ORGANIZATIONAL GOALS AND THE DECISION-MAKING OF AIR FORCE STAFF OFFICERS: A BEHAVIORAL EXPERIMENT

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A C K N O W L E D G M E N T S

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A. M. H.

The University of Texas at Austin

April 15, 1975

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INTRODUCTION

This study investigates some specific aspects of a general question: How is the decision-making behavior of an organization's middle-level managers influenced by the relative importance its senior executives place upon organizational goals? Although the belief that middle-level managers should incorporate the relative importance their senior executives place upon the organization's goals into their own decision-making seems widespread, little empirical evidence exists to indicate the degree to which this actually occurs in real organizations. In this study, empirical evidence relating to this question is gathered from within a large military organization. The results of a behavioral experiment in which the experimental decision-making task utilized five weighted organizational goals as decision criteria are examined. Air Force officers who were assigned to middle-level positions as members of the headquarters staff of a major Air Force command served as the experimental subjects.

Problem Situation

Broad general questions such as the one presented above are probably best examined from some established point of view, and this approach has been adopted in this study. After a brief discussion of organizational goals, the conceptual framework used for examining the general question presented above is introduced. This conceptual framework serves as the primary frame of reference within which the proposals presented in this study are examined. It employs two major assumptions about middle-management decision-making which are related to the general question presented above.

Organizational Goals

Few productive discussions about management decision-making seem possible without adopting some concept of organizational goals. Cyert and March (1963, pp. 26-43) considered this problem. They pointed out that the classical approach involves assuming an organizational goal that is identical with that of some real or hypothetical entrepreneur. This approach usually emphasizes the importance of maximizing profits or seeking efficiency, and has been

widely used by accountants and economists. Cyert and March, however, did not consider the classical approach to be very useful for explaining the decision-making behavior of the members of organizations. Consequently, they considered a second approach which involves identifying some common goal that is shared by all the members of the organization. They felt this approach also was not useful for explaining the decision-making behavior of the members of organizations, because such internal goal consistency rarely exists in most organizations. Instead, they suggested a third approach be adopted. This approach involves thinking about the organization as a coalition of individuals. The goals of the overall coalition are considered to be determined by a bargaining process which takes place among the various members of the coalition. The goals supported by the dominant members of the organizational coalition are considered to be the goals of the organization. The relative importance placed upon different organizational goals varies with changes in the dominant organizational coalition.

Simon (1964) also considered how management decision-making is influenced by organizational goals. He suggested that management decision-making involves discovering courses of action that satisfy a set of constraints,

and felt that this set of constraints could be thought of as the organization's goals. He proposed that the set of constraints which define a satisfactory course of action are closely associated with some organizational role, and only indirectly with the personal motives of the individual who happens to assume that role. With this approach, organizational goals may be considered as the set of constraints which define the decision-making roles at the upper levels of the organizational hierarchy. Simon stated that it follows logically from this that the senior executives of an organization will support actions which satisfy these goals, and that their subordinates will tailor their decisions to the constraints established at the higher echelons of the organization.

The suggestions by Cyert and March (1963) about how organizational goals are formulated, and the proposals by Simon (1964) about how these goals influence management decision-making coincide with two major assumptions about these relationships implicit in the conceptual framework introduced in the following section.

Planning and Control Systems

The characteristics of the information provided by an organization's planning and control systems are

largely determined by the assumptions about management decision-making that were used in the design of these systems. Let us examine how two major assumptions about management decision-making are employed in a conceptual framework (Anthony, 1965) that has been widely used in the design of planning and control systems.

Anthony's framework. Anthony (1965, p. 9) described a conceptual framework for the design of planning and control systems which he felt could be applied in both nonprofit and profit-seeking organizations. His conceptual framework involves three interrelated processes, strategic planning, management control, and operational control. He defined these three processes as follows.

> Strategic planning is the process of deciding on the objectives of the organization, on changes in these objectives, on the resources used to attain these objectives, and on the policies that are to govern the acquisition, use, and disposition of these resources (Anthony, 1965, p. 16).
>
> Management control is the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives (Anthony, 1965, p. 17).
>
> Operational control is the process of assuring that specific tasks are carried out effectively and efficiently (Anthony, 1965, p. 18).

Since the operational control process involves few, if any, assumptions about management decision-making, it is of relatively little interest so far as this study is concerned. However, the relationships described between the strategic planning and management control processes imply some assumptions about middle-management decision-making that are of interest for this study. Let us examine these two processes further.

Anthony pointed out that the plans and policies that determine the overall direction of the organization are formulated during the strategic planning process. This kind of decision-making is normally associated with the higher echelons of the organization's management hierarchy, and involves both choosing the organization's goals and planning how to achieve those goals. On the other hand, the kind of decision-making that takes place during the management control process is normally associated with the middle-level echelons of the organization, and is felt to be constrained by the organizational goals and policies established during the strategic planning process (Anthony, 1965, pp. 24-40).

Anthony was careful to point out that he did not originate the conceptual approach described above. Many

others have used similar approaches. For example, Horngren (1972, pp. 153-157) used this approach to discuss the design of managerial accounting systems in his widely used managerial accounting text. Steiner (1969, pp. 268-271) stated that carefully defined organizational goals and policies should serve as guidelines for the more routine decisions made by an organization's middle-level managers in his book about long-range planning. Kanter (1972) and Davis (1974) both used similar approaches in their books about management information systems. Despite the widespread use of this conceptual approach, however, little empirical evidence exists to indicate the validity of the two assumptions about middle-level management decision-making implicitly employed.

The assumptions. Two major assumptions about middle-level management decision-making are implicit in the conceptual framework described above. First, this approach assumes that the decision-making behavior of an organization's middle-level managers is strongly influenced by organizational goals whose importance is prescribed by the organization's senior managers. Second, since it is generally agreed that large organizations have multiple goals, this approach assumes that middle-level managers are capable

of accurately perceiving the importance of multiple organizational goals and incorporating them into their decision-making processes. The research proposals presented later in this chapter are used to facilitate an empirical investigation of the validity of these two assumptions.

Some Perceptual Difficulties

Let us consider some of the perceptual difficulties faced by middle-level managers. Katz and Kahn (1966, pp. 260-265), among others, have pointed out that an organization's actual goals frequently differ from its stated goals. As a result, organizations sometimes issue pious policy statements about organizational goals with no real intention of changing how members function in their roles. If this is true, how do middle-level managers determine the actual goals of their organizations? It follows logically that they must have some perceptions about these goals if they are to incorporate them into their decision-making.

Schein (1971) has stated that an organization's members learn its goals, norms, values, and preferred ways of doing things as part of the organizational socialization process. Organizations socialize new members by

creating a series of events which perform the function of undoing old values. This prepares these individuals for the process of learning new values. They acquire these new values from several sources such as the official literature of the organization, the examples set by the organization's senior executives, direct instructions from immediate superiors, and as a result of the rewards and punishments associated with their own efforts at problem solving. Schein pointed out that the results of the organizational socialization process vary with individuals. Some individuals will reject an organization's goals and values completely, and leave it. Others will accept only those pivotal goals and values which must be accepted in order to remain in the organization. The majority of the individuals within an organization accept those goals and values which are relevant to their roles within the organization. A few accept nearly all the organization's goals and values, and are considered to be stereotypes of conformity by their contemporaries.

With these considerations in mind, it seems evident that an organization's middle-level managers sometimes have difficulty in forming accurate perceptions about their organization's goals. If they are unable to accurately

perceive what the goals of their organization are, and they incorporate their inaccurate perceptions into their decision-making, it follows logically that their decisions will not incorporate the organization's true goals.

Some Cognitive Difficulties

Since most organizations have multiple goals, and some goals are more important than others, managers must be capable of incorporating multiple criteria into their decision-making processes if they are to properly consider these goals in arriving at their decisions. Simon (1969) proposed that humans are restricted in their ability to make decisions and solve problems by their short-term memory limitations. Using information system terminology, he described these limitations as follows.

> The evidence is overwhelming that the system is basically serial in its operation: that it can process only a few symbols at a time and that the symbols being processed must be held in special limited memory structures whose content can be changed rapidly. The most striking limits on subjects' capabilities to employ efficient strategies arise from the very small capacity of the short-term memory structure (seven chunks). . . (Simon, 1969, p. 53).

It seems likely that the ability of individuals to incorporate multiple criteria into their decision-making

processes is related to the cognitive limitations described above by Simon. In a lengthy review article of the research that has been done in the area of human judgment, Slovic and Lichtenstein (1971) suggested that human decision-making capabilities might be even more limited than suggested by Simon. They cited empirical evidence which indicated that real decision-makers tend to emphasize only two or three criteria in arriving at a decision (when not instructed to do otherwise), even though other relevant criteria are available. Typically, one variable accounted for about forty percent of the explainable variance, and three variables accounted for over eighty percent of the explainable variance. This evidence suggests that middle-level managers might not be capable of incorporating more than about two or three organizational goals into their decision-making processes.

Research Setting

In order to investigate the validity of the two major assumptions about middle-management decision-making implicitly employed in the conceptual framework described by Anthony (1965), a behavioral experiment was conducted.

The experiment was conducted at the Air Training Command headquarters, Randolph Air Force Base, Texas, between September 16, 1974 and October 3, 1974. The experimental subjects were selected from officers assigned to middle-level management jobs as members of the Command's headquarters staff. Although the Air Training Command actually has four missions (recruiting, basic military training, technical training, and flying training), the behavioral experiment focused upon its largest and best-known mission, flying training. The pilot training program receives a great deal of management attention within the Air Training Command headquarters, for ten of the Command's fifteen active bases are devoted almost exclusively to this mission. Almost every member of the Command's headquarters staff becomes involved with some aspect of the activities of at least one of these bases at some time.

For purposes of the behavioral experiment, the pilot training program was considered to have five primary goals: (1) efficiency, as determined by the average cost per pilot graduated; (2) pilot quality, as determined by the flying ability of the pilots graduated; (3) personnel retention, as determined by the success of programs aimed at achieving an all-volunteer force; (4) compliance with

directives, as determined from inspections performed by the Inspector General; and (5) aircraft maintenance, as determined by the efficacy of efforts to maintain the primary aircraft in good flying condition.

The experimental decision-making task required the subjects to evaluate the overall performance of a number of hypothetical pilot training wings using only information which indicated whether performance was either satisfactory or unsatisfactory in each of the areas described above. After the pretest task, some subjects were provided with organizational policy statements which described the relative importance placed on these goals by the senior executives of the Air Training Command. In addition, some subjects were provided with feedback information which allowed them to compare their own decisions with decisions made by these senior executives.

Statement of the Problem

March and Simon (1958, pp. 6-7) grouped proposals which attempt to explain organizational behavior into three broad categories. The first category includes those proposals which assume that organization members are principally passive instruments who do not initiate action or

exert influence in any significant way. This is the approach taken in traditional, or "classical," organization theory. The second category includes those proposals which assume that organization members bring their personal attitudes, values, and goals with them into the organization and as a result must be somehow motivated to participate in the organization. With this approach, power phenomena, attitudes, and morale are considered the centrally important factors for explaining organizational behavior. The third category, the one into which this study falls, includes those proposals which consider organization members as decision-makers and problem solvers. With this approach, perception and thought processes are considered the centrally important factors in explaining organizational behavior.

The general question investigated in this study may be stated as follows: How is the decision-making behavior of an organization's middle-level managers influenced by the relative importance its senior executives place upon organizational goals? It is proposed that this question has a straightforward answer. Middle-level managers tend to place the same relative importance upon the criteria they use to arrive at decisions as they perceive their senior executives to place upon related organizational

goals. When they fail to do so accurately, this failure results primarily from either their inability to form accurate perceptions about these goals, or from cognitive difficulties related to incorporating multiple weighted criteria into their decision-making processes.

The general question stated above is investigated in this study by examining the validity of two assumptions about middle-management decision-making implicit in a widely used conceptual framework described by Anthony (1965). The first assumption is that the decision-making behavior of an organization's middle-level managers is strongly influenced by organizational goals whose importance is prescribed by the organization's senior managers. Since it is generally agreed that large organizations have multiple goals, the second assumption is that middle-level managers are capable of accurately perceiving the importance of multiple organizational goals and incorporating them into their decision-making processes. If these two assumptions about middle-management decision-making are valid, then the three research proposals presented below should accurately predict the decision-making behavior of an organization's middle-level managers.

The First Proposal

It is proposed that when middle-level managers receive a policy statement which indicates their senior executives have changed the relative importance placed upon the organization's goals, their decision-making behavior will be affected as follows:

1. They will place different relative weights on related criteria during their decision-making than their contemporaries who have no knowledge of the policy statement.

2. They will place relative weights on related criteria during their decision-making which approximate the policy statement description of the relative importance their senior executives place upon the organization's goals.

The Second Proposal

It is proposed that when the middle-level managers who received the policy statement mentioned above are subsequently allowed to compare their own decisions with decisions made by their senior executives, their decision-making behavior will be affected as follows:

1. Those who perceive their senior executives incorporated the same hierarchy of organizational goals

described in the policy statement into their actual decisions will place relative weights on related criteria during their decision-making which approximate the policy statement description of the relative importance their senior executives place on the organization's goals.

2. Those who perceive their senior executives incorporated a different hierarchy of organizational goals into their actual decisions than was described in the policy statement will place relative weights on related criteria during their decision-making which approximate this perception of the relative importance their senior executives place on the organization's goals.

3. Those who are unable to perceive any meaningful (i.e., nonrandom) pattern in the decisions made by their senior executives will place relative weights on related criteria during their decision-making which approximate the original policy statement description of the relative importance their senior executives place on the organization's goals.

The Third Proposal

It is proposed that middle-level managers who perceive their senior executives to place some (significant)

level of importance upon multiple organizational goals will also place some (significant) level of importance upon related multiple criteria during their own decision-making.

The Two Assumptions

The three research proposals presented above are used in this study to empirically examine the validity of two major assumptions about middle-management decision-making implicit in Anthony's (1965) conceptual framework. The first of these assumptions is that the decision-making behavior of an organization's middle-level managers is strongly influenced by organizational goals whose importance is prescribed by the senior managers of the organization. If this assumption is valid, the experimental subjects should be expected to change the relative weights they place on their decision criteria when they receive information which indicates their senior executives have changed the relative importance placed on related organizational goals. Furthermore, they should be expected to shift the relative weights they place on their decision criteria so they more closely correspond with the relative importance of organizational goals specified by their senior executives.

The second assumption is that middle-level managers are capable of accurately perceiving the importance of multiple organizational goals and incorporating them into their decision-making processes. If the first assumption is valid (i.e., the experimental subjects exhibit the desire to incorporate the organizational goals into their decision-making behavior), then the validity of the second assumption can be determined. Under these circumstances, the experimental subjects should be expected to place approximately the same relative weights on their decision criteria as the relative importance of organizational goals specified by their senior executives unless their perceptual and/or cognitive limitations make them incapable of doing so.

If both of the two assumptions about middle-management decision-making are valid, then the three research proposals presented above should be expected to accurately predict the decision-making behavior of the subjects who participated in the behavioral experiment. If, however, under the controlled circumstances of the behavioral experiment, the decision-making behavior of the experimental subjects differs significantly from the behavior predicted by the three research proposals, then it follows logically

that the validity of one or both of the two assumptions is questionable.

Objectives of the Study

The primary purpose of this study is the empirical investigation of the validity of two major assumptions about middle-management decision-making behavior implicit in the conceptual framework described by Anthony (1965). Since this conceptual framework has been widely used for the design of planning and control systems, the validity of these assumptions has important implications for the design of such systems. In addition, the study also examines how the perceptual and/or cognitive difficulties individuals encounter can affect their decision-making behavior.

Scope and Limitations of the Study

The use of working managers from an actual organization as experimental subjects provides the results of the behavioral experiment this study reports upon with a greater sense of realism than may usually be associated with such studies. Nevertheless, it should be pointed out that, in the strictest sense, the results of the behavioral

experiment may not be generalized beyond the middle-level staff officers assigned to the Air Training Command headquarters staff at the time of the experiment. Since the 75 experimental subjects were selected randomly from this larger population of 429 officers (first lieutenants through lieutenant colonels), however, considerable confidence is expressed that the results of the experiment may be considered to be representative of the performance of this particular management group.

The research findings are based upon an evaluation of the specific proposals which were investigated and upon the particular decision-making task which was utilized, and must be limited accordingly. Since the experimental subjects were all members of one military organization, and other organizations undoubtedly differ from this organization in various ways, the results of the experiment should not be applied to other organizations without carefully considering the possible effects of such differences. The degree to which organizational differences might alter the research findings presented in this study cannot be estimated here.

Organization of the Study

The remainder of the dissertation is divided into four chapters. The following chapter considers how the decision-making behavior exhibited by the experimental subjects can be represented in such a way that it may be described and analyzed. The Newell and Simon (1972) human information processing model is used to describe the decision-making process selected for examination. The use of the Brunswik Lens Model (Brunswik, 1943, 1952) approach for analyzing the data provided by the behavioral experiment is described. In addition, some studies whose findings were considered to be related to the objectives of the dissertation are summarized briefly.

The third chapter contains a description of the experimental design that was used for the behavioral experiment. The procedures that were used at the field location where the experiment was actually performed are discussed, and the analytic techniques that were used to examine the data provided by the experiment are explained.

The results of the behavioral experiment are presented in the fourth chapter. Initially, the evidence provided by the experiment is used to evaluate each of the three research proposals presented in the first chapter

and a few ancillary considerations. Next, the validity of the two major assumptions about middle-management decision-making implicit in Anthony's (1965) conceptual framework is examined in light of the evidence provided from the evaluation of the three research proposals.

Initially, the fifth chapter summarizes the research problem, the approach used for the investigation, and the research findings. Next, the implications of the research findings for the design of an organization's management control system are considered. Last, some suggestions for further research are presented.

C H A P T E R I I

THE REPRESENTATION OF HUMAN JUDGMENT

This chapter considers how the decision-making behavior of the middle-level staff officers assigned to the headquarters of the Air Training Command may be represented in such a way that it can be described and analyzed. Information is presented in four major sections. A brief description of the management environment of the officers the study is concerned with is presented in the first section. The second section focuses upon how these officers' decision-making behavior can be described within the framework of the Newell and Simon (1972) human information processing model. The third section focuses upon how the Brunswik Lens Model can be used to analyze the information provided by the behavioral experiment. Some studies whose findings are considered related to the research objectives of this dissertation are summarized briefly in the fourth section.

The Decision-Making Environment

The purpose of this section is to present a brief description of certain aspects of the management environment

of the middle-level staff officers assigned to the Air Training Command headquarters. A deliberate emphasis has been placed upon the decision-making environment associated with the management control process in relation to the Command's pilot training program, and no attempt has been made to describe the broad spectrum of duties these officers perform. Two primary references provide a description of the Air Force management environment, The USAF Management Process (Air Force Manual 25-1) and Organization Policy and Guidance (Air Force Manual 26-2). The following discussion is heavily dependent upon these two sources.

Policy Formulation and Implementation

The Air Force management process is characterized by the development of broad organizational policies at the upper levels of the organizational hierarchy which are widely disseminated throughout the organization. Commanders and managers at the local level are expected to be cognizant of these policies, and to apply them to specific situations and problems. The "Air Force Policy Letter for Commanders," distributed twice monthly from the Office of

the Secretary of the Air Force illustrates how this process works, and (along with its more comprehensive monthly supplement) contains statements of policy made by high officials of the Department of Defense and the Air Force. It is distributed to commanders and managers throughout the Air Force.

The Air Force organization structure follows the bureaucratic model. Broad military missions are assigned to specific organizations. Organizations are designed to suit the military missions assigned to them. Formal authority is vested in one individual, the organization commander, at each level of the organization. Centrally developed organizational policies are designed to focus the efforts of these organizations upon the common aims of the overall organization.

The Air Training Command and Its Headquarters

The Air Force is divided into 10 separate operating agencies and 15 major commands at its first level of decentralization. Separate operating agencies are highly specialized staff organizations which deal with a specific function. For example, the United States Air Force Academy

and the Air Force Accounting and Finance Center are two well-known separate operating agencies whose titles describe their functions. The major commands are much larger organizations than the separate operating agencies, and have military missions assigned to them that are much broader in scope.

The Air Training Command is the second largest of the Air Force's 15 major commands. It has four primary military missions: (1) recruiting, (2) basic military training, (3) technical training, and (4) flying training. Its operating budget during Fiscal Year 1974 was over one billion dollars, and its assets were valued at over $2.8 billion. It had almost 115,000 personnel assigned to 15 bases located in six states scattered from the Atlantic to the Pacific. The Command's headquarters is located at Randolph Air Force Base, San Antonio, Texas ("Air Training Command," 1974, pp. 70-71 and pp. 132-133).

The organizational structure of the Air Training Command headquarters is described in Organization and Functions, Headquarters Air Training Command (Air Training Command Regulation 23-1). The Headquarters is divided into 15 staff organizations and a support squadron. The staff organizations, called staff directorates, perform

specialized functional duties. The organizational structure of the Air Training Command headquarters is outlined in Figure 2.1.

Naturally, the size and complexity of the Air Training Command requires these staff organizations to perform a variety of activities. Most of these activities have been ignored in this study, which focuses upon a particular decision-making task related to the management control process (called staff surveilance within the Air Force). The officers assigned to the headquarters staff directorates use information about base-level units provided from field visits, inspections, and administrative reporting systems to judge whether these are performing adequately. With some of the staff directorates, such as the Inspector General, this evaluative function is primary and active, while with others it is secondary and passive. The behavioral experiment this study reports on was designed to investigate how the decision-making behavior of the middle-level staff officers who perform this evaluative function is influenced by the relative importance the Command's senior executives place upon the goals of the pilot training program.

