically that changes in the two aspects of tasks do imply differential subject reactions, care must be taken to specify which aspect of the task is being dealt with--and, indeed, just what is being manipulated and what is not.

A final--and related--issue has to do with the problem of "task specificity" and its implications for the generalizability of empirical results. Most researchers are well aware of the limitations on generalizability associated with using a single task for all subjects and/or conditions in an experiment. But the conceptualization of tasks proposed in this paper suggest that there may be a second aspect to this problem. Even if an experimenter uses a heterogeneity of tasks in an investigation or research program, he should consider varying <u>both</u> aspects of the tasks (i.e., the stimulus materials and the instructions) if he aspires to maximum generalizability.

Consider a hypothetical experimenter interested in the effects of threatening stimuli on behavior. Assume he uses a set of 20 different (but all threatening) stimulus cards as the basis of his threat induction. Each subject is presented with a randomly selected stimulus card and told, "Write a story

about this picture." The experimenter can generalize beyond a particular stimulus card, and legitimately talk about "threat" in more general terms, but he cannot generalize beyond the particular instructions used--in this case, "Write a story."

Alternatively, if an experimenter were interested in examining the effects of changes in the difficulty of experimental instructions, he should take steps to ensure that the stimulus materials which he used were varied as well--this time to avoid specificity of "content."

But if the task instructions (in the former example) or the stimulus material (in the latter) are to be varied, the question remains "On what dimensions?" Here again, the only reasonable answer at this point can be a plea for more work toward furthering our understanding of tasks and task characteristics.

And this, of course, is a reprise of the theme which has run through the entirety of this paper: tasks are important in behavioral research; they make differences in the ways subjects respond, differences which are not understood very well at present. It is the view of this writer that the substantive payoff of work aimed at gaining this understanding will be well worth the effort which must be expended.

References

Altman, I. Aspects of the criterion problem in small group research: II. The analysis of group tasks. Acta Pscyhologica, 1966, 25, 199-221.

Anderson, L. R. & Fiedler, F. E. The effect of participatory and supervisory leadership on group creativity. Journal of Applied Psychology, 1964, 48, 327-336.

Arnoult, M. D. The specification of a "social" stimulus. In S. B. Sells (Ed.) Stimulus determinants of behavior. New York: Ronald Press, 1963.

Bales, R. F. Interaction process analysis: A method for the study of small groups. Cambridge, Mass.: Addison-Wesley, 1950.

Barker, R. G. & Gump, P. Big school, small school. Stanford: Stanford University Press, 1964.

Bass, A. R., Hatton, G. I., McHale, T. J. & Stolurow, L. M. Originality, intelligence, and performance on problem solving tasks: A pilot study of their relationship. T. R. No. 2, Urbana, Ill.: Group Effectiveness Research Laboratory, University of Illinois, 1962.

Breer, P. E. & Locke, E. A. Task experience as a source of attitudes. Homewood, Ill.: Dorsey, 1965.

Carlson, S. Executive behavior: A study of the work load and the working methods of managing directors. Stockholm: Stromberg, 1951.

Carter, L., Haythorn, W. & Howell, M. A. A further investigation of the criteria of leadership. Journal of Abnormal and Social Psychology, 1950, 45, 350-358.

Carter, L. F., Haythorn, W., Shriver, B., & Lanzetta, J. The behavior of leaders and other group members. Journal of Abnormal and Social Psychology, 1951, 46, 589-595.

Carter, L. F. & Nixon, Mary. Ability, perceptual, personality, and interest factors associated with different criteria of leadership. Journal of Psychology, 1949, 27, 377-388.

Davis, G. A. Current status of research and theory in human problem solving. Psychological Bulletin, 1966, 66 (1), 36-54.

Dulany, D. E. Awareness, rules, and propositional control: A confrontation with S-R behavior theory. In D. Horton & T. Dixon (Eds.) Verbal behavior and general behavior theory. Englewood Cliffs, N. J.: Prentice-Hall, 1968.

Dunnette, M. D. Identification and enhancement of managerial effectiveness. Part II: Research problems and research results in the identification of managerial effectiveness. Richardson Foundation Survey Report, 1966. (mimeo)

Faucheux, C. & Mackenzie, K. C. Task dependency of organizational centrality: Its behavioral consequences. Journal of Experimental Social Psychology, 1966, 2, 361-375.

Ferguson, G. A. On transfer and human ability. Canadian Journal of Psychology, 1956, 10, 121-130.

Flanagan, J. C. The critical incident technique. Psychological Bulletin, 1954, 51, 327-358.