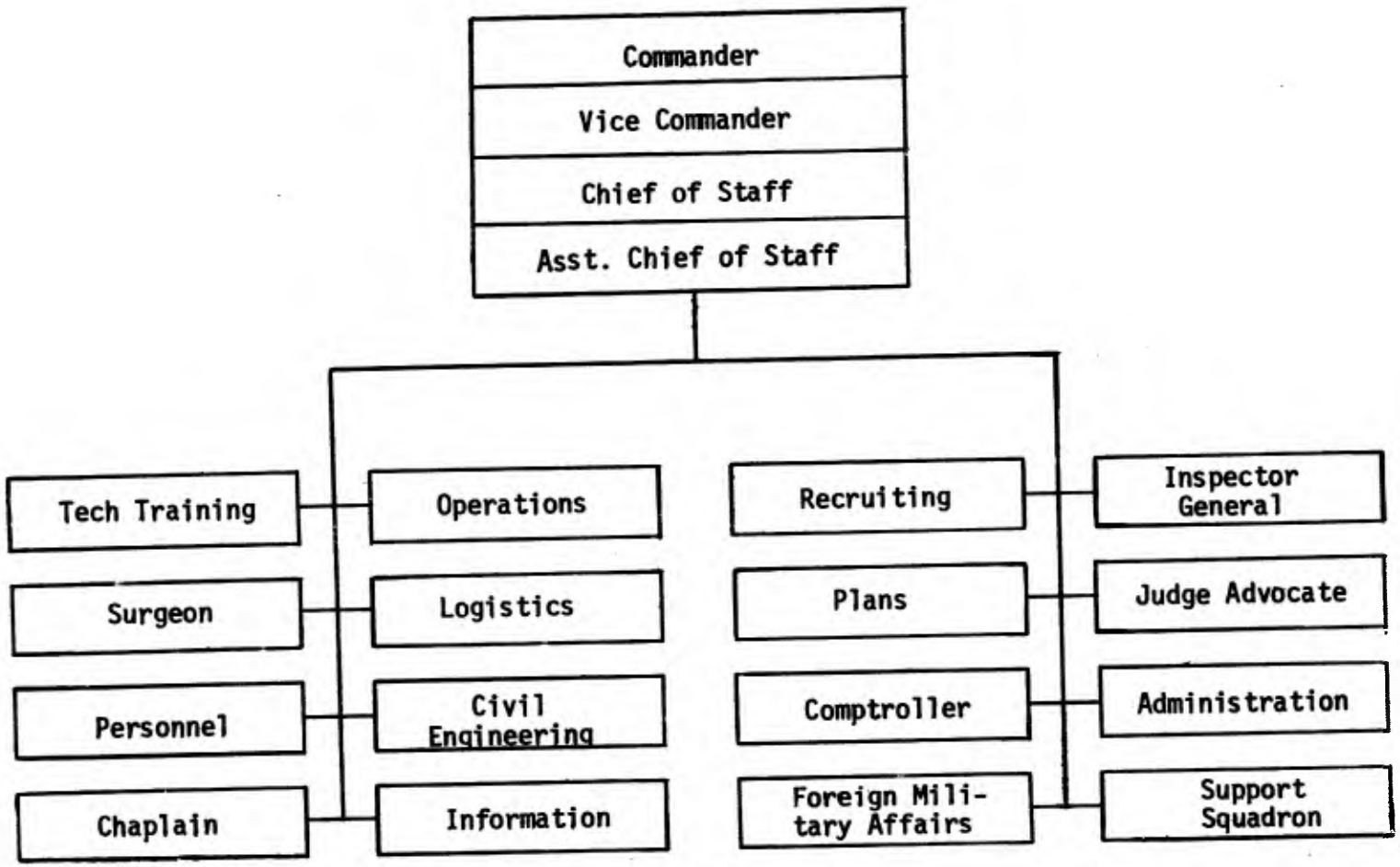

FIGURE 2.1

ORGANIZATIONAL STRUCTURE OF THE AIR TRAINING COMMAND HEADQUARTERS

(Organization and Functions, Headquarters Air Training Command (Air Training Command Manual 23-1, Randoplh Air Force Base, Texas, September 13, 1974, p. 3))

Goals of the Pilot Training Program

The existence of clearly stated, operational goals for the Command's pilot training program would facilitate their use as criteria for evaluating the performance of the base-level pilot training wings which actually train the future pilots of the Air Force. Unfortunately, no formal statement of these goals was found to exist at the Air Training Command headquarters. Since the nature of the research proposals investigated in this study are closely associated with such goals, it was necessary for the researcher to select a limited number of organizational goals which could be considered relevant criteria for evaluating the performance of base-level pilot training wings. After considering the related literature and the results of a preliminary study described later in this chapter, five organizational goals were finally selected: (1) efficiency, (2) pilot quality, (3) personnel retention, (4) compliance with directives, and (5) aircraft maintenance. Let us consider the criteria that were used in the selection process.

The computational requirements of the research methodology call for decision criteria to be used during

the experimental decision-making task that are uncorrelated with each other. Since the organizational goals described below serve as decision criteria during the experimental decision-making task, it follows that they should be as independent of each other as possible. If, in practice, it was possible for a pilot training wing's performance in a particular goal area to be evaluated as either "highly unsatisfactory" or "highly satisfactory" without determining how the wing's performance would be evaluated in the other goal areas, then these goals were considered to be independent of each other. Since organizational goals tend to be interrelated in the long term, this approach requires that a relatively short term viewpoint be taken. For example, it is possible for a pilot training wing's aircraft maintenance program to be evaluated as either "highly unsatisfactory" or "highly satisfactory" for a particular calendar quarter regardless of how its personnel retention program is evaluated, and the reverse situation is also possible. In order to make certain that the experimental subjects considered these goals to be independent of each other during the decision-making task, they were instructed to consider them as independent during their preliminary instructions (See Appendix A).

March and Simon (1958, pp. 155-157), among others, have stated that only operational goals influence management decision-making to a significant degree. In order for an organizational goal to be considered as an operational goal, some method must exist which allows its achievement, or lack of achievement, to be specified. When some administrative system existed within the Air Training Command which provided information which could be used to determine if an organizational goal was achieved either satisfactorily or unsatisfactorily, then that goal was considered to be an operational goal. Such systems existed for each of the five organizational goals described below.

In addition, only those organizational goals which could be considered important in actual management situations within the Air Training Command were considered appropriate for use as evaluation criteria. In making this determination, heavy reliance was placed upon whether statements about the importance of achieving a goal existed either in the literature of the Air Force or in the appropriate literature of organization theory.

The five organizational goals finally selected, which are examined in more detail below, include the

following: (1) efficiency, (2) pilot quality, (3) personnel retention, (4) compliance with directives, and (5) aircraft maintenance.

Efficiency. Katz and Kahn (1966, pp. 156-161) defined efficiency as the ratio of an organizational system's energic output (product) to its energic input (cost). Using this definition, the average cost per pilot graduated by a pilot training wing indicates the wing's efficiency; this measurement was used to represent efficiency in this study. Statements about the importance of achieving efficiency are widespread in the literature of the Air Force (McLucas, 1974, pp. 15-17), the literature of planning and control systems (Anthony, 1965, pp. 27-28), and the literature of organization theory (Katz and Kahn, 1966, pp. 158-159).

Pilot Quality. The primary purpose of the Air Training Command pilot training program is generally agreed to be the production of qualified pilots. Over time, a considerable emphasis has developed upon the quality of the pilots produced. The large emphasis upon the quality of the pilots graduated seems directly related to observations by Perrow (1970), pp. 166-170) that some organizations

place so much importance upon the quality of their output product that this characteristic becomes an organizational goal. Usually, such organizations are highly conscious of the quality of their product, pride themselves upon it, and often sacrifice short-run gains in order to maintain this goal. These characteristics are evident within the Air Training Command. The Command's emphasis upon the quality of the pilots it graduates is evidenced by the highly developed systems used to assure the achievement of this goal. For example, student pilots are required to undergo flight examinations with specially trained check pilots other than their usual instructor pilots at certain phases of their training. Those who do not satisfactorily complete such flight examinations are either provided with additional training until they can do so or eliminated from the pilot training program. In addition, instructor pilots are also examined regularly to assure that they use standardized instructional techniques, and to make certain that their level of flying proficiency is above criticism.

Personnel Retention. As Katz and Kahn (1966, pp. 337-338) have pointed out, sufficient qualified personnel must be kept within the organizational system to

perform its essential functions if the system is to survive. When it became apparent that the military draft law would not be extended beyond July 1, 1973, the Air Force greatly increased its efforts aimed at recruiting and retaining qualified individuals. The goal of an all-volunteer force has subsequently become of increasing importance within the Air Force (Seamans, 1973).

Compliance with Directives. The belief seems widespread that bureaucratic organizations, and especially military bureaucratic organizations, place extraordinary emphasis upon complying with organizational directives. Perrow (1970, pp. 153-154) has pointed out that such an emphasis upon achieving a certain method of operating can acquire the status of an organizational goal. In such instances, as much emphasis is placed upon obeying rules as upon actual achievements.

There seems little doubt that considerable importance is placed upon complying with directives throughout the Air Force. Within the Air Training Command, the Inspector General inspects the activities of subordinate organizations to determine if they have complied with Air Force and Air Training Command directives. The Inspector

General reports his findings to the commander of the Air Training Command.

Aircraft Maintenance. The aircraft maintenance program aims at maintaining the Air Force's aircraft in the best possible flying conditions. The Air Force has recently implemented a significant management effort aimed towards improving the effectiveness of this program. It is called the Maintenance Management Information and Control System (MMICS). This system is designed to take advantage of the computer facilities at all large Air Force bases, and aims at streamlining the clerical procedures used for insuring that each equipment deficiency has been properly serviced by a maintenance specialist. The decision to implement this system was made after evaluation studies by the RAND Corporation and the completion of a base-level test program (Smith, 1974). The importance of the maintenance program to the flying organizations of the Air Force is difficult to overstate. The large amount of resources devoted to this area within the Air Force indicates its importance. About one-third of the total Air Force budget is related to the maintenance program, and over one-third of all Air Force personnel work in maintenance career fields (Tanberg, 1970).

The Decision-Making Scenario

With the information presented above in mind, let us examine the decision-making situation abstracted for investigation with a behavioral experiment.

The middle-level staff officers of the Air Training Command Headquarters participate in the management control process by using information provided by field visits, inspection, and administrative information systems to judge the adequacy of the performance of the Command's base-level pilot training wings. The goals of the pilot training program are used as criteria in arriving at these decisions. The research proposals investigated in this dissertation suggest that the decision-making behavior of these middle-level staff officers is strongly influenced by their knowledge of the relative importance placed on these goals by the senior executives of the Command.

The decision-making situation described above was represented with an experimental decision-making task in the behavioral experiment this study reports upon. This task utilized the five organizational goals (efficiency, pilot quality, personnel retention, compliance with directives, and aircraft maintenance) as the decision criteria

to be used for evaluating the overall performance of a number of hypothetical pilot training wings. In each decision-making instance, the subjects were provided with information which indicated whether a wing had either satisfactorily or unsatisfactorily achieved each of the five decision criteria. Using only this information, the subjects were required to evaluate each wing's overall performance on an eight-point scale. The experimental task is described in more detail in the following chapter, and examples of the materials used for the experiment are presented in Appendix A.

The following section presents a model considered useful for describing the decision-making processes involved, and the succeeding section presents a different model considered useful for analyzing the results of the experimental decision-making task.

The Newell-Simon Model

Certain characteristics of the management environment of the middle-level staff officers assigned to the Air Training Command Headquarters have been described above. A particular decision-making situation which requires these officers to judge the adequacy of the performance of the Command's base-level pilot training wings

using information provided by field visits, inspections, and administrative information systems was emphasized. This section introduces a model which allows the various factors of this decision-making situation to be described more exactly. It examines the decision-making situation within the framework of the Newell-Simon human information processing model.

Characteristics of the Model

Newell and Simon (1972) have proposed a human information processing model which makes use of the analogy between computer processing and human information processing. They point out that by using such an analogy they do not mean to suggest that humans solve problems and make decisions like computers. Instead, their intent in utilizing this analogy is to provide a better understanding about how humans process information to reach decisions and solve problems. The Newell-Simon model of human information processing is outlined in Figure 2.2.

The more detailed description of human information processing presented by Newell and Simon (1972, pp. 19-87) has been summarized by Davis (1974, pp. 62-68). The human information processing system is considered to

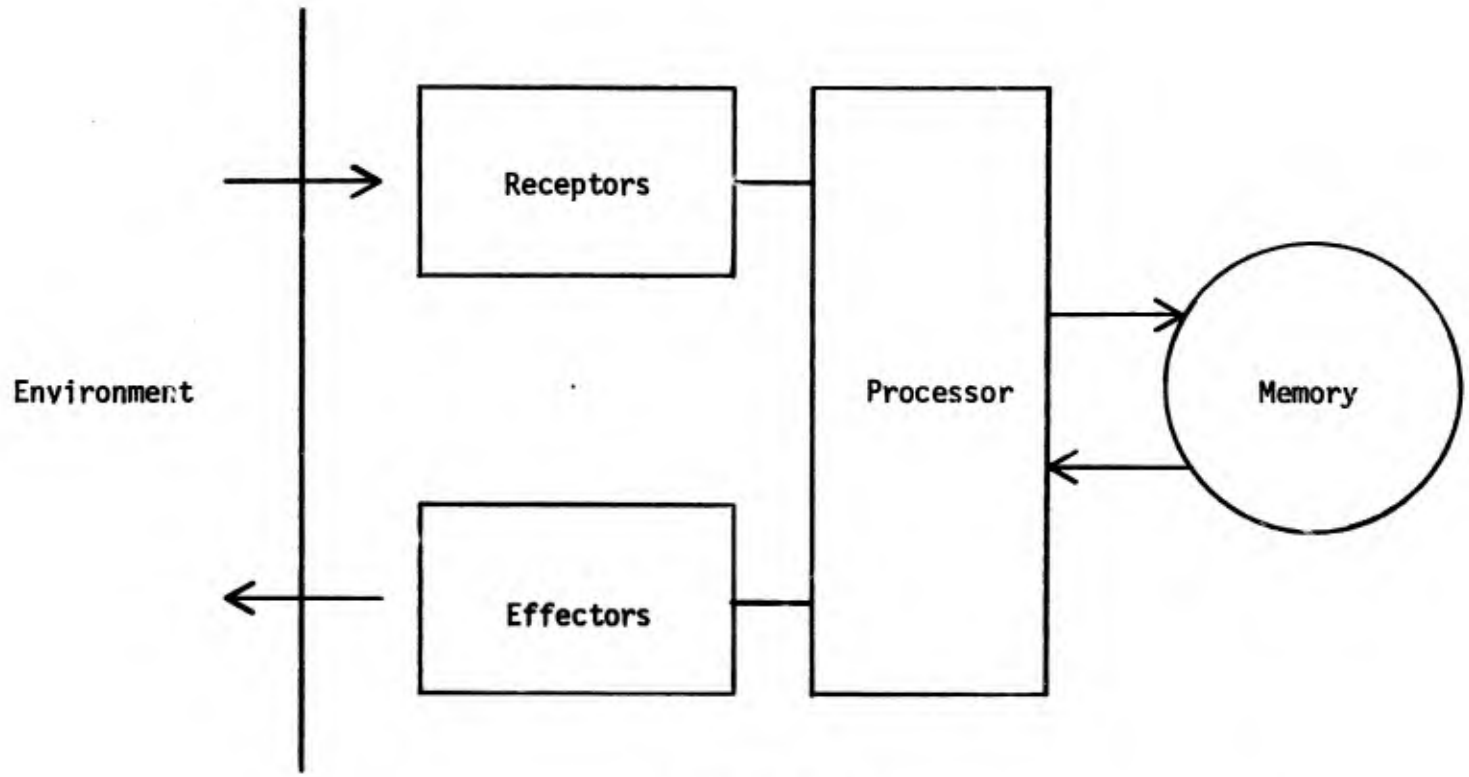

FIGURE 2.2

GENERAL STRUCTURE OF A HUMAN INFORMATION PROCESSING SYSTEM

(Newell, Allen and Herbert A. Simon, Human Problem Solving, 1972, p. 20)

consist of receptors which receive its input from the environment, a processor, memory, and motor output into the environment via its effectors. A receptor is a sense organ, a nerve ending that is specialized for the reception of stimuli. An effector is a muscle, gland, etc. that is capable of responding to the system's nerve impulses or other stimuli. Three different memories are involved: long-term memory, short-term memory, and external memory. The long-term memory is thought to have essentially an unlimited capacity. It requires only a few hundred milliseconds to recall (read) information from long-term memory. However, the time required to commit information to long-term memory (write time) is much longer, with 50 to 100 seconds being required to memorize a 10-digit number. The short-term memory is thought to be a component of the processor. It is believed to be quite small in capacity, and to hold only five to seven symbols or chunks of information. The process of committing information to short-term memory and recalling it from short-term memory appears to be relatively fast when compared with long-term memory times. Although the capacity of short-term memory appears to be five to seven chunks of information, only two symbols, or chunks, can be retained in short-term memory

during a time period when some different task is being accomplished, so it appears that short-term memory is also used for input and output processing. External memory consists of such media as a pad of paper, documents, books, etc. The write time for external memory is frequently less than the time required to commit information to long-term memory, but the access time is relatively slow.

The processor can only perform one task at a time, and consequently is described as a serial processor. It consists of three components: the elementary processor, the short-term memory, and the interpreter. The elementary processor contains a set of elementary information processes. These elementary information processes can be thought of as extremely basic functions, such as the replacement of one value with another (e.g., A = 6.0). The short-term memory, whose characteristics have been described above, holds the input and output symbol structures of the elementary information processes. The interpreter determines the relevant elementary information processes to be executed and their execution sequence--the particular program to be used for decision-making or problem solving. The relationships between the long-term memory, the processor, and the external memory in the Newell-Simon

model of human information processing are summarized in Figure 2.3.

Descriptive Usefulness of the Model

With the elements of the Newell-Simon model in mind, let us examine the decision-making task performed by the middle-level staff officers this study focuses upon. The primary features of this decison-making task have been related to the elements of the Newell-Simon human information processing model in Figure 2.4. Information about the pilot training wing (input) is provided to the decision-maker (processor) who interprets this information in light of the relative importance of organizational goals (stored in either long-term memory or in some external memory media such as an organizational policy statement) to reach a judgment (output) about the adequacy of the performance of the pilot training wing being considered. Under these circumstances, the evaluation decision (output) is affected by two factors, the performance information (input) and the relative importance of organizational goals (stored in either long-term memory or external memory).

Each of the subjects in the behavioral experiment this study is concerned with received the same performance

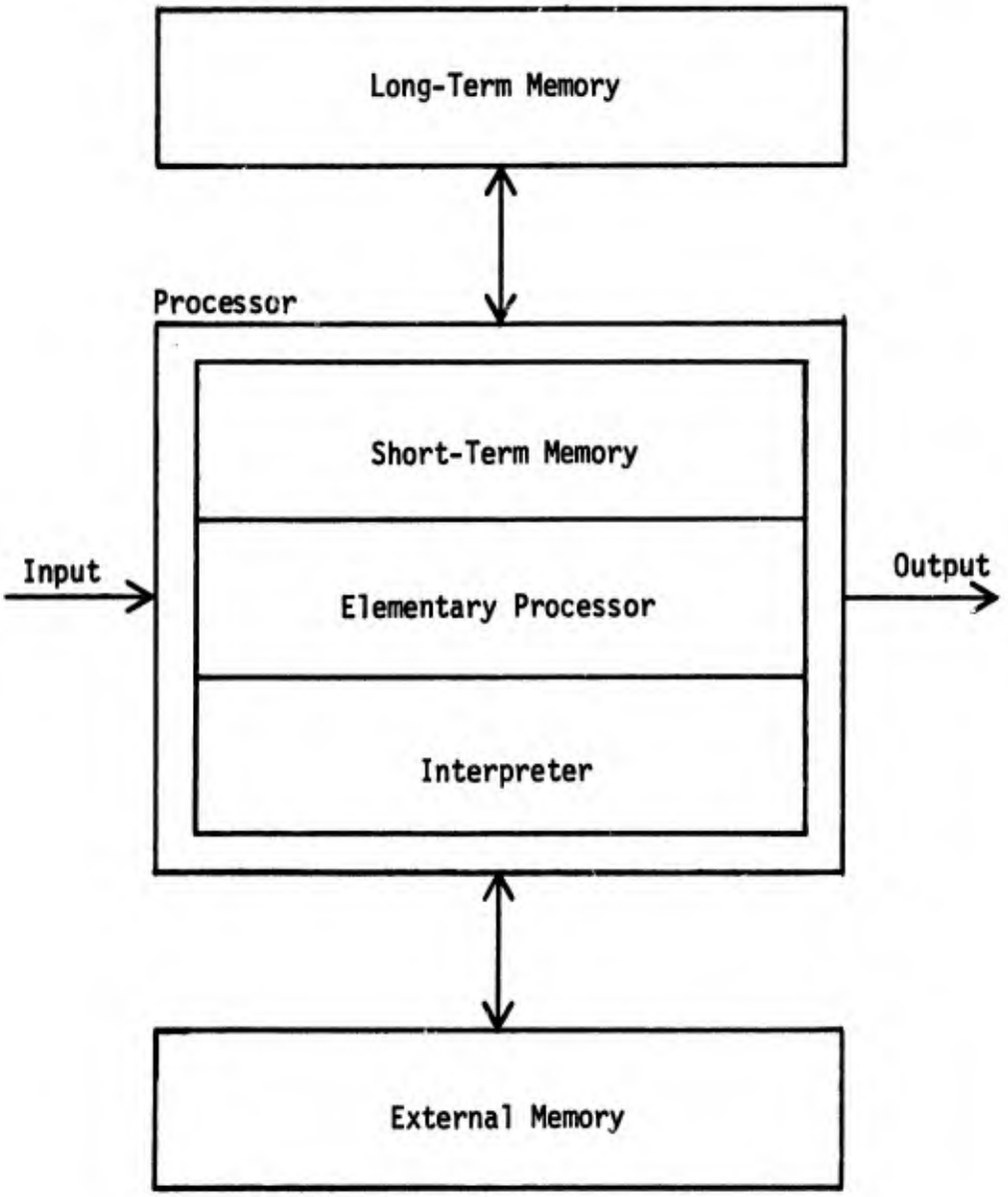

FIGURE 2.3

THE THREE MEMORIES OF THE NEWELL-SIMON MODEL

(Gordon B. Davis, Management Information Systems, 1974, p. 66)

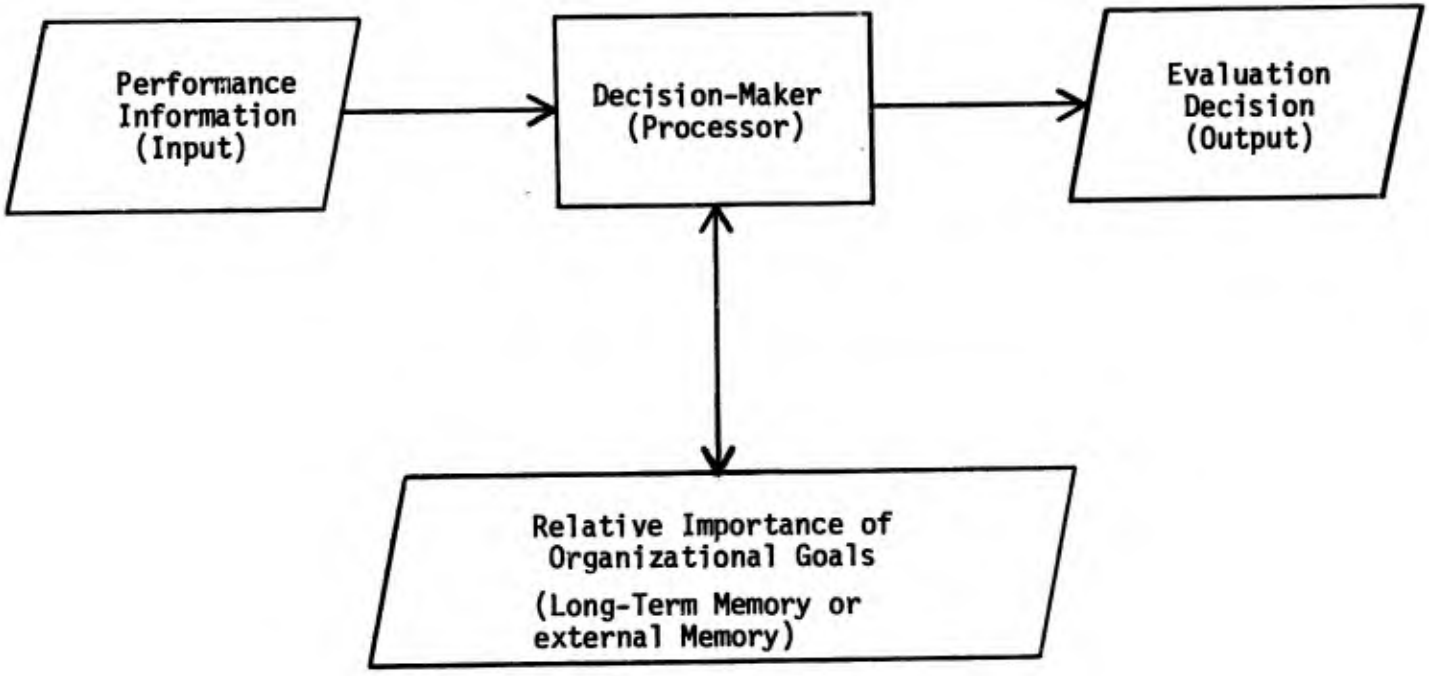

FIGURE 2.4

THE DECISION-MAKING TASK FACED BY SUBJECTS IN THE BEHAVIORAL EXPERIMENT

information (input) about the same hypothetical pilot training wings. Since all of the subjects received the same information of this character, changes in their evaluation decisions (output) cannot be attributed to this factor. However, the subjects did receive information of different types which indicated changes in the relative importance placed on the organization's goals. Under the controlled circumstances of the experiment, any changes in the subjects' evaluation decisions (output) may be attributed to their changed perceptions about the relative importance of the organization's goals.

With this in mind, the three research proposals presented in Chapter I may now be considered within the framework of the Newell-Simon model. The first proposal states that when middle-level managers receive an organizational policy statement which indicates their senior executives have changed the relative importance of organizational goals, their decision-making behavior will be influenced in a predictable manner. The second proposal states that when middle-level managers are subsequently allowed to compare their own decisions with decisions made by their senior executives, their decision-making behavior will be influenced according to their perceptions about

the hierarchy of organizational goals their senior executives incorporated into their decisions.

Let us place these two proposals within the framework of the Newell-Simon model. The decision-maker's knowledge about the relative importance placed on organizational goals by his senior executives is stored either in long-term memory or in some external memory media (such as an organizational policy statement). In order to use these goals as decision criteria, the stored information must be moved into the short-term memory. This involves either recalling the information from long-term memory or referring to the external memory media. If the decision-maker receives a new organizational policy statement which indicates the relative importance of organizational goals has changed, he may refer to this document when he makes decisions. In this case, the information may be thought to flow immediately from the external memory media to the short-term memory. However, if the decision-maker must perceive the relative importance of organizational goals as a result of comparing his own decisions with decisions made by his senior executives, a time period in which learning takes place must pass before he will have stored some changed relative importance of organizational goals into long-term memory.

In either eventuality, if the relative importance of organizational goals stored either in long-term memory or in external memory is changed, then the decision-maker's evaluation judgments (output) are expected to change accordingly. Of course, this presumes that no changes have been made in the elementary information processes to be executed and in their execution sequence (e.g., the program used for the decision).

The third research proposal presented in Chapter I states that middle-level managers will place some (significant) level of importance on all five of the organizational goals used as decision criteria when they perceive their senior executives to place some (significant) level of importance on all five goals. This proposal suggests that the number of criteria middle-level managers utilize in arriving at their decisions is influenced by their perceptions of the number of organizational goals their senior executives emphasize.

Newell and Simon (1972, pp. 787-796) characterize the human information processing system as an adaptive system that shapes itself to its environment during the problem-solving process. However, when the capabilities of the system are exceeded, adaptation breaks down,

and problems are solved inadequately or incompletely. One of the system's limiting characteristics that is believed to remain constant over different types of problems is the small capacity of short-term memory. The capacity of short-term memory is believed to be about five to seven chunks of information. However, almost all tasks which require concentration seem to subtract from the effective capacity of the short-term memory.

The expected behavior described by the third proposal assumes that middle-level managers are capable of placing some (significant) level of importance on as many as five decision criteria when arriving at a decision. Within the framework of the Newell-Simon model, this assumes that the short-term memory is capable of storing at least five decision criteria during processing. The expected behavior described by part two of the first proposal, and by the three parts of the second proposal, assumes that middle-level managers are capable of placing specific relative weights on as many as five decision criteria when arriving at a decision. Within the framework of the Newell-Simon model, this assumes that the short-term memory is capable of storing at least five explicitly weighted decision criteria during processing.

Restating the research proposals presented in Chapter I within the framework of the Newell-Simon human information processing model demonstrates the usefulness of this model for describing an individual's decision-making processes. Unfortunately, the Newell-Simon model does not provide the analytic capabilities needed for an objective evaluation of specific hypotheses derived from these proposals. However, these analytic tools are provided by the Brunswik Lens Model, to be discussed in the following section.

The Brunswik Lens Model

The first section of this chapter described a particular decision-making situation faced by middle-level staff officers assigned to the Air Training Command Headquarters. The second section pointed out the usefulness of the Newell-Simon human information processing model for describing the processes involved in reaching a decision. This section introduces the Brunswik Lens Model, which has been widely used by psychologists for describing and analyzing human decision-making. No attempt is made, however, to review the large body of research in human judgment that is conceptually associated with the Brunswik Lens Model.

Those seeking such a review are referred to a lengthy review article by Slovic and Lichtenstein (1971) as an entry into the literature of this area of research. This section focuses upon the analytic qualities of the Brunswik Lens Model that are considered useful for analyzing the information gathered with the behavioral experiment used to investigate the research proposals presented in Chapter I. In addition, an extension of the model is presented which increases its analytic flexibility.

Characteristics of the Model

The Brunswik Lens Model was originated by Egon Brunswik (1943, 1952). The model has been used extensively by psychologists to analyze human judgment, and has been described in detail by several writers. The description presented here was taken largely from Beach (1967), Hoffman, Slovic and Rorer (1968), and Ashton (1974). The essential elements of the model are summarized in Figure 2.5.

With this approach for analyzing human judgment, the world is considered to be divided into two parts--the environment (represented by the left side of the model) and the individual's judgment system (represented by the

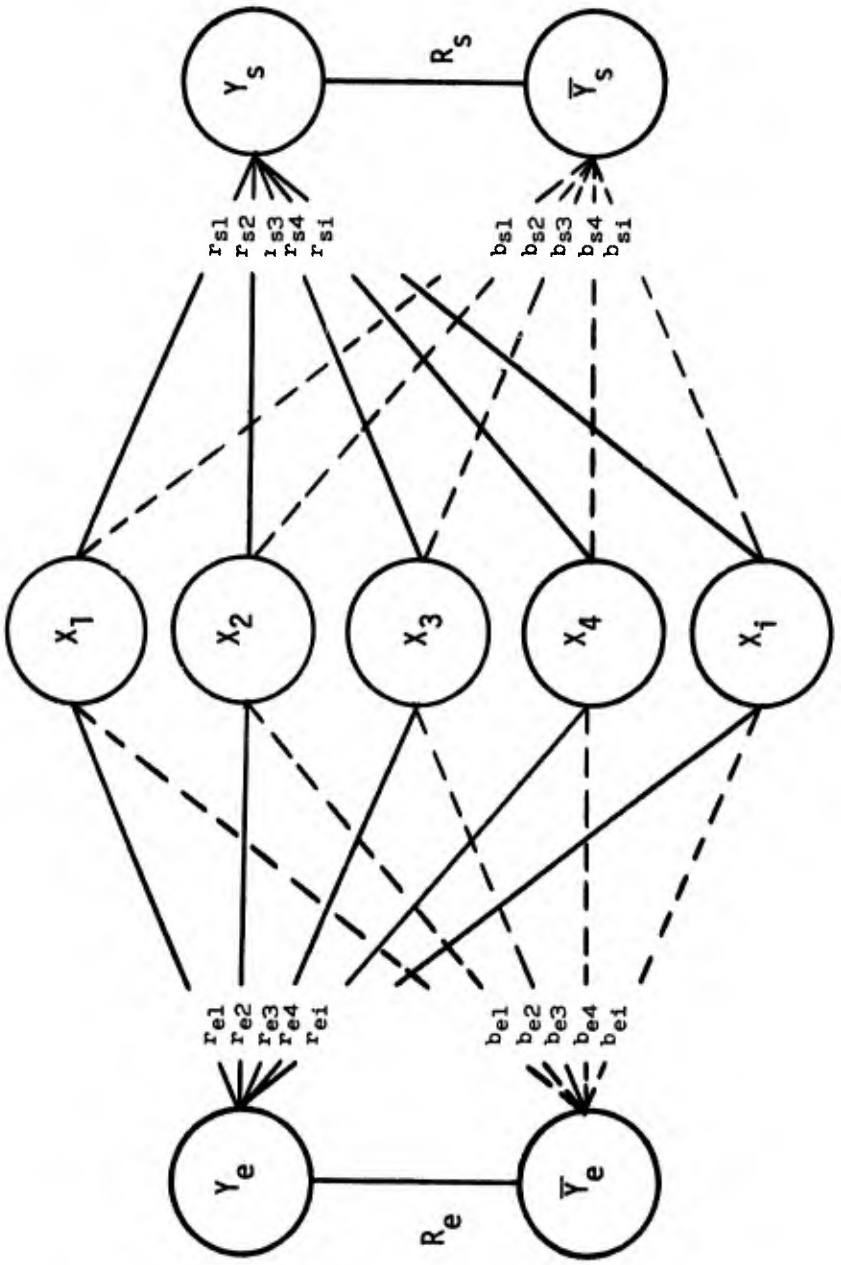

FIGURE 2.5

THE BRUNSWIK LENS MODEL

right side of the model). The various elements of the model presented in Figure 2.5 have been defined as indicated below:

Y_e = The true value for the portion of the environment about which the individual is concerned, called the "distal variable."

$\overline{Y}_e$ = The optimal statistical prediction of the distal variable, Y_e, obtained from regression analysis of repeated instances of the relationship between the cues, X_i and Y_e.

R_e = The multiple correlation coefficient, which indicates the degree to which the cues can serve as sources of information about the value of Y_e.

r_{ei} = The relationship between Y_e and X_i. This relationship is called the validity coefficient and is determined by correlating repeated occurrences of the cue and the distal variable.

b_{ei} = The optimal weight to be placed upon each cue in determining $\overline{Y}_e$, as obtained from regression analysis. These values are the respective beta weights associated with each cue.

X_i = An item of information, or cue, which may be used to judge the current state, or predict the future state, of the distal variable.

Y_s = The individual's judgment about the state of Y_e or his prediction of some future state of Y_e . Y_e and Y_s can differ for two reasons. First, they will differ if a less than perfect relationship exists between the distal variable and the cues. Second, they may differ if the individual does not use all the available cues in an optimal manner. During the experimental decision-making task, each indivdual evaluation decision about a hypothetical pilot training wing's overall performance represents an instance of Y_s.

$\overline{Y}_s$ = The statistician's optimal prediction of Y_s, obtained from regression analysis of repeated instances of the relationship between the cues, X_i and Y_s.

R_s = The multiple correlation coefficient indicating the relationship between $\overline{Y}_s$ and Y_s.

r_{si} = The relationship between the cues, X_i, and an individual's judgment about the distal

variable, Y_s. This relationship is determined by correlating repeated instances of X_i and Y_s. It is called a utilization coefficient and indicates the extent to which an individual uses the X_i to predict Y_e.

b_{si} = The respective beta weights associated with each cue as a result of regression analysis of the relationship between repeated instances of the cues, X_i and Y_s.

The relationships which exist on each side of the lens model have usually been analyzed with linear multiple regression equations. Although linearity is not a requirement of the lens model, a number of studies (Hammond and Summers, 1965) have established that a linear model accounts for nearly all of the explainable variance. Goldberg (1968) has indicated that, on the average, less than 2 percent of the explainable variance can normally be attributed to nonlinear effects. The amount of the explainable variance attributed to nonlinear effects did not exceed 6 percent even in decision-making situations deliberately selected for their nonlinear characteristics. A linear model has been used for the analysis performed in this study.

The left side of the Brunswik Lens Model refers to the actual environment and may be summarized as follows:

$$\bar{Y}_e = b_{e1}X_1 + b_{e2}X_2 + b_{e3}X_3 + b_{e4}X_4 + b_{ei}X_i \qquad (1)$$

The dependent variable $\bar{Y}_e$ is the predicted value of the distal variable, given cues X_1 through X_i , where each b_{ei} value is a multiple regression beta weight. The multiple correlation coefficient R_e indicates the degree to which the cues can be used to predict the distal variable.

The relationships involved with the right side of the model correspond to those of the left side. Here the focus is upon the relationships between the cues and Y_s , the individual's judgment of the distal variable Y_e, rather than the relationship between the cues and the distal variable itself. The apparent use the individual makes of the cues in reaching his decisions is indicated by the linear multiple regression equation below.

$$\bar{Y}_s = b_{s1}X_1 + b_{s2}X_2 + b_{s3}X_3 + b_{s4}X_4 + b_{si}X_i \qquad (2)$$

The dependent variable $\bar{Y}_s$ is the statistician's optimal prediction of the judgments the individual will reach.

The b_{si} values are the multiple regression beta weights associated with each of the variables.

The Brunswik Lens Model approach was used for the analysis of the experimental decision-making task utilized in the behavioral experiment used to examine this study's research proposals. Since this task required the subjects to reach decisions about hypothetical pilot training wings, no referent value exists in the real environment which corresponds to the distal variable Y_e so far as the experimental decision-making task is concerned. Consequently, the information usually associated with the left side of the Brunswik Lens Model is not available in this study.

Relative Importance of the Decision Variables

The use of statistical analysis for the investigation of the research proposals presented in Chapter I is dependent upon being able to determine the relative importance the experimental subjects placed upon each of the decision variables in arriving at their decisions. Hoffman (1960) initially proposed that the standard regression coefficients (beta weights) associated with each of the

independent variables could be used to indicate the relative importance of each variable. He suggested that these beta weights could easily be converted into a set of relative weights which could be computed with the following formula:

$$RW_i = \frac{b_{si} \; r_{si}}{R_s^2} \qquad (3)$$

where--

b_{si} = The standard regression coefficient (beta weight) for variable i, obtained by adjusting all variables to standard score form.

r_{si} = The utilization coefficient determined by correlating repeated occurrences of the cue and the individual's judgment of Y_s.

R_s^2 = The multiple correlation coefficient squared.

The use of relative weights has the principal advantage that the relative importance, or relative weight, of each of the independent variables is expressed as a percentage of the total explainable variance. Since the relative weight of each variable is a percentage of the total explainable variance, these relative weights sum to the value of the multiple correlation coefficient squared, as shown below:

$$R_s^2 = RW_1 + RW_2 + RW_3 + RW_4 + RW_i$$

This allows the relative importance an individual or group of individuals places upon each of the independent variables to be compared by comparing the relative weights involved.

Unfortunately, several prerequisites must be met if the computation of relative weights is to be meaningful, and these prerequisites are difficult to achieve in most practical situations. As Ward (1962) has pointed out, the formula for calculating the relative weight of each of the independent variables shown above is valid only when each independent variable is uncorrelated with the others. Such instances rarely occur.

Darlington (1968) also considered the determination of the relative importance of each decision variable in an article which described some of the lesser known uses, properties, and limitations of the linear multiple regression model. He mentioned that the most frequently used measures of the relative importance of the independent variables are derived from r_{si}^2, the squared utilization coefficient, and b_{si}^2, the squared beta weight. He pointed out that when all the independent variables are

uncorrelated, $r_{si}^2 = b_{si}^2$, and these two values are equivalent. In other words, the relative weight of a variable may be calculated with either formula.

$$RW_i = \frac{b_{si}r_{si}}{R^2} = \frac{b_{si}^2}{R^2} = \frac{r_{si}^2}{R^2} \qquad (4)$$

Darlington emphasized that the independent variables must be uncorrelated with each other and that the dependent variable must have no effect upon the independent variables in order for r_{si}^2 to equal b_{si}^2.

Although the prerequisites mentioned by Ward (1962) and Darlington (1968) rarely occur by chance in real-life situations, these conditions can be achieved in a planned experiment. The experiment this study reports on was planned so that the five independent variables which represent the five decision criteria in the regression equation would be uncorrelated with each other. This was achieved by deliberately choosing predictor vectors that are linearly independent of each other.

Since the independent predictor vectors were deliberately selected so they are linearly independent of each other, one may be assured that they are uncorrelated with each other and therefore independent of each other in

the mathematical sense. However, the relative independence of the five decision criteria represented by the five independent variables is another, and more difficult, question. As mentioned earlier in this chapter, considerable care was taken to select organizational goals for use as the decision criteria in the experimental task which are, in practice, relatively independent of each other. In addition, the experimental subjects were informed in their preliminary instructions that they should consider the five goals to be independent of each other.

These efforts are deemed sufficient to meet the prerequisites described by Ward (1962) and Darlington (1968) for the calculated relative weight of a variable to indicate the relative importance the decision-maker placed on that variable in arriving at his decision. As a result, the terms "relative importance" and "relative weight" are used interchangeably in this study.

An Extension of the Brunswik Lens Model

Conventionally, the environmental data (represented by the left side of the Brunswik Lens Model) is used as a standard for interpreting the individual's

decision-making (represented by the right side of the model). In order to investigate how feedback information about the environment affects an individual's decision-making, it is possible to provide him with the appropriate environmental data immediately after he reaches a decision so that he may compare his decision with the actual environmental value involved. The second research proposal presented in Chapter I involves this kind of situation. It suggests that an individual's decision-making will be affected when he is able to compare his own decisions with those made by his senior executives.

During the description of the characteristics of the Brunswik Lens Model that was presented above, it was mentioned that since hypothetical, rather than real, pilot training wings were utilized in the experimental task, no environmental data exists for this study. Consequently, if the experimental subjects were to be provided with the appropriate feedback information described in the second research proposal, some substitute for actual environmental data was required.

The same linear multiple regression equation used to analyze the subjects' decision-making may also be used to predict the decisions their senior executives would

have made had they incorporated a particular relative importance of organizational goals into their decision-making. These predicted values may then be used in place of environmental values. An extension of the Brunswik Lens Model where the left, or environmental, side of the model has been replaced with values determined in this manner is presented in Figure 2.6. The values on the right side of the lens model remain unchanged in this extension of the model. On the left side of the model, the values of Y_m and $\overline{Y}_m$ replace the previously discussed values of Y_e and $\overline{Y}_e$. The model used to determine the values for the left side of the lens model is shown below:

$$Y_m = \overline{b}_{m1}X_1 + \overline{b}_{m2}X_2 + \overline{b}_{m3}X_3 + \overline{b}_{m4}X_4 + \overline{b}_{m5}X_5 \qquad (5)$$

where:

Y_m = The overall performance evaluation score awarded a hypothetical pilot training wing when a particular relative importance of decision criteria is specified.

$\overline{b}_{mi}$ = The coefficient, or raw weight, associated with each of the independent variables in the linear multiple regression equation.

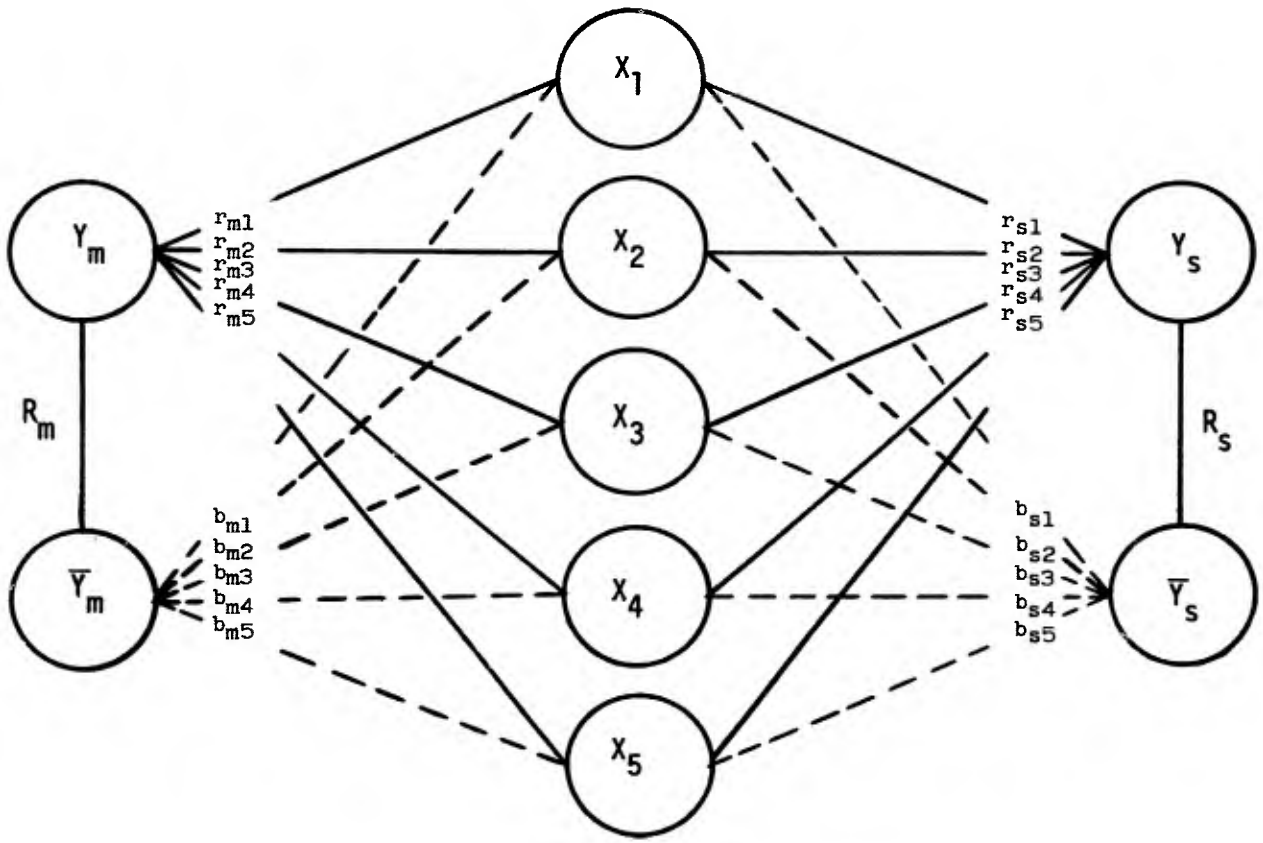

FIGURE 2.6

AN EXTENSION OF THE BRUNSWIK LENS MODEL

X_i = The organizational goal i used as decision variable i, or cue i, in the experimental task.