Fleishman, E. A. The description of supervisory behavior. Journal of Applied Psychology, 1953, 37, 1-6.

Fleishman, E. A. A factorial study of psychomotor abilities. Research Bulletin AFPTRC-TR-54-15, Lackland AFB, San Antonio, Texas: Air Force Personnel and Training Research Center, 1954.

Fleishman, E. A. Development of a behavior taxonomy for describing human tasks: A correlational-experimental approach. Journal of Applied Psychology, 1967, 51, 1-10.

Gagné, R. M. Human tasks and the classification of behavior. Paper delivered at the Tenth Annual Seminar Series, Psychology in Management, Occupational Research Center, Purdue University, April, 1964.

Gagné, R. M. Human problem solving: Internal and external events. In B. Kleinmuntz (Ed.) Problem solving: Research, method and theory. New York: Wiley, 1966.

Ghiselli, E. E. & Brown, C. W. Personnel and industrial psychology. New York: McGraw-Hill, 1955.

Golembiewski, R. T. The small group: An analysis of research concepts and operations. Chicago: University of Chicago Press, 1962.

Guilford, J. P. The structure of intellect. Psychological Bulletin, 1956, 53, 267-293.

Hackman, J. R. Effects of task characteristics on group products. Journal of Experimental Social Psychology, 1968, 4, 162-187.

Hare, A. P. Handbook of small group research. New York: Free Press of Glencoe, 1962.

Hemphill, J. K. Job descriptions for executives. Harvard Business Review, 1959, 37, 55-67.

Hoffman, L. R. & Smith, C. G. Some factors affecting the behaviors of members of problem solving groups. Sociometry, 1960, 23, 273-291.

Hunt, J. McV. Motivation inherent in information processing and action. In O. J. Harvey (Ed.) Motivation and social interaction. New York: Ronald, 1963.

Kelly, J. The study of executive behavior by activity sampling. Human Relations, 1964, 17, 277-287.

Krech, D. E. & Crutchfield, R. S. Elements of psychology. New York: Knopf, 1958.

Lanzetta, J. & Roby, T. B. Group performance as a function of work distribution patterns and task load. Sociometry, 1956, 19, 95-104.

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

Longenecker, E. C. Perceptual recognition as a function of anxiety, motivation, and the testing situation. Journal of Abnormal and Social Psychology, 1962, 64, (3), 215-221.

Lytle, C. W. Job evaluation methods. New York: Ronald Press, 1946.

McClelland, D. C., Atkinson, J. W., Clark, R. A. & Lowell, E. L. The achievement motive. New York: Appleton-Century-Crofts, 1953.

McCormick, E. J. Job dimensions: Their nature and possible uses. Paper read at American Psychological Association, Chicago, September, 1965.

McCormick, E. J., Finn, R. H. & Scheips, C. D. Patterns of job requirements. Journal of Applied Psychology, 1957, 41, 358-364.

McGrath, J. E. & Altman, I. Small group research: A synthesis and critique of the field. New York: Holt, 1966.

Miller, R. B. Task description and analysis. In R. M. Gagné (Ed.) Psychological principles in system development. New York: Holt, 1962.

Morris, C. G. Task effects on group interaction. Journal of Personality and Social Psychology, 1966, 5, 545-554.

Orr, D. B. A new method for clustering jobs. Journal of Applied Psychology, 1960, 44, 44-49.

Pepinsky, H. B. & Pepinsky, Pauline N. Organization, management strategy, and team productivity. In L. Petrullo & B. M. Bass (Eds.) Leadership and interpersonal behavior. New York Holt, 1961.

Roby, T. B. & Lanzetta, J. T. Considerations in the analysis of group tasks. Psychological Bulletin, 1958, 55, (2), 88-101.

Rotter, J. B. The role of the psychological situation in determining the direction of human behavior. In M. R. Jones (Ed.) Nebraska symposium on motivation. Lincoln: University of Nebraska Press, 1955.

Scott, W. E., Jr. Activation theory and task design. Organizational Behavior and Human Performance, 1966, 1 (1), 3-30.

Sells, S. B. Dimensions of stimulus situations which account for behiavior variance. In S. B. Sells (Ed.) Stimulus determinants of behavior. New York: Ronald Press, 1963.

Shaw, M. E. Scaling group tasks: A method for dimensional analysis. T. R. No. 1, ONR Contract NR 170-266, Nonr-580 (11), Gainseville, Fla.: Department of Psychology, University of Florida, 1963.

Steiner, I. D. Models for inferring relationships between group size and potential group productivity. Behavioral Science, 1966, 11, 273-283.