Since the numerical values of the decision variables are known in each decision-making instance--because each criterion is categorized as being met either satisfactorily or unsatisfactorily--one needs only to determine the numerical values to be used as coefficients ($\bar{b}_{mi}$) in order to calculate the value of Y_m with the linear multiple regression equation shown above. The calculation of the appropriate coefficients is possible when the relative importance of each variable is either known or specified. Since these calculations are somewhat involved, they have been presented in Appendix C.

The approach described above involves substituting values calculated with a linear multiple regression equation for the conventional environmental values, and then using these calculated values as the standard for interpreting the decision-making of the individuals involved. It should be kept in mind that this does <u>not</u> involve modeling the decision strategy of the experimental subjects and then comparing this model with the actual decisions made by the subjects, as described by Goldberg

(1970). Instead, a particular relative importance of organizational goals is specified--perhaps in an organizational policy statement--and the decisions which would result from this particular hierarchy of goals are calculated with the linear model.

The predictive ability of linear models has been documented in the literature. Dawes and Corrigan (1974) have indicated the superiority of such models over both human decision-makers and models of human decision-makers under the circumstances of the experimental task used in the behavioral experiment. An assumption of linearity in human mental processes is not required in order to take advantage of a linear model's predictive ability, just as such an assumption is not required in order to take advantage of its analytic qualities. As Hoffman (1960) has pointed out, the paramorphic representation of human judgment with a linear model does not require the assumption that linear mental processes are involved.

After the values of Y_m have been determined as described above, these values of Y_m may be used as the dependent variable with the X_i as independent variables, and regression analysis may be used to determine the values of $\overline{Y}_m$. $\overline{Y}_m$ has the same relationship to Y_m as the relationship previously described between Y_e and $\overline{Y}_e$. $\overline{Y}_m$ may

be determined with the equation shown below:

$$Y_m = b_{m1}X_1 + b_{m2}X_2 + b_{m3}X_3 + b_{m4}X_4 + b_{m5}X_5 \qquad (6)$$

where:

b_{mi} = The standard regression coefficient (beta weight) for variable i, obtained by adjusting all variables to standard score form.

X_i = The independent predictor variables; the cues in the framework of the Brunswik Lens Model.

However, since the model used to determine Y_m makes consistent estimations of this value, and is actually the same linear multiple regression model used for the regression analysis, the multiple correlation coefficient squared obtained from the regression analysis mentioned above equals one ($R^2 = 1.0$). Accordingly, $Y_m = \overline{Y}_m$, and in this instance the use of regression analysis simply demonstrates the mathematical consistency of the model for determining Y_m when the correct coefficients, or raw weights, associated with each of the independent variables are known, as well as its use for regression analysis.

The mathematical calculations involved in determining the correct coefficients, or raw weights, to be

used for determining the values of Y_m which incorporate a specified relative importance of organizational goals are shown in Appendix C. These values of Y_m were provided as feedback information to the members of Groups Three and Four during the experiment.

Relevant Literature

Some studies whose findings are considered to be related to the research objectives of this dissertation are summarized in this section. Unfortunately, it seems that those studies which focus upon middle-management decision-making tend to utilize relatively less concrete research methodologies. Also, although a large number of studies exist which are conceptually based upon the Brunswik Lens Model, only a few deal with topics related to this dissertation. No studies of middle-management decision-making which utilized the experimental methodology used in this dissertation were found in the literature.

The lack of concrete empirical evidence about middle-management decision-making seems apparent from the character of the articles currently being published in this area. In some cases, these are of the "expert opinion"

variety, and involve the presentation of normative proposals by some knowledgeable individual about how middle-management decision-making can be improved. These proposals tend to be supported almost entirely by evidence gleaned from the individual author's own experience. For example, Bomblatus (1974) was recently awarded a certificate of merit by the National Association of Accountants for an article in which he made several proposals aimed at helping middle-level managers to make better decisions. He apparently based these proposals upon his experience as a management consultant with a large accounting firm.

The proposals made by Bomblatus might very well be quite useful in practice. However, the character of the evidence from which he derives these proposals--personal experience--is questionable. Campbell and Stanley (1963, p. 4) have noted that it is quite possible that, over time, an individual might be able to observe that certain approaches work better than others. If these better approaches are retained, they may represent a valuable subset of all possible approaches. However, the cutting edge of this selection process is relatively imprecise in the usual organizational setting. Optimal conditions of observations do not exist in such a setting,

and an approach which survives might do so by pure chance. It is only with the controlled experiment that this selection process can be improved significantly, and such evidence is consequently to be preferred when it exists. It would appear that the selection of an article which relies almost entirely upon evidence derived from a single individual's experience for an honorary award is indicative of the character of the available evidence in this field of inquiry. With this in mind, let us examine a few of the studies related to middle-management decision-making available in the literature.

The Influence of Hierarchy

As a result of their review of the literature of middle-management leadership functions, Nealey and Fiedler (1968) concluded that relatively little academic research has focused upon this level of management. They considered three kinds of evidence: expert opinion, existing training practices, and empirical studies.

The consensus of expert opinion was that the emphasis of the first-level supervisor's work is upon the technical aspects of the job and the routine supervision of employees, while the middle-level manager's job requires

a broader perspective, greater administrative skill, and the ability to translate broad policy into action. Senior-level managers tend to be more concerned with the formulation of purposes and objectives.

Some of the differences associated with hierarchical levels of the organization are reflected in existing training practices. Although the basic contents of training programs aimed at first-level supervisors, middle-level managers, and senior-level managers seem to stress similar objectives such as attaining a broader company-wide point of view, the form of training differs. First-level supervisors tend to attend training programs conducted within their organizations, while middle-level and top-level managers typically attend instructional programs conducted at institutes and universities. Middle-level management training programs are almost always based on the career-development concept and are oriented towards preparing the middle-level manager for upward mobility.

The empirical studies reviewed by Nealey and Fiedler (1968) fall into four categories: (1) studies about the perceived importance of job conditions, (2) studies about satisfaction with job conditions, (3) studies about manager qualities thought to lead to success, and

(4) studies about differences in managerial behavior. Only those studies in the fourth category are directly related to management decision-making. Only a few studies were available in this category, and most of these dealt with comparatively small numbers of individuals. The evidence presented in the studies in this category was gathered either through self-reports or from observations of individual authors. The preponderance of the evidence indicated that hierarchical levels do influence management behavior.

Blankenship and Miles (1968) examined the effects of three structural properties--size, hierarchical level, and span of control--upon management decision-making behavior. They based their conclusions upon self-reports of the decision-making behavior of 190 managers who served in eight different organizations, all of which were engaged in light manufacturing. The dominant point emerging from this study was the overriding influence of the manager's hierarchical position in the organization upon his decision-making behavior.

In the same vein, Katzell, Barrett, Vann, and Hogan (1974) collected self-reports from 194 middle-level civilian managers of the United States Army about how

nine aspects of management were influenced by various features of the organizational setting in which they worked. An analysis of the data collected revealed that functions such as staffing, controlling, and time spent with others varied according to the manager's level in the organizational hierarchy. The organization's military mission was also found to affect the character of management decision-making.

A Theory of Large Managerial Firms

Monsen and Downs (1965) proposed a theory of large managerial firms which has the potential for explaining the motivational basis of middle-management decision-making. They proposed that, in general, managers behave so as to maximize their own lifetime incomes. A manager's income was defined to include both monetary elements and nonmonetary elements such as prestige, power, etc.

Monsen and Downs indicated that the best way for a middle-level manager to maximize his lifetime income was to be promoted to a more important position. Since such promotions are usually based almost entirely upon the recommendations of senior executives, the best

way for a middle-level manager to improve his promotion opportunity is to do whatever will please and impress his senior executives, regardless of how these actions affect the organization. This theory predicts that middle-level managers will tend to be risk-avoiders who initiate proposals which embody the preconceived notions of their senior executives.

An Information Processing Model

Howard and Morgenroth (1968) constructed an information processing model of a repetitive pricing decision made by two middle-level managers in a large commercial organization. The input information used by these two decision-makers was identified, and a binary flow chart model of their decision-making process was constructed. The output of the model was tested against records of past decisions, and the model's validity was found to be exceptionally high.

This study demonstrated that it is possible to construct a valid information processing model of a particular decision-making process. Unfortunately, the model itself has little generalizability, for it was based upon the decision-making behavior of only two individuals.

However, of interest to this study was the observation by Howard and Morgenroth that the two middle-level managers whose behavior was modeled did not use all the information available to them in arriving at their decisions. It was felt that the importance these two managers placed upon the available information was related to the goals of their organization.

Decision-Making by Independent Auditors

Ashton (1973) examined the professional judgment of independent auditors in his unpublished doctoral dissertation. He examined their judgment consistency across individuals and over time, and their ability to recognize the extent to which they utilized each of six criteria in arriving at decisions. Sixty-three auditors from four public accounting firms served as subjects in the behavioral experiment used to collect the information.

During the experimental decision-making task, each subject was presented with 32 hypothetical situations which depicted an internal control system of a hypothetical business firm. In each of these situations, the same six criteria were used to evaluate the internal control

system. The subjects were told whether each of these criteria had been met satisfactorily or unsatisfactorily in each situation and then asked to evaluate the internal control system using a six-point scale. The same experiment was repeated using the same subjects after several weeks had elapsed in order to evaluate the subjects' judgment consistency over time.

The results of Ashton's experiment revealed that judgment consensus among individual auditors varied considerably. Although most auditors tended to emphasize only two criteria in arriving at their decisions, different auditors relied upon different criteria. Each of the six criteria used was considered most important by at least one auditor, and each of the six criteria was considered least important by at least one auditor. However, each individual's judgment was found to be relatively consistent over time.

Ashton raised a question which is related conceptually to the research objectives of this dissertation. Since judgment inconsistency across individuals is not considered desirable for auditors, Ashton speculated about how the auditors within a particular organization might be enabled to make more consistent decisions. He suggested

that if some senior executive specified the relative importance to be placed upon the decision criteria used for evaluating an internal control system, and if the auditors were provided with feedback information about the relative importance they actually placed upon these decision criteria, the auditors might be able to adjust their decision-making accordingly and achieve greater consistency across individuals. In essense, Ashton suggested that the decision-making behavior of auditors would be influenced by knowledge of the relative importance their senior executives placed upon the decision criteria used for evaluating an internal control system. The similarity between this suggestion and the research proposals investigated in this study seems apparent.

A Quantitative Approach to Policy Analysis

A recent study performed by Vesper and Sayeki (1973) is considered to be related to the research objectives of this dissertation. They proposed a quantitative approach for relating specific decisions (action alternatives) to specific organizational policies (policy areas) which in turn were related to organizational objectives

derived from some overall organizational goal. They presented a quantitative model which was used as a standard for evaluating how consistently individual decision-makers incorporated organizational policies into their decisions. They tested this approach (Sayeki and Vesper, 1973) in a decision-making experiment in which student subjects used organizational policies, organizational objectives, and organizational goals as decision criteria for choosing among alternatives. The subjects' decisions were compared with decisions reached by using the quantitative model; they were found to make fairly consistent decisions in relation to the specified short-term goals and less consistent decisions in relation to the specified long-term goals.

The approach taken by Vesper and Sayeki is related to that taken in this dissertation--a model is used to predict decision outcomes and then used as a standard for judging the viability of decisions made by experimental subjects. Unfortunately, the specific research questions addressed in their study are quite different from those addressed in this study, so a direct comparison of results is not possible.

Experimental Study of Policy Implementation

Summers, Taliaferro, and Fletcher (1970) performed an experimental study which produced results which have some implications for this dissertation. They asked their experimental subjects to predict another person's decisions about the socioeconomic growth of 150 hypothetical countries using four decision criteria: (1) the amount of foreign investment in the country, (2) the influence the country's government exerted over private enterprise, (3) the amount of foreign aid received from the United States, and (4) the number of socialist members in the country's legislature.

Ninety-six university students were assigned to 24 cells in a 3 × 2 × 4 (different policy setters by complexity of policies by type of prior information received) partially nested experimental design. One group received the relative weights the policy setter felt he placed upon each of the criteria. The second group received the relative weights the policy setter actually placed upon the criteria as calculated mathematically. The third group received the policy setter's own verbal description of his decision-making policy. The fourth group was given no

advance information about the policy setter's decision-making policy before the experimental task.

The experimental subjects evaluated 150 hypothetical countries, and each subject was informed of how the policy setter whose decisions he was attempting to predict had evaluated each country immediately after he had completed his own evaluation.

An analysis of the data revealed that: (1) complex policies were more difficult to implement than simple policies; (2) those subjects who received the relative weights the policy setter placed upon each of the criteria performed best; (3) those subjects who received the relative weights the policy setter felt he placed upon each of the criteria performed second best; and (4) those subjects who received a verbal description of the policy to be implemented performed about the same as the control group subjects who received no advance information about the policy setter's decision-making policy. A linear model was used to predict each policy setter's decisions, and the decisions made by the subjects were compared with the results achieved by the model. In no instance did the subjects' performance approach the performance achieved with the linear model.

The experimental decision-making task used in the behavioral experiment this dissertation uses to investigate the research proposals presented in Chapter I has several similarities with the decision-making task used in the Summers, Taliaferro, and Fletcher study. In both instances, the subjects were asked to implement another person's policy. Feedback information about how the policy setter made decisions was used in both experimental tasks.

A Preliminary Experimental Study

A small-scale preliminary study which incorporated the same basic experimental design and decision-making task as that used in this dissertation was performed during the spring of 1974. Nine Air Force officers attending graduate programs in various schools of The University of Texas at Austin volunteered to act as experimental subjects. They were asked to evaluate the overall performance of a number of hypothetical pilot training wings using information about five organizational goals which served as decision criteria. After the pretest, the subjects in the experimental groups were presented with organizational policy statements indicating

the relative importance the senior executives of their organization placed upon the five organizational goals. During the posttest, the subjects again evaluated the overall performance of the same hypothetical pilot training wings previously evaluated during the pretest. No feedback information was provided to the subjects. It was hypothesized that the decision-making behavior of those individuals who received organizational policy statements would differ from that of those individuals in the control group who did not receive organizational policy statements. This hypothesis was supported by the information provided from the experiment. It was also hypothesized that the experimental subjects would place the same relative importance upon each of the decision criteria as was indicated in the organizational policy statement. This hypothesis was supported for one experimental group and rejected using the data provided by the other experimental group.

The primary purpose of the preliminary study was to define the research proposals to be investigated in this dissertation. In addition, the viability of the particular organizational goals used as decision criteria was examined. As a result, two of the organizational goals

used during the preliminary study were discarded when it was concluded that the subjects considered them to be interrelated. These two goals were replaced with goals that were considered to be independent of each other. Since only nine subjects were involved in the preliminary study, its results were considered to be tentative and consequently were interpreted with extreme caution. However, the evidence provided by this study appeared to justify the effort involved in performing the larger study this dissertation represents.

Summary

This chapter considered how the decision-making behavior of middle-level staff officers assigned to the Air Training Command Headquarters could be represented in such a way that it could be described and analyzed. The focus was upon a particular decision-making situation in which these officers use information provided by field visits, inspections, and administrative information systems to evaluate the adequacy of the performance of the Command's pilot training wings. The framework provided by the Newell-Simon human information processing model was used to describe this decision-making situation, and the

research proposals presented in Chapter I were restated within the framework provided by this model. The analytic qualities of the Brunswik Lens Model considered useful for analyzing the results of the experimental decision-making task were described, along with an extension of this model which increases its flexibility.

The findings of studies considered relevant to the research objectives of this dissertation were summarized. The studies initially presented illustrated the shortage of concrete empirical evidence about middle-management decision-making in the relevant literature. Several following studies established some general observations. Human decision-making behavior can be modeled. It can be analyzed quantitatively. A quantitative model can be useful as a standard for determining if human decision-making is consistent with a particular organizational policy. A small-scale preliminary study was used to define the research proposals considered in this study.

C H A P T E R I I I

THE RESEARCH METHODOLOGY

The research methodology and the analytic techniques used to investigate the research proposals presented in Chapter I are described in this chapter. The first section describes the experimental design used for the behavioral experiment. The second section considers the experimental decision-making task used for the pretest and posttest. The procedures used at the field location at the Air Training Command Headquarters during the administration of the experiment are described in the third section. The fourth section considers the techniques used for analyzing the data gathered with the experiment.

The Experimental Design

The experimental design described in this section is a carefully structured approach to inquiry. Its primary emphasis is directed towards achieving a high level of internal validity. However, under the circumstances in which the design was used during this study, sufficient external validity exists for the results of the experiment

to be reasonably generalized to a specific group--the middle-level staff officers assigned to the Air Training Command Headquarters.

The experimental design has been described in detail by Campbell and Stanley (1963). The information presented here leans heavily upon their work, and the individual who wishes a more exhaustive explanation than is presented here should consult Campbell and Stanley (1963).

Internal and External Validity

The overall validity of a behavioral experiment may be considered from two primary viewpoints, its internal validity and its external validity. Internal validity is the primary requirement without which an experiment is uninterpretable, for it allows the following question to be answered: Did the experimental treatment actually make a difference in this specific experimental instance? External validity, on the other hand, considers the question of generalizability, and answers the question: To what populations and settings can the effect be generalized? Naturally, both internal and external validity are important. Without internal validity, an experiment is possibly without scientific meaning. Without external validity in some degree, the results of

an experiment cannot be reasonably applied beyond the particular subjects and circumstances of the experiment itself. Unfortunately, those features which increase one of these attributes frequently jeopardize the other.

Let us consider twelve extraneous variables which frequently threaten the validity of an experiment, and then later consider how well the experimental design and the administration of the experiment protected against the biasing effects of these variables. The extraneous variables are: (1) history, (2) maturation, (3) testing, (4) instrumentation, (5) statistical regression, (6) assignment, (7) mortality, (8) interaction, (9) reactive effects of testing, (10) selection, (11) reactive effects of the experimental arrangements, and (12) multiple-treatment interference. The first eight variables are concerned with factors which can affect the internal validity of an experiment and the last four represent factors which can affect its external validity. Each variable is considered in detail below.

1. History. Specific events, in addition to the experimental treatment, which occur between the pretest measurement and the posttest measurement have the potential for biasing the results of an experiment.

2. Maturation. Those processes within the experimental subjects which operate as a function of the passage of time, such as growing older, growing hungrier, growing more tired, etc., have the potential for biasing the results of an experiment.

3. Testing. The completion of a pretest can, in some instances, affect the completion of a posttest. For example, individuals who complete an intelligence measuring test will normally score higher if they retake the same test within a reasonable time period.

4. Instrumentation. Changes in the calibration of a measuring instrument, or changes in the scorers or observers used, may produce changes in the measurement results.

5. Statistical regression. Individuals who achieve extreme scores on a test should normally be expected to subsequently achieve scores that are closer to the mean score even if no experimental treatment is applied.

6. Assignment. Almost any method of systematically assigning subjects to comparison groups has the potential for biasing the results of an experiment.

7. Mortality. The loss of experimental subjects from an experiment while the experiment is in progress has

the potential for biasing the results of an experiment. This refers to subjects who commence the experiment but who do not finish it.

8. Interaction. Interaction effects between the variables, such as assignment and maturation, etc., can confound the results of an experiment. This possibility exists when some systematic method has been used to assign individuals to comparison groups.

9. Reactive effects of testing. In some instances, the pretest might increase or decrease the experimental subjects' sensitivity or responsiveness to the experimental treatment. This is especially likely in attitude studies if the pretest introduces a considerable amount of unusual content. For example, when investigating racial attitudes, if the pretest introduces a highly concentrated dosage of hostile expletives, it is very likely that the subjects' susceptibility to subsequent persuasion is changed as a result. This has the potential for causing the results of an experiment not to be generalizable to some outside group which did not receive the pretest.

10. Selection. When the experimental subjects are volunteers, or are selected in some systematic manner

from a target population, the possibility always exists that the subjects differ systematically from the overall target population. This has the potential for causing the results of an experiment not to be generalizable to the target population.

11. Reactive effects of the experimental arrangements. When the experimental subjects are placed in an artificial setting for the experiment, this artificiality, in conjunction with the subjects' knowledge that they are acting as subjects in an experiment, might cause unrealistic behavior on their part. If this happens, it is possible that the results of the experiment might not be comparable to the real-life behavior of the subjects.

12. Multiple-treatment interference. When subjects are subjected to multiple treatments which cannot be erased, interference between the treatments can develop. When this happens, the results of a single treatment may not be generalizable to a target population.

The Pretest-Posttest-Control Group Design

The essentials of the pretest-posttest-control group experimental design used for the experiment are summarized below.

Group One	R	O_1		O_2
Group Two	R	O_1	X	O_2
Group Three	R	O_1	X	O_{2f1}
Group Four	R	O_1	X	O_{2f2}
Group Five	R	O_1	X	O_{2f3}

Definition of Terms:

R = Random assignment of individual subjects to the five comparison groups.

O_1 = The pretest task.

X = The experimental treatment.

O_2 = The posttest task.

O_{2f1} = The posttest task including feedback of the first category.

O_{2f2} = The posttest task including feedback of the second category.

O_{2f3} = The posttest task including feedback of the third category.

Figure 3.1 Pretest-Posttest-Control Group Experimental Design

The use of a pretest allows the researcher to determine empirically if significant differences exist in the decision-making behavior of the members of the five

comparison groups prior to the administration of the experimental treatment. When the pretest indicates no differences exist, and the experiment is carefully done, one may be assured that any differences measured during the posttest result from the experimental treatment.

It is not normally considered proper to compare a particular group's pretest results with its posttest results. Such a comparison does not control for the effects of the extraneous variables described above. Instead, experimental groups are compared with a control group to determine if the experimental treatment had an effect. In this study, Group One serves as the control group for Group Two. The members of Group Two receive information contained in the instructions they receive prior to performing the posttest which is expected to influence their decision-making. The members of Group One do not receive this information. If these two groups have been shown not to differ during the pretest, any differences in their decision-making behavior observed during the posttest may be attributed to the additional information received by the members of Group Two.

Group Two serves as the control group for Group Three, Group Four, and Group Five. The members of the

latter three groups receive certain feedback information which the members of Group Two do not receive. If the members of these four groups have been shown not to differ during the pretest, any differences in their decision-making behavior during the posttest may be attributed to the feedback information received by the members of Groups Three, Four, and Five.

The use of this experimental design allows one to determine if the additional information supplied to the members of Group Two prior to the posttest had an effect upon their decision-making behavior. It also allows one to determine if either of the three forms of feedback information supplied to the members of Groups Three, Four, and Five had an effect upon their decision-making behavior. However, since none of the comparison groups received the feedback information without first receiving the additional information supplied in the instructions they received prior to the posttest, the effect of receiving the feedback information in the absence of the instructions cannot be determined. However, since the research objectives of the dissertation did not involve an investigation of these effects, this limitation in the design of the experiment has little consequence here.

Let us consider how this research design protects against the extraneous variables which can bias the results of an experiment next.

Protection against Extraneous Variables

Since the pretest-posttest-control group experimental design described above emphasizes achieving internal validity, it provides a high level of protection against the potentially biasing effects of the first eight of the twelve extraneous variables mentioned previously. In addition, the potentially disrupting effects of the last four extraneous variables were substantially eliminated by careful planning and administration of the experiment. Let us consider how the potentially biasing effects of these variables were avoided by examining each variable individually.

1. History. Since the experiment was administered to members of all five comparison groups concurrently, history is controlled for.

2. Maturation. Maturation is controlled for by the same circumstances by which history is controlled for.

3. Testing. All members of all groups received the pretest. Any effects would be manifested equally in all comparison groups.

4. Instrumentation. The same analytic techniques were consistently used to measure the results of the experiment, and the same individual administered the experiment to each of the subjects, so instrumentation is controlled for.

5. Statistical regression. Group means were used to test hypotheses, so regression is controlled for.

6. Assignment. Individual subjects were randomly assigned to comparison groups to control for the potentially biasing effects of systematic assignment methods.

7. Mortality. All subjects who commenced the experiment also completed it, so mortality is not a factor.

8. Interaction. All experimental subjects were randomly assigned to the five comparison groups, and consequently the potential effects of interaction between the extraneous variables mentioned above are controlled for.

9. Reactive effects of testing. The pretest experimental task introduced very little, if any, new

information to the subjects. The subjects already were familiar with the basic decision-making task involved, and with the five decision variables that were used in the task as a result of their duties. Great care was taken to avoid structuring the subjects' approach to the experimental task and to avoid influencing them as the relative importance of the decision variables until the pretest was completed. The pretest task did not involve the formulation of attitudes or opinions which did not already exist prior to the experiment. Consequently, the potential for reactive effects from the pretest was substantially eliminated.

10. Selection. Selection biases were avoided by randomly selecting the experimental subjects from an official list of all middle-level staff officers assigned to the Air Training Command Headquarters staff directorates.

11. Reactive effects of the experimental arrangements. It was not disclosed to the subjects that they were participating in a behavioral experiment--this is discussed more fully during the description of the administration of the experiment. Each subject completed the experiment in his normal duty station rather than in

an artificial experimental environment. Consequently, the potential for reactive effects from experimental arrangements was substantially eliminated.

12. Multiple-treatment interference. Multiple-treatment interference was not a factor because of the research objectives of the study. These objectives did not require the measurement of the effects of the feedback information in the absence of the initial experimental treatment of the instructions provided prior to the posttest experimental task.

The Experimental Task

The same experimental decision-making task was utilized during both the pretest and posttest portions of the behavioral experiment. Examples of the materials used by the subjects are included in Appendix A. These materials were contained in a bound booklet which each subject completed individually. An understanding of the information presented in this section might be facilitated by a brief examination of the materials in Appendix A prior to reading the section.

The Decision-Making Situation

The decision-making task used as a pretest and posttest in the behavioral experiment abstracts the essential elements of a particular decision-making situation middle-level staff officers assigned to the Air Training Command Headquarters encounter in the course of their duties. In this situation, these officers make decisions associated with the management control process in relation to the Command's pilot training program. They use information provided by field visits, inspections, and administrative information systems to judge the adequacy of the performance of the Command's base-level pilot training wings. When a wing's performance is considered to be inadequate, appropriate corrective action is required by the headquarters staff directorate concerned with the area of deficiency.

Five primary goals of the pilot training program were identified: (1) efficiency, (2) pilot quality, (3) personnel retention, (4) compliance with directives, and (5) aircraft maintenance. These particular goals were selected from a number of pilot training program goals because they met certain requirements: (1) They are relatively independent of each other; (2) their

achievement is measurable, and consequently they are operational goals; and (3) their importance in actual management situations is supported in either the literature of the Air Force or the literature of organization theory. Because of these characteristics, these five organizational goals were considered to be valid criteria for evaluating the performance of the Air Training Command's pilot training wings.

It is proposed in this dissertation that the decision-making behavior of the middle-level staff officers mentioned above is greatly influenced by their knowledge of the relative importance placed upon these goals by their senior executives. Two sources of knowledge are considered explicitly in the behavioral experiment. First, it is assumed that these officers obtain information about the relative importance placed upon these goals by their senior executives from official policy statements. Second, it is assumed that these officers obtain information about the relative importance their senior executives place upon these goals as a result of comparing their own decisions with related decisions made by their senior executives. The decision-making task described below was designed so the effects of information from these two sources could be measured.

The Experimental Decision-Making Task

An experimental decision-making task was designed which abstracts the essential elements of the decision-making situation described above. This task utilizes the five organizational goals as decision criteria for evaluating the overall performance of a number of hypothetical pilot training wings. The same five criteria are used to evaluate each of these wings. In each of the decision-making situations, or cases, information is presented which indicates whether each of the five decision criteria is met either satisfactorily or unsatisfactorily by the hypothetical wing being judged. It is important to note that each of the five criteria has only two possible classifications, either satisfactory or unsatisfactory. Since only five decision critera are utilized, only 32 distinct combinations of these five criteria exist ($2^5 = 32$). In each situation, the subject is required to evaluate the overall performance of the hypothetical pilot training wing on an eight-point scale using only the information provided about the five decision criteria. An illustration of this is presented in Appendix A.

The Pretest

During the pretest, each subject judged the overall performance of each of the 32 hypothetical pilot training wings. An analysis of the results allowed the relative weight each subject placed upon each of the decision criteria to be determined, an indication of the relative importance each subject placed upon each of the criteria. The calculation of these values during the pretest allowed the researcher to determine empirically that no differences existed in the decision-making behavior of the members of the five comparison groups prior to the administration of the experimental treatment. In addition, the pretest provided an indication of the relative importance placed upon these organizational goals within the target organization at the time the experiment was performed.

The Experimental Treatments

After the completion of the pretest, the members of the five comparison groups received additional instructions prior to the posttest. Since Group One served as the basic control group, the instructions provided to the members of this group were not designed to influence their

decision-making behavior during the posttest. A copy of the instructions provided to the members of Group One prior to the posttest is presented in Appendix A.

The members of Group Two were provided with the same instructions prior to the posttest as the members of Group One. In addition, they were also provided with additional information which indicated that, as a result of changes in the environment of the Air Training Command, their senior executives had concluded that a changed relative importance would be placed upon achieving the goals of the pilot training program in the future. The new relative importance of these goals was as indicated in Figure 3.2.

1.	Efficiency	25
2.	Pilot Quality	25
3.	Personnel retention	20
4.	Compliance with directives	15
5.	Aircraft maintenance	15
		100

Figure 3.2. Policy Statement Relative Importance of Organizational Goals

A copy of the instructions provided to the members of Group Two prior to the posttest is presented in Appendix A.

The members of Group Three were provided with the same instructions and additional information about the changed relative importance to be placed upon the five organizational goals as the members of Group Two. In addition, they were provided with information which indicated that after they had completed their evaluation of each of the hypothetical pilot training wings, they could learn how that wing had been evaluated by the senior executives of the Air Training Command from information presented on the following page. A copy of the instructions provided to the members of Group Three is presented in Appendix A.

The feedback information provided to the members of Group Three indicated that the senior executives of the Air Training Command had systematically incorporated the relative importance of organizational goals indicated in the instructions they received prior to the posttest into their actual decisions. The evaluations attributed to the senior executives of the Air Training Command were actually calculated with a linear model, as described in Appendix C.

The members of Group Four were provided with the same instructions and additional information provided

to the members of Group Three. However, the feedback information provided to the members of Group Four indicated that the senior executives of the Air Training Command had systematically incorporated a different relative importance of organizational goals into their actual evaluation decisions than was indicated in the instructions received prior to the posttest. The relative importance of organizational goals indicated by the feedback information provided to the members of Group Four is shown in Figure 3.3. The evaluation scores provided as feedback were actually calculated in the manner described in Appendix C.

1.	Efficiency	3
2.	Pilot Quality	88
3.	Personnel Retention	3
4.	Compliance with Directives	3
5.	Aircraft Maintenance	3
		100

Figure 3.3. Group Four Relative Importance of Organizational Goals Indicated by Feedback

During the preliminary study that was described in Chapter II, the Air Force officers who served as experimental subjects placed an overwhelming importance upon

the goal of pilot quality during the decision-making task. As a result, it was anticipated that the subjects of this study would also place great importance on this goal prior to receiving the policy statement. The pretest data shown in Appendix B indicates that the subjects did, in fact, place great importance on this goal during the pretest.

The feedback information provided to the members of Group Four indicated that the senior executives of the organization placed the relative importance indicated in Figure 3.3 on the goals during their actual decision-making. This was designed to indicate that, although they had issued a policy statement officially stating that the relative importance of organizational goals indicated in Figure 3.2 should be used, the senior executives of the organization continued to place overwhelming importance upon the goal of pilot quality in reaching their own decisions. Consequently, the subjects in Group Four were faced with making decisions based on the relative importance their senior executives placed on the organization's goals. The information from the policy statement and the feedback information was contradictory.

The members of Group Five were provided with the same instructions and information as the members of

Groups Three and Four. However, the feedback information they were provided with was random data, which was obtained by translating numbers from a table of random digits into evaluation scores. If the decision-making behavior of middle-level managers is influenced by feedback information in any form, even random feedback information which cannot be logically associated with the organizational policy statement, then even those individuals in Group Five who correctly identify the feedback as random data should be expected to place different relative weights upon the decision criteria than the individuals in Group Two who received no feedback information. If these individuals are not influenced by random feedback information, however, their decisions should not differ substantially from those made by the members of Group Two.

The Posttest

During the posttest, each subject was again required to judge the overall performance of each of the 32 hypothetical pilot training wings. An analysis of the results allow the relative weight each subject placed upon each of the decision criteria to be determined. This

indicated the relative importance the subjects placed upon the decision criteria after they had been exposed to the experimental treatments described above.

A number of the experimental subjects received feedback information during the posttest. In order for an individual to derive useful knowledge from feedback information, a learning process which involves observing several instances in which the feedback information differs from the individual's own judgment must take place. In order to facilitate this process during the posttest, the nine hypothetical pilot training wings for which the feedback information provided to the members of Group Three and Group Four differed most were selected for special attention. These nine wings were presented initially during the posttest. This procedure provided the members of Group Four with the maximum opportunity to observe that the evaluations which would have been presented had the senior executives of the Command incorporated the relative importance of organizational goals indicated in the instructions prior to the posttest into their actual decisions. All 32 of the hypothetical pilot training wings presented during the pretest were again presented during the posttest after the initial presentation of these nine

wings. Consequently, the subjects were required to make a total of 41 decisions during the posttest. However, only the latter 32 decisions entered into the analysis of data since the initial nine wings were presented solely to facilitate the learning process.

After the Posttest

Those experimental subjects who received feedback information during the posttest were asked some questions after they had completed the experiment. These questions were designed to determine if the subjects were able to determine the relative importance of organizational goals which had been incorporated into the evaluation decisions they received as feedback information. A copy of these questions is presented in Appendix A.

Presentation of the Experimental Materials

It has been suggested that the experimental subjects might tend to infer some relative importance of the decision criteria from the order in which they were presented. In order to avoid communicating the researcher's own beliefs about the relative importance of these

variables to the subjects, the order in which the decision variables were presented was selected randomly. The same approach was used to select the order of the 32 hypothetical pilot training wings for presentation in the pretest and posttest. The order selected for these wings was maintained in both the pretest and posttest, except for the initial presentation of the nine wings selected for special attention mentioned above.

Administration of the Experiment

The behavioral experiment was performed at the Air Training Command Headquarters at Randolph Air Force Base, San Antonio, Texas, between September 16, 1974, and October 4, 1974. Permission to perform the study was obtained several months in advance through the Assistant Chief of Staff, Air Training Command Headquarters (ATC/CSA).

Selection and Assignment of Subjects

The procedures described below were used to select the subjects who participated in the experiment and to assign these subjects to the five comparison groups.

These procedures have been discussed by Hansen, Hurwitz and Madow (1953, pp. 116-118), and are designed to assure random selection and assignment.

1. A computer listing of the 429 middle-level staff officers (First Lieutenants through Lieutenant Colonels) assigned to the Air Training Command Headquarters staff directorates as of September 13, 1974, was obtained from the headquarters personnel directorate. This group of individuals was considered to be the target population towards which it was intended to generalize the results of the behavioral experiment.

2. The names of the officers on the computer listing were numbered from 001 through 429 so that the selection of a number within this range became synonomous with the selection of a name shown on the computer listing.

3. Seventy-five numbers within the range mentioned were randomly selected.

4. The 75 numbers mentioned above were randomly assigned into five groups composed of 15 numbers each.

5. The five groups were randomly assigned the numbers one through five. These groups have previously been referred to, and will hereafter be referred to as Group One, Group Two, Group Three, Group Four, and Group Five.

6. An additional pool of 25 unused numbers within the previously mentioned range was randomly selected.

Based upon the normal history of the Headquarters, it was expected that about 15 percent of the officers assigned would be absent from their normal duty station, primarily because of temporary duty elsewhere and for ordinary leave. When it was discovered that one of the 75 individuals initially identified as a potential experimental subject would be absent during the time period of the experiment, he was replaced with the individual identified by the next unused number in the additional pool of numbers mentioned above. Nine of the 75 individuals initially identified were absent (about 12 percent), and were replaced in this manner. Eight of these individuals were on temporary duty elsewhere, and one individual was seriously ill with influenza.

The individuals who were initially identified as potential subjects but who were not present for duty and consequently replaced were compared with their replacements in three areas. No significant differences were observed in regards to aviation rating (nonrated, pilot, or navigator), component status (regular or reserve

officer), and education level. In addition, the immediate superiors of those absent were contacted by telephone and questioned to determine if other systematic differences might exist. None were discovered. Although it cannot be proved that these individuals did not differ in some systematic way from their contemporaries, temporary duty is a routine aspect of headquarters staff duty, and is usually allocated as evenly as is practical among those assigned to a particular duty section. This custom suggests that no significant systematic differences existed between the individuals who were absent on temporary duty during the time period of the experiment and their contemporaries who were present for duty.

Executing the Experiment

Each of the experimental subjects was contacted individually at his normal duty location by the researcher performing the experiment. They were not initially informed that a behavioral experiment was being conducted. Instead, they were told that the results of the decision-making task would serve as the basis for a statistical model of the decision-making processes typical of staff

officers. After each subject had examined the written instructions, he was allowed to ask verbal questions of the researcher. Great care was taken to avoid predisposing the subjects towards any particular approach to the task, and to avoid suggesting any particular relative importance of the organizational goals used as decision criteria. Questions other than those directed towards the mechanics of completing the requirements of the decision-making task were deferred until after the completion of the exercise.

The materials composing the behavioral experiment (see Appendix A) were contained in a bound booklet which was left with each subject during the time in which it was completed. The subjects completed the experiment in their normal work areas during their spare time--this posed no difficulty since official permission to perform the study had been obtained in advance. In most instances, an experimental booklet was in the possession of an experimental subject for about two days. The booklets were distributed to an equal number of subjects assigned to each of the comparison groups each day so that approximately the same number of subjects within each comparison group were executing the experiment at any particular time.

The random order in which the subjects were assigned to comparison groups was used to decide the order in which the individuals were initially contacted.

A short checklist was used in order to make certain that each experimental subject received the same verbal instructions during the preliminary interview conducted prior to executing the experiment. Each subject was instructed not to consult with others, and not to discuss the booklet's contents with others until after October 4, 1974, when the experiment was expected to have concluded. Each subject was told to follow the written instructions as carefully as possible, and to telephone the researcher in the event he had further questions. Each subject was instructed to complete each page of the booklet in its normal sequence. Each subject was informed that he would be provided with certain unspecified information about his decision-making processes at a later date. It was emphasized that the decision-making task should be approached just as similar tasks were approached during the normal course of the individual's duties. The existence of different comparison groups was carefully concealed from the experimental subjects.

Terminal Interviews

Each subject was interviewed a second time after he had completed the experiment. During this interview, the subterfuge previously maintained was discarded and the booklet was identified as a behavioral experiment. Two subjects with academic backgrounds in behavioral science areas had already perceived this; the other subjects indicated that they had not guessed they were participating in a behavioral experiment. A preponderance of the subjects volunteered that they had become interested in performing the decision-making task as they progressed through the exercise. When asked, only three subjects stated that they felt other organizational goals would be significantly better as criteria for evaluating the performance of actual pilot training wings; these subjects suggested the use of several such goals, all of which were considered to be interrelated with pilot quality. The other subjects indicated that the organizational goals used in the experiment could be considered valid criteria for evaluating the performance of actual pilot training wings.

The subjects indicated that the average time required to complete the experiment was about 45 minutes.

However, several subjects indicated they had used considerably more time. Most of this additional time was used to devise some kind of model to aid them in their decision-making. The majority of the subjects described intuitive approaches to the decision-making task.

All of the subjects indicated that they had worked alone, and that they would not discuss the experiment with others until after the specified time period had elapsed.

The Analysis of Data

This section describes the techniques used to analyze the data provided by the behavioral experiment. The relative importance of each decision variable is considered to be synonomous with the calculated relative weight of each decision variable during this analysis, as established in Chapter II. With this in mind, the analysis aims at determining the relative weight associated with each of the decision variables under the differing sets of circumstances described by the four research proposals this dissertation investigates. The calculation of these relative weights is described initially in this section.

After these relative weights have been calculated, they may be compared in order to evaluate the likelihood of specific hypotheses derived from the four research proposals.

Calculating the Relative Weights

The first step in the analysis of the data gathered with the behavioral experiment was to calculate the relative weights associated with the five decision criteria under the various sets of circumstances involved. It should be recalled that each experimental subject evaluated the overall performance of 32 different pilot training wings during both the pretest and posttest decision-making tasks. The different combinations of the five decision criteria presented for these decisions represented all possible combinations of these five criteria.

Regression analysis was used as the first step of the analysis. The evaluation decisions made by the subjects served as the dependent variable, and the five decision criteria used to arrive at these decisions served as the independent variables. A computer program, MULTJR2, maintained on the CDC 6600 computer at The University of

Texas at Austin was used to perform the actual calculations. The output of this program contains the information necessary for using the formula presented by Hoffman (1960) to calculate the relative weight of each of the variables. This formula and the calculations involved are presented in Chapter II.

The relative weights determined in this manner were the basis for the comparisons made in evaluating specific hypotheses derived from the research proposals described in Chapter I.

Evaluating Hypotheses with a General Linear Model

A general linear mathematical model was used to evaluate several of the hypotheses examined in this study. The better known techniques of analysis of variance and analysis of covariance are special cases of this more general approach, and the assumptions inherent in these more familiar approaches also apply here. (See Glass and Stanley, 1970, pp. 338-342 for a discussion of these assumptions.)

The principal advantage of a general linear mathematical model over these more traditional approaches

is its flexibility. The researcher is allowed to formulate a model which describes and evaluates his particular research problem rather than being forced to fit his problem into some standard design. The general linear mathematical model used here has been described in detail by Ward and Jennings (1973) in their recent book. They also describe the computer program, PROGRAM MODEL, that was used for the actual calculations involved. The computer program is part of the EDSTATJ statistical package maintained on the CDC 6600 computer at The University of Texas at Austin. The short discussion presented here considers only a single example of how such a model may be used to evaluate a hypothesis. The individual who is interested in a more complete discussion of this approach should consult the source mentioned above.

Three essential steps are involved in order to evaluate a null hypothesis with a general linear mathematical model. First, an initial model, called the Full Model, must be formulated. This model describes the problem situation and provides good estimates of the expected values to be compared. Second, the assumptions inherent in the null hypothesis must be made explicit and imposed upon the Full Model. Imposing these assumptions yields another

model, called the Restricted Model. If the null hypothesis has a high probability of being true, the expected values estimated by the Restricted Model will not differ significantly from the expected values estimated by the Full Model. This means that the numerical values of the residual (error) vectors associated with the two models, when squared and summed, will not differ significantly. These squared error values are the Error Sum of Squares (SSE) associated with each of the two models. They are compared to evaluate the null hypothesis. This comparison is the third step mentioned above. In this study, the F Test is used for evaluating this comparison.

The following null hypothesis is evaluated in order to demonstrate the utility of this approach.

> Ho: There is no difference between the relative weights placed on the five decision criteria by the members of Groups One, Two, Three, Four, and Five during the pretest.
>
> Ha: The members of at least one comparison group placed a different relative weight upon at least one of the five decision criteria during the pretest than the members of the other groups.

The Full Model indicated below will provide good estimates of the expected values (means) to be compared.

$$
\begin{aligned}
Y = {} & a_{1,1}X^{(1,1)} + a_{1,2}X^{(1,2)} + a_{1,3}X^{(1,3)} + a_{1,4}X^{(1,4)} \\
& + a_{1,5}X^{(1,5)} + a_{2,1}X^{(2,1)} + a_{2,2}X^{(2,2)} + a_{2,3}X^{(2,3)} \\
& + a_{2,4}X^{(2,4)} + a_{2,5}X^{(2,5)} + a_{3,1}X^{(3,1)} + a_{3,2}X^{(3,2)} \\
& + a_{3,3}X^{(3,3)} + a_{3,4}X^{(3,4)} + a_{3,5}X^{(3,5)} + a_{4,1}X^{(4,1)} \\
& + a_{4,2}X^{(4,2)} + a_{4,3}X^{(4,3)} + a_{4,4}X^{(4,4)} + a_{4,5}X^{(4,5)} \\
& + a_{5,1}X^{(5,1)} + a_{5,2}X^{(5,2)} + a_{5,3}X^{(5,3)} + a_{5,4}X^{(5,4)} \\
& + a_{5,5}X^{(5,5)} + E
\end{aligned}
\tag{6}
$$

Where:

Y = A vector which contains the relative weight each subject placed upon each decision criterion during the pretest.