Stigers, M. F. & Reed, E. G. The theory and practice of job rating. New York: McGraw-Hill, 1944.

Szalay, L. Analysis of creativity tasks. Part II; Task analysis, theoretical considerations, and methodological proposal. Unpublished manuscript, Group Effectiveness Research Laboratory, University of Illinois, 1962.

Thibaut, J. W. & Kelley, H. H. The social psychology of groups. New York: Wiley, 1959.

Weick, K. E. Laboratory experimentation with organizations. In J. G. March (Ed.) Handbook of organizations. Chicago, Illinois: Rand-McNally, 1965.

Wohlwill, J. F. The physical environment: A problem for a psychology of stimulation. Journal of Social Issues, 1966, 22 (4), 29-38.

Footnotes

1. This report is adapted in part from a paper prepared for the Conference on Social and Psychological Factors in Stress, Behavioral Science Division, U. S. Air Force Office of Scientific Research, University of Illinois, May, 1967. Thanks are due Ann Garvin for her assistance, and to the numerous individuals who read and commented on an earlier draft of the manuscript.
2. Exceptions to this general state of affairs are present in the field of group psychology (in which the dependency of "group vs. individual" performance on the nature of the task has been well established) and in studies of psychomotor performance, as exemplified by the work of Fleishman (e.g., 1967).
3. A chapter by Weick (1965) on laboratory experimentation on organizations was very helpful in the process of locating task definitions and arguments relevant to these issues.
4. Three of the approaches to be discussed (task qua task, task as behavior requirement, and task as behavior description) originally were proposed by McGrath & Altman (1966) in their comprehensive review and critique of the small group field. Additional material on the task qua task and the task as behavior requirement approaches is provided by Altman (1966).
5. Although McCormick indicates that the items included in the analyses were "worker-oriented," the last factor seems to be more reflective of the nature of the situation than

it does of "specific human behaviors" as McCormick suggests worker-oriented items should be. McCormick (personal communication) has explained that, for the applications intended for the factor analytic results, it was important to include situational and environmental items as well as task characteristics to be able to interpret the factors in terms of the "demands" that the situation imposes on the individual. This "mixing" of item types is characteristic of much of the traditional "job analysis" literature. Ghiselli & Brown (1955), for example, include in their discussion of the "scope of job analysis" information relevant to methods and procedures of work, physical conditions of the work environment, relations of the job with other jobs, and conditions of employment. Similar diversity characterizes the earlier discussions of job analysis of Stigers & Reed (1944) and of Lytle (1946).

6. This learning process can, of course, be short-circuited by <u>telling</u> the performer what the relevant process-outcome links are when he is given the task. This frequently is done when the person who assigns the task is anxious that the performer develop a particular pattern of behavior (e.g., successful performance) as quickly as possible.
7. This problem is, of course, identical with that of measuring the characteristics of an assigned task after it has been "redefined" by a performer.

8. It should be noted that a trial outcome need not exist for every task. For example, if a performer were permitted only one attempt at solution and the task conditions were arranged so as to insure that this solution resulted directly from his first approach to the task, the notion of a trial outcome would not be necessary. However, it is difficult to imagine a task in which even covert trial and error processes are completely ruled out so as to eliminate the possibility of any trial outcomes.

9. While this discussion will focus on the role of tasks in research settings, the reader should not infer from it that tasks are of interest only because of their methodological implications. Such is far from the case. Tasks represent an important class of "situational" variables, and this class of variables, while "underinvestigated," is nonetheless very important for understanding individual and social behavior. Thus, further systematic examination of tasks and their effects not only should contribute to the methodological adequacy of the field, but also should expand substantially the existing body of knowledge about the general effects of situations on human behavior.

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13. ABSTRACT

This paper attempts to lay the ground work for furthering our understanding of the differences among tasks and the ways in which tasks influence behavior. Three general "problem areas" are reviewed and evaluated in the paper: (a) problems in defining the concept "task"--i.e., what are the components and characteristics of an adequate task definition; (b) problems relevant to the description of tasks--i.e., what are the most useful and appropriate bases for making task descriptions and comparisons; and (c) problems relevant to understanding task effects--i.e.,how do task factors make differences in the ways people think and act.

After evaluating several issues relevant to the problems of task definition and description, one working definition of the concept is proposed, and one general approach to task description is suggested as likely to be most useful in understanding the behavioral impact of tasks. Finally, a framework is proposed which outlines the diversity of effects which may be attributable to task factors in a performance situation, and suggests how these effects may be conceptualized and related.

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