$X^{(r,c)}$ = A vector in which an element has the value "1" if the corresponding value in vector Y is related to Group r, decision criteria c. Otherwise, the elements of this vector have the value "0."

$a_{r,c}$ = The estimate of the expected values (the mean) to be compared.

E = The error, or residual, vector.

If the relationships hypothesized in the null hypothesis are true, then the following relationships exist.

$$a_{1,1} = a_{2,1} = a_{3,1} = a_{4,1} = a_{5,1} = a_1$$

$$a_{1,2} = a_{2,2} = a_{3,2} = a_{4,2} = a_{5,2} = a_2$$

$$a_{1,3} = a_{2,3} = a_{3,3} = a_{4,3} = a_{5,3} = a_3$$

$$a_{1,4} = a_{2,4} = a_{3,4} = a_{4,4} = a_{5,4} = a_4$$

$$a_{1,5} = a_{2,5} = a_{3,5} = a_{4,5} = a_{5,5} = a_5$$

The $a_{r,c}$ values are as defined above. The values for a_1, a_2, a_3, a_4 and a_5 are estimates of the expected values (the means) to be compared for the relative weights of the five decision criteria when all five groups are included as the basis for the estimates. When these assumptions have been imposed as restrictions upon the Full Model, we obtain, after a few routine mathematical manipulations, the Restricted Model as follows:

$$Y = a_1X^{(1)} + a_2X^{(2)} + a_3X^{(3)} + a_4X^{(4)} + a_5X^{(5)} + E \qquad (7)$$

Where:

Y = Same as for the Full Model; a vector which contains the relative weight each subject placed upon each decision criterion during the pretest.

$X^{(c)}$ = A vector in which an element has the value "1" if the corresponding value in vector Y is related to criteria c. Otherwise, an element has the value "0."

E = The error or residual vector.

The third step in evaluating the null hypothesis is to test if the Error Sum of Squares (SSE) for the two models shown above differs significantly. It should be recalled that the rationale for testing hypotheses in the manner indicated here is based on the idea that if the null hypothesis is true, the Error Sum of Squares (SSE) will not differ significantly for the two models. This can be examined with an F Test, where the F value is computed as follows.

$$F = \frac{(q_r - q_f) / (n_f - n_r)}{q_f / (n - n_f)} \qquad (8)$$

Where:

q_f = Error Sum of Squares (SSE) for the Full Model.

q_r = Error Sum of Squares (SSE) for the Restricted Model.

n_f = The number of linearly independent predictor vectors in the Full Model.

n_r = The number of linearly independent predictor vectors in the Restricted Model.

n = The number of elements in each vector.

For the example presented here, the F value is:

$$F = \frac{(44,571 - 42,315) / (25 - 5)}{42,315 / (375 - 25)} \qquad (9)$$

$$= .9339$$

$$p = .54$$

Accordingly, the null hypothesis cannot be rejected.

Although this approach for evaluating hypotheses generates considerable statistical power, its primary advantage is its flexibility. By using a general linear

mathematical model to test a hypothesis, it is possible for the researcher to evaluate a particular question instead of sometimes being forced to alter the question to fit a particular statistical model.

C H A P T E R I V

THE RESULTS OF THE EXPERIMENT

This chapter presents the results of the behavioral experiment. The experiment was designed to investigate some specific aspects of a general question: How is the decision-making behavior of middle-level mangers influenced by the relative importance their senior executives place on the organization's goals? In general, it is proposed that middle-level managers tend to place the same relative importance on the criteria they use to arrive at decisions as they perceive their senior executives to place on the organization's goals. When they fail to do so accurately, this failure primarily results from either their inability to form accurate perceptions from the information available to them, or from cognitive difficulties related to incorporating multiple weighted criteria into their decision-making processes.

A conceptual framework described by Anthony (1965) that has been widely used in the design of planning and control systems implicitly incorporates two major assumptions about middle-management decision-making. First,

this approach assumes that the decision-making behavior of an organization's middle-level managers is strongly influenced by organizational goals whose importance is prescribed by the organization's senior managers. Second, since it is generally agreed that large organizations have multiple goals, this approach assumes that middle-level managers are capable of accurately perceiving the importance of multiple organizational goals and incorporating them into their decision-making processes. The general question presented above has been investigated here within the conceptual framework described by Anthony (1965). The evidence provided by the behavioral experiment is used to evaluate the validity of the two major assumptions about middle-management decision-making implicit in this framework.

The information presented in this chapter is contained in three sections. The first section considers the three research proposals presented in Chapter I, along with some ancillary matters. The second section examines the evidence provided by the behavioral experiment which indicates how the decision-making behavior of the experimental subjects was influenced by information about the relative importance their senior executives placed on the

organization's goals. The third section examines the experimental evidence which indicates the perceptual and cognitive difficulties encountered by the subjects as they performed the experimental decision-making task.

The Research Proposals

The three primary research proposals initially presented in Chapter I are examined in this section, along with some ancillary considerations. If the two major assumptions about middle-management decision-making implicit in the conceptual framework described by Anthony (1965) are valid, the three research proposals should accurately predict the decision-making behavior of the experimental subjects. If, under the controlled circumstances of the behavioral experiment, the decision-making behavior of the experimental subjects differs significantly from their predicted behavior, then the validity of one or both of these assumptions must be questioned.

Some Preliminary Considerations

Several considerations should be kept in mind while reviewing the evidence presented in this section.

First, it was necessary to select some alpha level to be used for evaluating the null hypotheses presented here in order for consistent decisions to be made. Glass and Stanley (1970; pp. 271-279) have reported that the decisions to classify a null hypothesis as either true or false may never be made with certainty. When a relatively large alpha level is used, the chances of rejecting a true null hypothesis (a Type I error) are increased, and the chances of accepting a false null hypothesis (a Type II error) are decreased. If a relatively small alpha level is used, the chances of rejecting a true null hypothesis are decreased, but the chances of accepting a false null hypothesis are increased. When the consequences of either of these errors are extreme, the choice of an appropriate alpha level must be made carefully. However, under the circumstances of the experiment described here, no extreme consequences seem evident for either type of error. Consequently, the conventional alpha error level of .05 was selected. This level was selected simply because some level must be used in order to assure consistent decisions. The actual probability levels are also presented for those who might prefer to evaluate the evidence using some other alpha error level.

Second, the five organizational goals considered to be the primary goals of the Air Training Command pilot training program were used as decision criteria for evaluating the overall performance of the hypothetical pilot training wings during the experimental decision-making task. This was done in order to largely eliminate the difficulty which might occur, in practice, in determining whether a particular decision criterion was directly related to a particular organizational goal. The idea was to simplify the perceptual task presented to the experimental subjects, and to allow them to easily relate decision criteria to organizational goals.

Third, the organizational policy statement that was presented to some of the experimental subjects prior to the posttest associated a numerical value with each of the five organizational goals. (See Appendix A.) The size of these numerical values indicated the importance of the goals in relation to each other. These numerical values correspond directly to the calculated relative weights associated with each decision variable. It should also be kept in mind that under the circumstances of this experiment, the terms "relative importance" and "relative weight" are synonomous, and are used interchangeably.

Fourth, there was no difference between the relative weights placed on the criteria for the five comparison groups during the pretest. Consequently, differences during the posttest may be attributed to the experimental treatments described.

Fifth, the relative weights the subjects placed on the criteria during the pretest are an indication of the relative importance placed on the five organizational goals in the organization in which the subjects served. Since these relative weights differed considerably from those presented in the organizational policy statement used in the experiment, the decision-making task involved was one in which the subjects were asked to change the relative importance they associated with these five goals. The average relative weights placed on the five criteria by the members of all five comparison groups during the pretest are compared with those indicated in the policy statement in Table 4.1.

The First Proposal

It is proposed that when middle-level managers receive a policy statement which indicates their senior

TABLE 4.1

AVERAGE PRETEST RELATIVE WEIGHTS AND POLICY STATEMENT RELATIVE WEIGHTS

	Pretest	Policy Statement
1. Efficiency	09	26
2. Pilot Quality	53	26
3. Personnel Retention	08	20
4. Compliance with Directives	09	14
5. Aircraft Maintenance	21	14

executives have changed the relative importance placed upon organizational goals, their decision-making behavior will be influenced as follows:

1. They will place a different relative importance upon related criteria during their decision-making than their contemporaries who have no knowledge of the policy statement.
2. They will place a relative importance upon related criteria during their decision-making which approximates the policy statement description of the relative importance their senior executives place upon organizational goals.

The decision-making behavior exhibited by the members of Group Two was used to examine the first proposal. Group One is the control group for Group Two, in addition to being the primary control group for the overall experiment. Its members received no information whatsoever about the relative importance their senior executives placed on the organization's goals at any time throughout the experiment. The members of Group Two received an organizational policy statement in their instructions prior to the pretest. (See Appendix A for a copy of the policy

statement.) Any differences in the decision-making behavior of the members of these two groups during the posttest may be attributed to the policy statement received by the members of Group Two.

Part one. Part one of the first proposal predicts that the decision-making behavior of middle-level managers will be influenced when they receive an organizational policy statement which indicates their senior executives have changed the relative importance placed on the organization's goals. The manner in which their decision-making behavior will be influenced is not specified. If part one of the first proposal is to be supported by the decision-making behavior of the experimental subjects, the members of Group Two should be expected to place relative weights on the decision criteria which are different from those the members of Group One place on these criteria. If the subjects are not strongly influenced by the policy statement, the relative weights they place on the decision criteria should not be significantly different from those of the members of Group One.

The average relative weights placed on the five decision criteria during the posttest by the members of Group One and Group Two are shown in Table 4.2.

TABLE 4.2

GROUP ONE AND GROUP TWO AVERAGE RELATIVE WEIGHTS

	Group One	Group Two
1. Efficiency	07	24
2. Pilot Quality	48	42
3. Personnel Retention	08	15
4. Compliance with Directives	09	08
5. Aircraft Maintenance	28	11

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The null and alternate hypotheses presented below examine how the decision-making behavior of the members of Group Two was affected by the policy statement.

Ho_1: There is no difference between the relative weights placed on the decision criteria by the members of Groups One and Two.

Ha_1: The members of Group Two placed different relative weights on the decision criteria than the members of Group One.

The general linear mathematical model described in Chapter III was used to evaluate the null hypothesis. The results are presented below.

Degrees of Freedom	F-value	Alpha Probability
$DF_1 = 5$ $DF_2 = 140$	9.4	.000

As a result of the evidence presented above, the null hypothesis was rejected and its alternate was accepted as true. The decision-making behavior of the members of Group Two was strongly influenced by the policy statement.

Part two. Part two of the first proposal predicts how the decision-making behavior of middle-level

managers will be influenced by a policy statement which indicates their senior executives have changed the relative importance placed on the organization's goals. If part two of the first proposal is to be supported by the decision-making behavior of the experimental subjects, the members of Group Two should be expected to place relative weights on the decision criteria which approximate those specified in the policy statement. The average relative weights placed on the five decision criteria by the members of Group Two during the posttest are compared with the relative weights specified in the policy statement in Table 4.3.

The null and alternate hypotheses presented below examine the likelihood that the relative weights the subjects in Group Two placed on the decision criteria are approximately those indicated in the policy statement.

Ho_2: The relative weights the members of Group Two placed on the decision criteria are no different from the relative weights indicated in the policy statement.

Ha_2: The members of Group Two placed different relative weights on the decision criteria than those indicated in the policy statement.

TABLE 4.3

GROUP TWO AVERAGE RELATIVE WEIGHTS AND POLICY

STATEMENT RELATIVE WEIGHTS

	Group Two	Policy Statement
1. Efficiency	24	26
2. Pilot Quality	42	26
3. Personnel Retention	15	20
4. Compliance with Directives	08	14
5. Aircraft Maintenance	11	14

The approach used to evaluate the null hypothesis considers the relative weights for the five decision criteria presented in the policy statement as potential population means ($\bar{X}_{r,c}$) in the parent population from which the Group Two sample data were drawn. Since multiple comparison groups and multiple criteria are involved, subscripts have been used to refer to Group r, Criterion c in each instance. Using this approach, a two-tail t-test with 14 degrees of freedom was used to evaluate the null hypothesis. The results are shown below.

Ho_2	t-value	Alpha Probability
$\bar{X}_{2,1} = 26$	-0.716	.486
$\bar{X}_{2,2} = 26$	+5.392	.000
$\bar{X}_{2,3} = 20$	-2.812	.015
$\bar{X}_{2,4} = 14$	-3.937	.00[illegible]
$\bar{X}_{2,5} = 14$	-1.380	.192

The evidence presented above indicates that the members of Group Two placed different relative weights on the second, third, and fourth criteria than those indicated in the policy statement. They placed approximately the same relative weights on the first and fifth criteria as those indicated in the policy statement.

Summary of evidence. The first proposal predicted the decision-making behavior of middle-level managers who received an organizational policy statement which indicated their senior executives had changed the relative importance placed upon the organization's goals. Part one of the first proposal predicted that middle-level managers would be influenced by the policy statement and would change the relative weights they placed on the decision criteria as a result of this influence. The evidence provided by the behavioral experiment supports part one of the first proposal. The subjects who received a policy statement placed significantly different relative weights on the decision criteria than their contemporaries who had no knowledge of the policy statement.

Part two of the first proposal predicted that the decision-making behavior of the middle-level managers who received the policy statement would be influenced so they would place approximately the same relative weights on the decision criteria as those presented in the policy statement. The evidence provided by the behavioral experiment was mixed, but the majority of the evidence did not support part two of the first proposal. The subjects who received the policy statement placed approximately the

same relative weights on only two of the five decision criteria as those presented in the policy statement. They placed significantly different relative weights on three of the five decision criteria than those presented in the policy statement.

The Second Proposal

It is proposed that when the middle-level managers who received the policy statement mentioned above are subsequently allowed to compare their own decisions with decisions made by their senior executives, their decision-making behavior will be influenced as follows:

1. Those who perceive their senior executives incorporated the same hierarchy of organizational goals described in the policy statement into their actual decisions will place a relative importance upon related criteria during their own decision-making which approximates the policy statement description of the relative importance their senior executives place upon organizational goals.
2. Those who perceive their senior executives incorporated a different hierarchy of organizational

goals into their actual decisions than was described in the policy statement will place a relative importance upon related criteria during their decision-making which approximates their perception of the relative importance their senior executives placed upon organizational goals.

3. Those who are unable to perceive any meaningful pattern in the decisions made by their senior executives will place a relative importance upon related criteria during their own decision-making which approximates the original policy statement description of the relative importance their senior executives placed upon organizational goals.

The second proposal predicts how the decision-making behavior of middle-level managers will be influenced when they compare their own decisions with those made by their senior executives. Essentially, this proposal considers how three kinds of feedback information about the decisions made by their senior executives affects the decision-making of middle-level managers.

The decision-making behavior exhibited by Groups Three, Four, and Five was used to examine the second proposal. Group Two is the control group for each of these

three groups. The members of Groups Three, Four, and Five all received the same information, including the organizational policy statement, prior to the posttest. In addition, the members of these three groups received feedback information which allowed them to compare their own decisions with decisions made by their senior executives. The feedback information provided to the members of Group Three was designed to indicate that their senior executives incorporated the same hierarchy of goals indicated in the policy statement into their actual decisions. The feedback information provided to the members of Group Four was designed to indicate that the senior executives incorporated a different goal hierarchy into their actual decisions than was presented in the policy statement. The feedback information provided to the members of Group Five was random data, and was intended to indicate that the senior executives had not systematically incorporated any particular goal relationship into their decisions.

Part one. Part one of the second proposal was examined in light of the decision-making behavior of the members of Group Three. The members of Group Three received the policy statement prior to the posttest and feedback information during the posttest which indicated that

their senior executives had incorporated the same hierarchy of goals into their actual decisions as presented in the policy statement. After the posttest, they were asked to identify the character of the feedback information they received. (See Appendix A.) Twelve of the 15 subjects in Group Three stated that the feedback information they received during the posttest indicated that their senior executives incorporated the same hierarchy of goals presented in the policy statement into their actual decisions. The other three subjects did not correctly identify the character of the feedback information they received. Appendix B contains a summary of the experimental data for Group Three.

Part one of the second proposal predicts that middle-level managers who perceive their senior executives to incorporate the same hierarchy of goals described in a policy statement into their actual decisions will place approximately the same relative weights on related decision criteria during their own decision-making as those indicated in the policy statement. If part one of the first proposal is to be supported by the decision-making behavior of the experimental subjects, the 12 members of Group Three who correctly identified the feedback

information should be expected to place relative weights on the decision criteria which approximate those specified in the policy statement. The average relative weights placed on the five decision criteria by these members of Group Three during the posttest are compared with the relative weights specified in the policy statement in Table 4.4.

The null and alternate hypotheses presented below examine the likelihood that the relative weights the specified subjects in Group Three placed on the decision criteria are approximately those indicated in the policy statement.

Ho_3: The relative weights placed on the decision criteria by the members of Group Three who correctly identified the feedback information are no different from the relative weights indicated in the policy statement.

Ha_3: The members of Group Three who correctly identified the feedback information placed different relative weights on the decision criteria than those indicated in the policy statement.

A two-tail t-test with 11 degrees of freedom was used to evaluate the null hypothesis. The results are shown on page 147.

TABLE 4.4

GROUP THREE AVERAGE RELATIVE WEIGHTS OF INDIVIDUALS WHO IDENTIFIED FEEDBACK AND POLICY STATEMENT RELATIVE WEIGHTS

	Group Three	Policy Statement
1. Efficiency	28	26
2. Pilot Quality	32	26
3. Personnel Retention	22	20
4. Compliance with Directives	09	14
5. Aircraft Maintenance	09	14

Ho_3	t-Values	Alpha Probability
$\bar{X}_3,1 = 26$	+0.716	.489
$\bar{X}_3,2 = 26$	+2.618	.026
$\bar{X}_3,3 = 20$	+1.225	.250
$\bar{X}_3,4 = 14$	-5.390	.000
$\bar{X}_3,5 = 14$	-3.123	.019

The evidence presented above indicates that the members of Group Three placed different relative weights on the second, fourth, and fifth criteria than those indicated in the policy statement. They placed approximately the same relative weights on the first and third criteria as those indicated in the policy statement.

Part two. Part two of the second proposal was examined in light of the decision-making behavior of the members of Group Four. The members of Group Four received the policy statement prior to the posttest and feedback information during the posttest. This feedback information indicated that their senior executives had incorporated a different hierarchy of goals into their actual decisions than was presented in the policy statement. After the posttest, the members of Group Four were asked to

identify the character of the feedback information they had received.

Thirteen of the 15 subjects in Group Four indicated that their senior executives had incorporated a different relative importance of organizational goals into their actual decisions than was presented in the policy statement. The other two subjects did not correctly identify the character of the feedback information they received. The 13 individuals who correctly identified the character of the feedback information they received during the posttest were asked to indicate the relative importance they perceived their senior executives placed on each of the five organizational goals in arriving at their decisions. (See Appendix B for a summary of the data for Group Four.)

Part two of the second proposal predicts that middle-level managers who perceive their senior executives to incorporate a different hierarchy of goals into their actual decisions than was presented in the policy statement will place this perceived relative importance upon related decision criteria during their own decision-making. If part two of the second proposal is to be supported by the decision-making behavior of the experimental subjects,

the 13 members of Group Three identified above should be expected to place approximately the same relative weights on the five decision criteria during their own decision-making as they perceived their senior executives to place. The average relative weights these subjects perceived their senior executives to utilize are compared with the actual relative weights they themselves placed on the five decision criteria in Table 4.5.

The null and alternate hypotheses presented below examine the likelihood that the specified members of Group Four placed approximately the same relative weights on the decision criteria during their own decision-making as they perceived were placed on these criteria by their senior executives in reaching their decisions.

Ho_4: There is no difference between the relative weights the specified members of Group Four perceived their senior executives to place on the decision criteria and the relative weights they placed on these criteria during their own decision-making.

Ha_4: The specified members of Group Four placed different relative weights on the decision criteria during their own decision-making than they perceived were placed on these criteria by their senior executives.

TABLE 4.5

GROUP FOUR PERCEIVED RELATIVE WEIGHTS AND ACTUAL RELATIVE WEIGHTS FOR SELECTED INDIVIDUALS

	Perceived Weights	Relative Weights
1. Efficiency	13	11
2. Pilot Quality	56	65
3. Personnel Retention	08	09
4. Compliance with Directives	09	05
5. Aircraft Maintenance	14	10

A two-tail t-test with 24 degrees of freedom was used to evaluate the null hypothesis presented above. The results of this evaluation are presented below.

Ho_4	t-values	Alpha Probability
$\overline{X}_{4,1} = \overline{X}_{4,1p}$	-0.441	.664
$\overline{X}_{4,2} = \overline{X}_{4,2p}$	+1.264	.221
$\overline{X}_{4,3} = \overline{X}_{4,3p}$	+0.444	.662
$\overline{X}_{4,4} = \overline{X}_{4,4p}$	-2.574	.017
$\overline{X}_{4,5} = \overline{X}_{4,5p}$	-1.156	.263

The evidence presented above indicates that the experimental subjects placed approximately the same relative weights on four of the five criteria as they perceived their senior executives to place on each of these criteria. They placed a different relative weight on the fourth criterion than they perceived was placed on this criterion by their senior executives.

Part three. Part three of the second proposal was examined in light of the decision-making behavior of the members of Group Five. The members of Group Five received the policy statement prior to the posttest and feedback information during the posttest. The feedback

information the members of Group Five received was determined by translating numbers from a table of random digits into evaluation scores for the hypothetical pilot training wings. The use of random data as feedback information was designed to indicate that no relationship existed between the relative importance of the organizational goals presented in the policy statement and the evaluation decisions made by the organization's senior executives. After the posttest, the members of Group Five were asked to identify the character of the feedback information they received. Eleven of the 15 subjects in Group Four indicated that they could not perceive any meaningful pattern in the decisions made by their senior executives. The other four subjects did not correctly identify the character of the feedback information they received. (Appendix B contains a summary of the experimental data for Group Five.)

Part three of the second proposal predicts that middle-level managers who, when they are allowed to compare their own decisions with those made by their senior executives, cannot perceive any meaningful pattern in the decisions made by their senior executives will place approximately the same relative importance upon related

decision criteria during their decision-making as indicated in the original policy statement. If part three of the second proposal is to be supported by the decision-making behavior of the experimental subjects, this decision-making behavior should be expected of the 11 subjects in Group Five who indicated they perceived no meaningful pattern in the decisions made by their senior executives. These individuals should be expected to place approximately the same relative weights on the decision criteria as those presented in the policy statement. The average relative weights placed on the five decision criteria by the members of Group Five during the posttest are compared in Table 4.6 with the relative weights presented in the policy statement.

The null and alternate hypotheses presented below examine the likelihood that the relative weights the specified subjects in Group Five placed on the decision criteria are approximately those indicated in the policy statement.

Ho_5: The relative weights placed on the decision criteria by the members of Group Five who correctly identified the feedback information are no different from the relative weights indicated in the policy statement.

TABLE 4.6

GROUP FIVE AVERAGE RELATIVE WEIGHTS FOR SELECTED INDIVIDUALS AND POLICY STATEMENT RELATIVE WEIGHTS

	Group Five	Policy Statement
1. Efficiency	20	26
2. Pilot Quality	45	26
3. Personnel Retention	15	20
4. Compliance with Directives	08	14
5. Aircraft Maintenance	12	14

Ha_5: The members of Group Five who correctly identified the feedback information placed different relative weights on the decision criteria than those indicated in the policy statement.

A two-tail t-test with 10 degrees of freedom was used to evaluate the null hypothesis. The results of this evaluation are presented below.

Ho_5	t-values	Alpha Probability
$\overline{X}_{5,1} = 26$	-1.682	.129
$\overline{X}_{5,2} = 26$	+3.327	.009
$\overline{X}_{5,3} = 20$	-2.347	.043
$\overline{X}_{5,4} = 14$	-5.474	.000
$\overline{X}_{5,5} = 14$	-2.128	.062

When the previously established alpha level of .05 is adherred to, the evidence presented above indicates the specified members of Group Five placed different relative weights on the second, third, and fourth criteria than those indicated in the policy statement. They placed approximately the same relative weights on the first and fifth criteria as those indicated in the policy statement.

Summary of evidence. The second proposal considers how feedback information about the decisions made by their senior executives can influence the decision-making behavior of middle-level managers. The evidence related to the three parts of this proposal is considered separately.

Part one. Part one of the second proposal predicts the decision-making behavior of middle-level managers who perceive their senior executives to incorporate the same hierarchy of goals presented in the policy statement into their actual decisions. It predicts these individuals will place approximately the same relative weights on the decision criteria during their own decision-making as those indicated in the policy statement. The evidence provided by the behavioral experiment is mixed, but the majority of the evidence does not support part one of the second proposal. The experimental subjects placed approximately the same relative weights as those specified in the policy statement on only two of the five decision criteria. They placed significantly different relative weights on three of the five decision criteria than those presented in the policy statement.

Part two: Part two of the second proposal predicts the decision-making behavior of middle-level managers who perceive their senior executives to incorporate a different hierarchy of goals into their actual decisions than was presented in the policy statement. It predicts that these individuals will place approximately the same relative weights on the decision criteria as they perceived were placed on these criteria by their senior executives.

Most of the evidence provided by the behavioral experiment supports part two of the second proposal. The subjects involved placed approximately the same relative weights on four of the five decision criteria during their own decision-making as they perceived their senior executives to place on these criteria during their decision-making. However, the subjects involved placed a significantly different relative weight on one of the decision criteria than they perceived their senior executives to place on that criterion.

Part three: Part three of the second proposal predicts the decision-making behavior of middle-level managers who cannot perceive any meaningful pattern in the decisions made by their senior executives. It predicts

that these individuals will place approximately the same relative weights on the decision criteria during their own decision-making as those presented in the original policy statement. The evidence provided by the behavioral experiment is mixed, but the majority of the evidence does not support part three of the second proposal. The experimental subjects involved placed approximately the same relative weights on only two of the five decision criteria as those indicated in the policy statement. They placed different relative weights on three of the five decision criteria than those presented in the policy statement.

Third Proposal

It is proposed that middle-level managers who perceive their senior executives to place some (significant) level of importance on multiple organizational goals will also place some (significant) level of importance on related multiple criteria during their own decision-making.

The third proposal is concerned with whether the number of criteria a middle-level manager utilizes in reaching his decisions is influenced by the number of criteria he perceives his senior executives to utilize in reaching their decisions. This proposal predicts that,

even though middle-level managers might not place approximately the same relative weights on the decision criteria specified by their senior executives, they will place some weight on each of the criteria when they perceive their senior executives to do so. The relationship suggested by this proposal is therefore less precise than the relationships suggested by the preceding two proposals.

The evidence used for evaluating this proposal is indirect evidence. Consequently, some explanations are required before the evidence can be properly evaluated.

Fourteen individuals in Group Three and 15 individuals in Group Four answered the questions presented them after the posttest in such a way that they indicated they perceived their senior executives to place some level of importance on each of the five decision criteria. (See Appendix B.) Let us consider these 29 individuals as members of a single comparison group called Group Six. This group is composed only of individuals who perceived their senior executives to place some level of importance on each of the five decision criteria.

Originally, the members of both Group Six and Group One were randomly selected from the same parent population, and then randomly assigned to their respective

groups. As a result, the percentage of individuals who perceived their senior executives to utilize all five criteria prior to the experiment would be distributed equally among the groups. Furthermore, the percentage of individuals who utilized all five decision criteria would be distributed equally among the groups. The latter statement can be demonstrated empirically by comparing the percentage of individuals in Group Six who utilized all five decision criteria during the pretest and the percentage of individuals in Group One who utilized all five criteria during the pretest. The null and alternate hypotheses presented below make this comparison.

Ho_6: There is no difference between the percentage of individuals in Group Six and Group One who placed some (significant) relative weight on each of the five decision criteria during the pretest.

Ha_6: A different percentage of individuals in Group Six placed some (significant) relative weight on each of the five decision criteria during the pretest than the percentage of individuals in Group One who did so.

An examination of the formula for calculating the relative weight of a variable presented in Chapter III

reveals that when the standardized regression coefficient (beta weight) of a variable is equal to zero, then the relative weight of that variable is also zero. The computer program (MULTIR2, maintained on the CDC 6600 computer at The University of Texas at Austin) used for the regression analysis examines the beta weight of each of the independent variables. The hypothesis that each beta weight is equal to zero is evaluated, and a t-value which indicates the likelihood of this hypothesis is printed in the program's output. With 30 degrees of freedom (n - 2), and an alpha level of .05, a computed t-value in excess of 2.04 indicates that the beta weight associated with the variable was greater than zero. In this event, some (significant at the .05 level) relative weight was placed on that variable.

The t-value associated with each of the independent variables was examined for each of the individuals in Group Six and in Group One. Nineteen of the 29 individuals in Group Six (19/29 = .66 = p_6) placed some (significant) relative weight on each of the five decision variables during the pretest. Nine of the 15 individuals in Group One (9/15 = .60 = p_1) placed some (significant) relative weight on each of the five decision variables during

the pretest. A two-tail t-test with 42 degress of freedom was used to evaluate the null hypothesis presented above. The results of the evaluation are presented below.

Ho_6	t-value	Alpha Probability
$P_6 = P_1$	+0.387	.700

The null hypothesis may not be rejected at the .05 level and consequently is accepted as true. The same percentage of individuals utilized each of the five decision criteria to some degree in reaching their decisions during the pretest.

Group One is the basic control group for the behavioral experiment. Consequently, its members were not provided with any information whatsoever about the relative importance placed on the organizational goals by their senior executives. The individuals in Group Six were all provided with information which indicated their senior executives placed some (significant) level of importance on each of the five criteria. All of these individuals indicated that they perceived their senior executives to place some (significant) level of importance on each of the five criteria.

The t-value associated with each of the decision variables was examined for each of the individuals in Groups One and Six during the posttest. Nine of the 15 individuals in Group One ($9/15 = .60 = P_1$) and 26 of the 29 individuals in Group Six ($26/29 = .90 = P_6$) placed some significant relative weight on each of the five variables. If no relationship exists between the number of criteria an individual utilizes and his perception of the number of criteria utilized by his senior executives, then no difference between the percentage of individuals who utilize all five criteria during the posttest should exist for the two groups. The null and alternate hypotheses below examine these relationships.

Ho_7: There is no difference between the percentage of individuals in Groups One and Six who placed some (significant) relative weight on each of the criteria during the posttest.

Ha_7: A greater percentage of individuals in Group Six than in Group One placed some (significant) relative weight on each of the five decision criteria during the posttest.

A one-tail t-test with 42 degrees of freedom was used to evaluate the null hypothesis. The results of this evaluation are presented below.

Ho_7	t-value	Alpha Probability
$P_6 = P_1$	+2.459	.009

Based on the evidence presented above, the null hypothesis was rejected and its alternate was accepted as true.

The evidence provided by the behavioral experiment supports the third proposal. A greater percentage of individuals in the group composed only of those persons who perceived their senior executives to place some level of importance on each of the five criteria also placed some (significant) relative weight on each of the five criteria than in the control group.

Ancillary Considerations

Two ancillary considerations are examined here. First, the suggestion that the decision-making behavior of middle-level managers is influenced by feedback information about their senior executives' decisions only when the information contained in the feedback information is relevant

to the decision-making task at hand is considered. The second question examined here involves whether or not middle-level managers shift the relative weights they place on the criteria in the direction of those indicated in the policy statement. It is suggested that they are able to shift the relative weights placed on the criteria in the proper direction in some instances where they might not be successful in placing approximately the same relative weights on the criteria as specified.

Influence of feedback information. The members of Groups Three, Four, and Five all received feedback information which allowed them to compare their own decisions with those of their senior executives. The members of Group Two did not receive feedback information, although they did receive the other information received by the other three groups. Consequently, Group Two is the proper control group for each of the other three groups when evaluating the effects of the feedback information.

The suggestion that the decision-making behavior of middle-level managers is influenced only by relevant feedback information is considered here. The feedback information provided to the members of Groups Three and Four contained information about the relative importance the

organization's senior executives placed on its goals. The feedback information provided to the members of Group Five did not contain information about the relative importance the organization's senior executives placed on the five goals. (See Appendix B for summary data.) Consequently, the feedback information provided to the members of Groups Three and Four was relevant to the decision-making task, whereas the feedback information provided to the members of Group Five was not relevant to the decision-making task. It should also be kept in mind that most of the members of Groups Three and Four perceived the feedback information they received to be relevant to the decision-making task. However, most of the members of Group Five did not perceive the feedback information they received to be relevant to the decision-making task. The perceptions of the individuals involved are based upon whether they classified the feedback information they received as either indicating the basis of their senior executives' decisions or as not having any meaningful pattern. (See Appendix A.)

If relevant feedback information influences the decision-making behavior of middle-level managers, the members of Groups Three and Four should be expected to place different relative weights on the decision criteria than

the members of Group Two. If feedback information that is not relevant to the decision-making task does not influence the decision-making behavior of middle-level managers, the members of Group Five should be expected to place about the same relative weights on the decision criteria as the members of Group Two.

The average relative weights placed on the decision criteria by the members of Groups Two and Three during the posttest are shown in Table 4.7.

The likelihood of the suggested relationships is examined by the null and alternate hypotheses presented below.

Ho_8: There is no difference between the relative weights placed on the decision criteria by the members of Groups Two and Three.

Ha_8: The members of Group Three placed different relative weights on the decision criteria than the members of Group Two.

The null hypothesis was evaluated with a general linear model. The results of this evaluation are shown on the following page.

TABLE 4.7

GROUP TWO AND GROUP THREE AVERAGE RELATIVE WEIGHTS

	Group Two	Group Three
1. Efficiency	24	26
2. Pilot Quality	42	34
3. Personnel Retention	15	23
4. Compliance with Directives	08	08
5. Aircraft Maintenance	11	09

Degrees of Freedom	F-value	Alpha Probability
$DF_1 = 5$ $DF_2 = 140$	2.6	.028

Based on this evidence, the null hypothesis was rejected and its alternate was accepted as true. The members of Group Three were influenced by the feedback information they received.

The average relative weights placed on the decision criteria by the members of Groups Two and Four are shown in Table 4.8.

The relationships suggested above between these two groups are examined by the null and alternate hypotheses presented below.

Ho_9: There is no difference between the relative weights placed on the decision criteria by the members of Groups Two and Four.

Ha_9: The members of Group Four placed different relative weights on the decision criteria than the members of Group Two.

The null hypothesis was evaluated with a general linear model. The results are shown below.

TABLE 4.8

GROUP TWO AND GROUP FOUR AVERAGE RELATIVE WEIGHTS

	Group Two	Group Four
1. Efficiency	24	12
2. Pilot Quality	42	65
3. Personnel Retention	15	09
4. Compliance with Directives	08	05
5. Aircraft Maintenance	11	09

Degrees of Freedom	F-value	Alpha Probability
$DF_1 = 5$ $DF_2 = 140$	8.9	.000

Based on this evidence, the null hypothesis was rejected and its alternate was accepted as true. The decision-making behavior of the members of Group Four was influenced by the feedback information they received.

The average relative weights placed on the decision criteria by the members of Groups Two and Five are shown in Table 4.9.

The suggested relationships between these two groups are examined by the null and alternate hypotheses presented below.

Ho_{10}: There is no difference between the relative weights placed on the decision criteria by the members of Groups Two and Five.

Ha_{10}: The members of Group Five placed different relative weights on the decision criteria than the members of Group Two.

The null hypothesis was evaluated with a general linear model. The results of this evaluation are shown on the following page.

TABLE 4.9

GROUP TWO AND GROUP FIVE AVERAGE RELATIVE WEIGHTS

	Group Two	Group Five
1. Efficiency	24	23
2. Pilot Quality	42	42
3. Personnel Retention	15	14
4. Compliance with Directives	08	10
5. Aircraft Maintenance	11	11

Degrees of Freedom	F-value	Alpha Probability
$DF_1 = 5$ $DF_2 = 140$	.061	.998

Based on this evidence, the null hypothesis may not be rejected at the .05 level. Consequently, it was accepted as true. The members of Group Five were not influenced by the feedback information they received.

The evidence that has been presented above about the decision-making behavior of Groups Three, Four, and Five indicates that the decision-making behavior of the experimental subjects was not influenced by feedback information that was not relevant to the decision-making task at hand. The decision-making behavior of the experimental subjects was influenced by feedback information that was relevant to the decision-making task at hand. It should be kept in mind that the relevant feedback information was also perceived as relevant by most of the subjects involved, and the feedback information which was not relevant was also perceived as not relevant by most of the subjects involved.

Directional shift of relative weights. The question of whether middle-level managers are able to shift

the relative weights they place on decision criteria in the direction of the specified relative weights is considered here. The evidence presented earlier in this chapter in relation to the first and second research proposals indicates that the subjects placed approximately the same relative weights on only two of the five criteria as those specified in the policy statement. However, it is possible that middle-level managers shift the relative weights they place on a larger number of criteria in the direction of the relative weights specified, without successfully placing approximately the same relative weights on the criteria as was specified.

This suggestion may be examined by comparing the decision-making behavior of the members of Groups Two and Three with that of the members of Group One. The members of Groups Two and Three received the organizational policy statement. The members of Group Three also received feedback information which corroborated the policy statement. The relative weights placed on the criteria by the members of Group One represent those the members of Groups Two and Three would be expected to have placed on the criteria had they received no information about the relative importance their senior executives placed on the organization's goals.

As a result, Group One is the control group for each of the other two groups.

If the decision-making behavior exhibited by the members of Groups Two and Three is to support the suggestion presented above, the members of these two groups should be expected to shift the relative weights they place on the decision criteria in the direction of the relative weights indicated in the policy statement (and by the feedback information).

Group Two. The average relative weights placed on the decision criteria by the members of Groups One and Two are shown in Table 4.10, along with the relative weights indicated in the policy statement. The null and alternate hypotheses presented below examine the likelihood that the individuals in Group Two shifted the relative weights they placed on the decision criteria significantly in the direction of the relative weights indicated in the policy statement.

Ho_{11}: There is no difference between the relative weights placed on the decision criteria by the members of Groups One and Two.

TABLE 4.10

GROUP ONE AND GROUP TWO AVERAGE RELATIVE WEIGHTS AND

POLICY STATEMENT RELATIVE WEIGHTS

	Group One	Group Two	Policy Statement
1. Efficiency	07	24	26
2. Pilot Quality	48	42	26
3. Personnel Retention	08	15	20
4. Compliance with Directives	09	08	14
5. Aircraft Maintenance	28	11	14

Ha_{11}: The members of Group Two shifted the relative weights they placed on the decision criteria in the direction of those indicated in the policy statement.

A one-tail t-test with 28 degrees of freedom was used to evaluate the null hypothesis. The results are shown below.

Ho_{11}	t-values	Probability
$\bar{X}_{1,1} = \bar{X}_{2,1}$	-5.680	.000
$\bar{X}_{1,2} = \bar{X}_{2,2}$	+1.090	.147
$\bar{X}_{1,3} = \bar{X}_{2,3}$	-2.652	.005
$\bar{X}_{1,4} = \bar{X}_{2,4}$	-0.376	.605
$\bar{X}_{1,5} = \bar{X}_{2,5}$	+4.126	.000

Based on the evidence presented above, the null hypothesis was rejected for the first, third, and fifth decision criteria. The relative weights placed on these three criteria were shifted significantly in the direction of the relative weights indicated in the policy statement. The null hypothesis may not be rejected at the .05 level for the second and fourth criteria. The relative weights placed on these two criteria were not shifted significantly from those which would have been expected had the members of

Group Two received no information about the relative importance their senior executives placed on the organization's goals.

Group Three. The average relative weights placed on the decision criteria by the members of Groups One and Three are shown in Table 4.11, along with the relative weights indicated in the policy statement. The null and alternate hypotheses presented below examine the likelihood that the individuals in Group Three shifted the relative weights they placed on the decision criteria significantly in the direction of the relative weights indicated in the policy statement.

Ho_{12}: There is no difference between the relative weights placed on the decision criteria by the members of Groups One and Three.

Ha_{12}: The members of Group Three shifted the relative weights they placed on the decision criteria in the direction of those indicated in the policy statement.

A one-tail t-test with 28 degrees of freedom was used to evaluate the null hypothesis. The results of the evaluation are shown below.

TABLE 4.11

GROUP ONE AND GROUP THREE AVERAGE RELATIVE WEIGHTS

AND POLICY STATEMENT RELATIVE WEIGHTS

	Group One	Group Three	Policy Statement
1. Efficiency	07	26	26
2. Pilot Quality	48	34	26
3. Personnel Retention	08	23	20
4. Compliance with Directives	09	08	14
5. Aircraft Maintenance	28	09	14

Ho_{12}	t-values	Alpha Probability
$\bar{X}_{1,1} = \bar{X}_{3,1}$	-14.441	.000
$\bar{X}_{1,2} = \bar{X}_{3,2}$	+ 9.904	.000
$\bar{X}_{1,3} = \bar{X}_{3,3}$	-15.694	.000
$\bar{X}_{1,4} = \bar{X}_{3,4}$	+ 1.109	.890
$\bar{X}_{1,5} = \bar{X}_{3,5}$	+15.224	.000

Based on the evidence presented above, the null hypothesis was rejected and its alternate was accepted as true for the first, second, third, and fifth criteria. The relative weights placed on these four criteria were shifted significantly in the direction of the relative weights indicated in the policy statement. The null hypothesis may not be rejected at the .05 level for the fourth criterion. The relative weight placed on this decision criterion was not shifted significantly from what would have been expected had the members of Group Three received no information about the relative importance their senior executives placed on the organization's goals.

Summary of evidence. The subjects in Group Two shifted the relative weights they placed on three of the decision criteria in the direction of those indicated in

the policy statement. Evidence presented earlier in this chapter indicated that these subjects placed approximately the same relative weights as those indicated in the policy statement on only two of the three criteria whose relative weights they shifted in the direction of those indicated in the policy statement. The subjects in Group Four shifted the relative weights they placed on four of the decision criteria in the direction of those indicated in the policy statement. Evidence presented earlier in this chapter indicated that these subjects placed approximately the same relative weights as those indicated in the policy statement on only two of the four criteria whose relative weights they shifted in the direction of those indicated in the policy statement.

The Evidence and the Assumptions

At the beginning of this section, it was pointed out that the three research proposals would accurately predict the decision-making behavior of the experimental subjects only if the two assumptions about middle-management decision-making being examined were completely valid. Since the research proposals did not accurately predict

the subjects' decision-making behavior in all instances, it seems apparent that these two assumptions about middle-management decision-making should be re-examined. The section following this one considers the evidence which indicates the influence of information about the relative importance placed on the organization's goals by the senior executives upon the decision-making behavior of the experimental subjects. The succeeding section examines the evidence which indicates the perceptual and cognitive difficulties the experimental subjects encountered.

Pervasive Influence of the Senior Executives

As mentioned earlier in this chapter, a conceptual framework (Anthony, 1965) that has been widely used in the design of planning and control systems implicitly incorporates two major assumptions about middle-management decision-making. One of these assumptions is that the decision-making behavior of an organization's middle-level managers is strongly influenced by organizational goals whose importance is prescribed by the organization's senior managers. The evidence provided by the behavioral experiment which relates to this assumption about middle-management decision-making is examined in this section in

order to determine if the evidence indicates the assumption to be valid.

If the evidence provided by the behavioral experiment is to consistently support the assumption described above, the experimental subjects should be expected to change their decision-making behavior whenever they receive information which indicates their senior executives have changed the relative importance placed on the organization's goals. Furthermore, they should be expected to change their decision-making behavior in accordance with the character of the information received. The members of Group Two (who received the policy statement) should be expected to place relative weights on the decision criteria which deviate less from those specified in the policy statement than the relative weights of the members of Group One (who received no policy statement). The relative weights placed on the decision criteria by the members of Group Three (who received the policy statement with corroborating feedback information) should be expected to deviate less from those specified in the policy statement than the relative weights of the members of Group One (who received no policy statement and no feedback information) and Group Two (who received the policy statement but did

not receive feedback information). However, the members of Group Four (who received the policy statement and contradictory feedback information) should be expected to place relative weights on the decision criteria which deviate more from those specified in the policy statement than the relative weights of the members of Groups Two and Three (who did not receive contradictory information). The members of Group Five (who received the policy statement and random feedback which was largely disregarded) should be expected to place relative weights on the decision criteria which deviate less from those specified in the policy statement than those of the members of Group One (who received no policy statement).

If the relative weights specified in the policy statement are assumed to represent population means in a population where the official policy was consistently implemented, the standard deviation from the policy statement relative weights can be calculated for each of the criteria. The standard deviation calculated in this manner represents the dispersion of the sample values provided by each of the comparison groups from the relative weights specified in the policy statement (Clark and Schkade, 1969, p. 63). If the subjects place relative weights on the

decision criteria which tend to resemble those specified in the policy statement, the standard devision will be relatively small. If the subjects place relative weights on the decision criteria which tend to differ from those specified in the policy statement, the standard deviation will be relatively large. Consequently, the standard deviation calculated in this fashion can be used to determine if the decision-making behavior predicted for each of the comparison groups actually occurred.

Group One

Group One served as the basic control group for the behavioral experiment. Its members received no information whatsoever about the relative importance that their senior executives placed on the organization's goals. Consequently, the decision-making behavior of these individuals was not influenced by such information. It should be kept in mind, however, that as a result of the preliminary study mentioned in Chapter II the researcher had some advance knowledge of the approximate relative weights the subjects in this control group would be expected to place on the decision criteria. Based on this advance knowledge, a relative importance of organizational goals was specified in the organizational policy statement that was quite

different from what was predicted for Group One based on the preliminary study. Consequently, the standard deviation of the control group from the policy statement was expected to be relatively large. The standard deviation of Group One relative weights from those specified in the policy statement is summarized in Table 4.12. The average standard deviation per criterion for Group One was 19.4.

Group Two

The members of Group Two received the organizational policy statement. In order for the first assumption about middle-management decision-making behavior that was discussed earlier to be supported by the evidence, the standard deviation of the Group Two relative weights from those in the policy statement should be expected to be smaller than the standard deviation for the control group, Group One. The standard deviation of the Group Two relative weights from those in the policy statement is shown in Table 4.13. The average standard deviation per criterion for Group Two was 11.7, compared with 19.4 for Group One. This evidence supported the first assumption.

Group Three

The members of Group Three received the policy statement. They also received feedback information which

TABLE 4.12

STANDARD DEVIATION FROM POLICY STATEMENT FOR GROUP ONE

	Group One
1. Efficiency	20.4
2. Pilot Quality	28.1
3. Personnel Retention	14.1
4. Compliance with Directives	9.7
5. Aircraft Maintenance	19.6
Average standard deviation per criterion (square root of average variance)	19.4

TABLE 4.13

STANDARD DEVIATION FROM POLICY STATEMENT FOR GROUPS ONE AND TWO

	Group One	Group Two
1. Efficiency	20.4	10.6
2. Pilot Quality	28.1	19.0
3. Personnel Retention	14.1	8.2
4. Compliance with Directives	9.7	8.4
5. Aircraft Maintenance	19.6	8.5
Average standard deviation per criterion (square root of average variance)	19.4	11.7

corroborated the policy statement. Evidence presented earlier in this chapter indicated that the members of Group Three placed different relative weights on the decision criteria than the members of Group Two. The evidence also indicated that most of the members of Group Three perceived the feedback information to be relevant to the decision-making task at hand.

Under these circumstances, the members of Group Three should be expected to be influenced by the information provided from each of these two sources, the policy statement and the feedback information. Consequently, if the first assumption about middle-management decision-making is to be supported by the evidence, the standard deviation for Group Three should be expected to be smaller than the standard deviation for Groups One and Two. The standard deviation for Group Three is summarized in Table 4.14. The average standard deviation per criterion for Group Three was 9.3, compared with 11.7 for Group Two and 19.4 for Group One. This evidence supports the first assumption.

Group Four

The members of Group Four received the policy statement. They also received feedback information which indicated their senior executives actually

TABLE 4.14

STANDARD DEVIATION FROM POLICY STATEMENT FOR

GROUPS ONE, TWO, AND THREE

	Group One	Group Two	Group Three
1. Efficiency	20.4	10.6	10.3
2. Pilot Quality	28.1	19.0	13.3
3. Personnel Retention	14.1	8.2	6.9
4. Compliance with Directives	9.7	8.4	6.7
5. Aircraft Maintenance	19.6	8.5	7.5
Average standard deviation per criterion (square root of average variance)	19.4	11.7	9.3

incorporated a different hierarchy of goals into their decisions than was presented in the policy statement. Evidence presented earlier in this chapter indicated that these subjects were influenced by the feedback information, and that they considered the feedback information to be relevant to the decision-making task at hand.

Under these circumstances, the members of Group Four should be expected to be influenced by the information provided from both the policy statement and the feedback information. The feedback information was designed to resemble the relative importance of organizational goals predicted for the subjects during the pretest. Consequently, it also resembled the relative weights placed on the decision criteria by the members of the control group, Group One, during the posttest. As a result of the influence of this feedback information, if the first assumption about middle-management decision-making is to be supported by the evidence in this instance, the standard deviation of the Group Four relative weights from those in the policy statement should be expected to be larger than that of either Group Two or Group Three. The Group Four standard deviation is presented in Table 4.15. The average standard deviation per criterion for Group Four was 21.9,

TABLE 4.15

STANDARD DEVIATION FROM POLICY STATEMENT FOR

GROUPS TWO, THREE, AND FOUR

	Group Two	Group Three	Group Four
1. Efficiency	10.6	10.3	18.2
2. Pilot Quality	19.0	13.3	44.7
3. Personnel Retention	8.2	6.9	13.4
4. Compliance with Directives	8.4	6.7	9.6
5. Aircraft Maintenance	8.5	7.5	11.1
Average standard deviation per criterion (square root of average variance)	11.7	9.3	21.9

compared with 9.3 for Group Three and 11.7 for Group Two. This evidence supports the first assumption.

Group Five

The members of Group Five received the policy statement, and random feedback information. Evidence presented earlier in this chapter indicated that the relative weights placed on the decision criteria by the members of Group Five were not significantly different from those placed on the criteria by the members of Group Two. This indicates that the subjects were not influenced by the random feedback information.

Under these circumstances, the members of Group Five should be expected to be influenced by the policy statement. Consequently, if the assumption about middle-management decision-making mentioned earlier is to be supported by the evidence, the standard deviation of Group Five relative weights from those indicated in the policy statement should be smaller than for the control group, Group One. The average standard deviation for Group Five is presented in Table 4.16. The Group Five average standard deviation per criterion was 14.0, compared with 19.4 for Group One, the control group. This evidence supports the first assumption.

TABLE 4.16

STANDARD DEVIATION FROM POLICY STATEMENT FOR GROUPS ONE AND FIVE

	Group One	Group Five
1. Efficiency	20.4	14.7
2. Pilot Quality	28.1	24.1
3. Personnel Retention	14.1	9.5
4. Compliance with Directives	9.7	7.6
5. Aircraft Maintenance	19.6	5.5
Average standard deviation per criterion (square root of average variance)	19.4	14.0

Summary of Evidence

The standard deviation for each of the comparison groups has been summarized in Table 4.17. The evidence presented in this section indicates that in every instance the experimental subjects changed their decision-making behavior in the direction predicted by the first assumption about middle-management decision-making discussed earlier. The pervasive influence of the senior managers of the organization upon the decision-making behavior of the experimental subjects is apparent. The empirical evidence provided by the behavioral experiment supports the validity of the first assumption--that the decision-making behavior of middle-level managers is strongly influenced by organizational goals whose importance is prescribed by the organization's senior managers.

Perceptual and Cognitive Difficulties

The preceding section examined the evidence related to the first of two primary assumptions about middle-management decision-making implicit in a widely used conceptual framework (Anthony, 1965) for planning and control systems. The evidence indicated that the decision-making

TABLE 4.17

SUMMARY OF STANDARD DEVIATION FROM POLICY STATEMENT FOR GROUPS ONE, TWO, THREE, FOUR, AND FIVE

	Group One	Group Two	Group Three	Group Four	Group Five
1. Efficiency	20.4	10.6	10.3	18.2	14.7
2. Pilot Quality	28.1	19.0	13.3	44.7	24.1
3. Personnel Retention	14.1	8.2	6.9	13.4	9.5
4. Compliance with Directives	9.7	8.4	6.7	9.6	7.6
5. Aircraft Maintenance	19.6	8.5	7.5	11.1	5.5
Average standard deviation per criterion (square root of average variance)	19.4	11.7	9.3	21.9	14.0

behavior of the experimental subjects was strongly influenced by organizational goals whose importance was prescribed by their senior executives. In every instance where the subjects received information about the relative importance their senior executives placed on the organization's goals, they changed their decision-making behavior in the direction predicted by the first assumption. In other words, the subjects indicated the desire to incorporate the relative importance of organizational goals specified by their senior executives into their own decision-making in every instance where they received information on this subject.

Newell and Simon (1972, pp. 54-55) have stated that when a motivated individual fails to perform a task accurately, this indicates the limits of his capabilities. This same reasoning has been adopted for this study. Accordingly, in those instances where the experimental subjects failed to perform the decision-making task accurately, this indicated they were either unable to accurately perceive the correct relationships involved or unable to incorporate five weighted criteria into their decision-making processes.

The Evidence

The evidence provided by the behavioral experiment indicated that the experimental subjects made substantial perceptual and/or cognitive errors when they attempted to incorporate the relative importance of organizational goals specified by their senior executives into their own decision-making. The appropriate evidence is reviewed below. Although in some instances the distinction between the subjects' perceptual errors and their cognitive errors seems apparent, in other instances both types of errors are probably involved. Since either type of error, or some combination of both types of error, would affect the subjects' decision-making performance, no attempt has been made to classify the evidence according to the type of error involved.

The members of Group Two were provided with a policy statement which indicated the changed relative importance placed on the organization's goals by their senior executives. These individuals placed approximately the same relative weights on two of the five decision criteria as those indicated in the policy statement. They also shifted the relative weight placed on one additional criterion in the direction of that specified in the policy statement.

The members of Group Three were provided with the policy statement and with feedback information which corroborated the policy statement. These individuals placed approximately the same relative weights on two of the five decision criteria as those specified in the policy statement (and by the feedback information). They also shifted the relative weights placed on two additional criteria in the direction of those indicated in the policy statement. After they completed the posttest, the members of Group Three were asked to identify the character of the feedback information they were provided. Three of the 15 members of Group Three were unable to perceive that the feedback information they received indicated their senior executives incorporated the same hierarchy of goals presented in the policy statement into their actual decisions.

The members of Group Four were provided with the policy statement and with feedback information. This feedback information indicated that their senior executives incorporated a different hierarchy of goals into their actual decisions than was presented in the policy statement. After they completed the posttest, the members of Group Four were asked to identify the character of the feedback information provided. Two of the 15 members of Group

Four were unable to perceive that the feedback information they received indicated their senior executives incorporated a different hierarchy of goals into their actual decisions than was presented in the policy statement.

The 13 subjects in Group Four who were able to correctly identify the character of the feedback information they received were asked for further information. These individuals were asked to indicate the relative weights they believed their senior executives had placed on each of the five decision criteria in order to arrive at the decisions presented as feedback information. The relative weights they perceived their senior executives to place on the criteria are presented in Appendix B. The averages of these perceived relative weights are compared with the relative weights actually indicated by the feedback information in Table 4.18.

The null and alternate hypotheses presented below examine the likelihood that the subjects made no substantial perceptual errors in estimating the relative weights their senior executives placed on the five decision criteria.

Ho_{13}: There is no difference between the relative weights the feedback information indicated for the

TABLE 4.18

RELATIVE WEIGHTS PERCEIVED BY 13 MEMBERS OF GROUP FOUR

AND ACTUAL FEEDBACK RELATIVE WEIGHTS

	Perceived Weights	Feedback Weights
1. Efficiency	13	02
2. Pilot Quality	56	92
3. Personnel Retention	08	02
4. Compliance with Directives	09	02
5. Aircraft Maintenance	14	02

decision criteria and those perceived by the specified members of Group Four.

Ha_{13}: The specified members of Group Four perceived their senior executives to place different relative weights on the decision criteria than those indicated by the feedback information.

A two-tail t-test with 24 degrees of freedom was used to evaluate the null hypothesis. The results are shown below.

Ho_{13}	t-values	Alpha Probability
$\bar{X}_{4,1p} = 02$	+5.729	.000
$\bar{X}_{4,2p} = 92$	-9.454	.000
$\bar{X}_{4,3p} = 02$	+5.565	.000
$\bar{X}_{4,4p} = 02$	+6.194	.000
$\bar{X}_{4,5p} = 02$	+6.623	.000

Based on the evidence presented above, the null hypothesis was rejected and its alternate was accepted as true. The experimental subjects made substantial perceptual errors in interpreting the information provided by the feedback information.

However, the evidence presented earlier in this chapter indicated that the members of Group Four were able

to place approximately the same relative weights on four of the five criteria as the relative weights they perceived their senior executives to place on those criteria. They placed a different relative weight on one criterion than they perceived their senior executives to place.

The members of Group Five were provided with the policy statement and with random feedback information. When asked to identify the character of the feedback information they received after they had completed the posttest, four of the 15 members of Group Five were unable to perceive that no systematic pattern existed in the feedback information they received. In general, the decision-making behavior of the members of Group Five was relatively unaffected by the random feedback information, and corresponded closely with that of the members of Group Two, who received no feedback information.

Some indirect evidence presented earlier in this chapter indicated that a greater percentage of those individuals who perceived their senior executives to utilize all five criteria in reaching decisions also utilized all five criteria in reaching their own decision than the percentage of individuals in the control group who utilized all five criteria. This evidence indicated that the

experimental subjects were capable of placing some (significant) relative weight on each of the five decision criteria in arriving at their decisions.

Summary of Evidence

The evidence indicates that the experimental subjects made perceptual and cognitive errors in understanding and using the information presented to them. Those subjects who received a policy statement and corroborating feedback information performed best. They placed approximately the same relative weights on two of the five decision criteria as those specified, and shifted the relative weights they placed on two additional criteria in the direction of those specified. The subjects who received a policy statement without feedback information were the next best performers. They placed approximately the same relative weights on two of the five decision criteria as those specified, and shifted the relative weights they placed on one additional criterion in the direction of the relative weights specified. Those individuals who received random feedback information exhibited approximately the same decision-making behavior as those who received no feedback.

Twenty percent of the subjects were unable to correctly identify the character of the feedback information they received. Those individuals in Group Four who correctly identified the feedback information they received made substantial errors in estimating the relative weights their senior executives used in arriving at the decisions provided as feedback information. However, these same individuals were able to place approximately the same relative weights on four of the five decision criteria as they perceived their senior executives to have placed on these criteria. This suggests that, if perceptual errors could be eliminated, the subjects are capable of incorporating as many as four weighted criteria into their decision-making processes.

The evidence summarized above indicated that the experimental subjects encountered substantial perceptual and/or cognitive difficulties when they attempted to incorporate the specified relative importance of organizational goals into their decision-making processes. As a result of this evidence, the validity of the second assumption--that middle-level managers are capable of accurately perceiving and incorporating the importance of multiple organizational goals into their decision-making processes--seems questionable.

The implications of the research findings in regards to the two assumptions about middle-management decision-making that have been evaluated in this chapter are considered in the following chapter.

C H A P T E R V

SUMMARY, IMPLICATIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

The information contained in this chapter is presented in four sections. The first section summarizes the research problem and the approach used for the investigation. The second section summarizes the research findings. The implications of the research findings are considered in the third section. Some suggestions for further research are presented in the fourth section.

Summary of Problem and Research Approach

This study investigated some specific aspects of a general question: How is the decision-making behavior of an organization's middle-level managers influenced by the relative importance its senior executives place upon the organization's goals? It was proposed that this question has a straightforward answer. Middle-level managers tend to place the same relative importance upon the criteria they use to arrive at decisions as they perceive their senior executives to place upon related organizational

goals. When they fail to do so accurately, this failure primarily results from either their inability to form accurate perceptions about these goals, or from cognitive difficulties related to incorporating multiple weighted criteria into their decision-making processes.

The Conceptual Framework

The general question presented above was investigated by examining the validity of two assumptions implicit in a conceptual framework that has been widely used in the design of planning and control systems (Anthony, 1965). This frameowrk involves three interrelated processes, strategic planning, management control, and operational control. These processes have been defined as follows:

> Strategic planning is the process of deciding on the objectives of the organization, on changes in these objectives, and on the policies that are to govern the acquisition, use, and disposition of these resources. (Anthony, 1965, p. 16)
>
> Management control is the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives. (Anthony, 1965, p. 17)
>
> Operational control is the process of assuring that specific tasks are carried out effectively and efficiently. (Anthony, 1965, p. 18)

The operational control process involves few, if any, assumptions about management decision-making, and consequently was of little interest so far as this study was concerned. Instead, this study focused upon some relationships implicit between the strategic planning and management control processes.

The plans and policies that determine the overall direction of the organization are formulated during the strategic planning process. This kind of decision-making is normally associated most closely with the senior managers of the organization, and involves choosing the organization's goals and planning how to achieve them. The kind of decision-making that takes place during the management control process is normally associated most with the middle-level managers of the organization, and is felt to be constrained by the organizational goals and policies established during the strategic planning process (Anthony, 1965, pp. 25-40).

Two major assumptions about middle-management decision-making are implicit in the relationships between the strategic planning and management control processes described above. First, this framework assumes that the decision-making behavior of middle-level managers is

strongly influenced by organizational goals whose importance is prescribed by the organization's senior managers. Second, since it is generally agreed that large organizations have multiple goals, this framework assumes that middle-level managers are capable of accurately perceiving the importance of multiple organizational goals and incorporating them into their decision-making processes.

The Research Approach

In order to examine the validity of the two assumptions about middle-management decision-making mentioned above, a behavioral experiment was conducted at the Air Training Command headquarters at Randolph Air Force Base, Texas, between September 16, 1974, and October 3, 1974. Seventy-five subjects were selected randomly from the 429 middle-level staff officers assigned to the Command's headquarters staff. Although the Air Training Command has four major military missions (recruiting, basic military training, technical training, and flying training), the behavioral experiment focused only upon its largest and best-known mission, flying training. The training of Air Force pilots receives a great deal of management attention within the Air Training Command headquarters, for ten of the

Command's fifteen active bases are devoted almost exclusively to this mission.

For purposes of the experiment, the pilot training program was considered to have five primary goals: (1) efficiency, as determined by the average cost per pilot graduated; (2) pilot quality, as determined by the flying ability of the pilots graduated; (3) personnel retension, as determined by the success of programs aimed at achieving an all-volunteer force; (4) compliance with directives, as determined from inspections performed by the Inspector General; and (5) aircraft maintenance, as determined by specific programs aimed at evaluating the efficacy of efforts to maintain the primary aircraft in good flying condition. The Air Training Command had formal information systems which collected performance information about each of these areas when this study was performed, so these goals were considered to be operational goals. Since the performance of a particular pilot training wing may, in practice, be considered highly satisfactory in one of these areas while being considered highly unsatisfactory in another, these areas were considered to be independent of each other in the short term.

The pretest-posttest-control group experimental design (with five comparison groups) described by Campbell

and Stanley (1963, pp. 13-24) was used for the experiment. Although this design emphasizes achieving a high level of internal validity, the circumstances involved allow the results of the experiment to be generalized to the middle-level staff officers assigned to the Air Training Command headquarters when the experiment was performed. The experimental decision-making task required the subjects to evaluate the overall performance of a number of hypothetical base-level pilot training wings based only upon information which indicated whether performance was either satisfactory or unsatisfactory in each of the organizational goal areas mentioned above. Before the posttest, some subjects were provided with organizational policy statements which indicated that a changed relative importance was placed on the organization's goals by their senior executives. In addition, some subjects were provided with feedback information which allowed them to compare their own decisions with decisions made by their senior executives. After the posttest, some of the subjects were required to furnish certain information about the feedback information they had been provided with.

Summary of Research Findings

The general question considered in this study was investigated by evaluating the validity of two major assumptions about middle-management decision-making implicit in the conceptual framework described by Anthony (1965). This framework assumes (1) that the decision-making behavior of middle-level managers is influenced by organizational goals whose importance is prescribed by senior management, and (2) middle-level managers are capable of accurately perceiving and incorporating the importance of multiple organizational goals into their decision-making processes. In order to evaluate the validity of these two assumptions, three primary research proposals were formulated. These three primary research proposals should have accurately predicted the decision-making behavior of the subjects during the behavioral experiment if both these assumptions were valid within the environment of the experiment.

The First Assumption

The evidence provided by the behavioral experiment supported the validity of the first assumption about

middle-management decision-making. In every situation where the experimental subjects received information about the relative importance placed on the organization's goals by their senior executives, their decision-making behavior was affected. Furthermore, the evidence indicated that in every instance the subjects adjusted their decision-making behavior in the direction of the decision-making behavior specified by their senior executives. Based on this evidence, it was concluded that the first assumption about middle-management decision-making was valid within the framework of the behavioral experiment.

When considering the results of the behavioral experiment, it is important to keep in mind that the subjects were not offered any inducements aimed at motivating them to incorporate the relative importance of organizational goals specified by their senior executives into their own decision-making processes. Despite this, the results of the experiment indicate that the subjects did significantly adjust their decision-making behavior in the direction of that specified by their senior executives. A possible explanation of the individual motivations that influenced the experimental subjects to alter their decision-making behavior towards that specified by their senior

executives is provided by the theory of large managerial firms proposed by Monsen and Downs (1965). The particular portion of this theory considered relevant to this study was summarized earlier in Chapter II.

Monsen and Downs (1965) proposed that middle-level managers behave so as to maximize their own lifetime incomes (where income is defined to include both monetary elements and nonmonetary elements such as prestige, power, etc.). Since the best way for a middle-level manager to maximize his lifetime income is to be promoted, and his promotions are based almost entirely upon the recommendations of his seniors, a middle-level manager is therefore motivated to do whatever pleases his senior executives. In general, the Monsen and Downs theory contends that relationships which normally exist within the environment of an organization act to motivate individuals in middle-management roles to exhibit behavior in consonance with that specified by their senior executives. Since the decision-making behavior predicted by the first assumption about middle-management decision-making that was discussed above may be considered as a subset of the behavior predicted by the Monsen and Downs theory, the empirical evidence provided by the behavioral experiment also supports the

validity of that portion of the theory which predicts the behavior of middle-level managers.

The Second Assumption

The evidence provided by the behavioral experiment indicated that the first assumption about middle-management decision-making discussed above was valid within the environment of the behavioral experiment. Establishing the validity of the first assumption ascertains that the experimental subjects exhibited the desire to incorporate the relative importance of organizational goals specified by their senior executives into their own decision-making. Newell and Simon (1972, pp. 54-55) have stated that when a motivated individual fails to perform a task accurately, this indicates the limits of his capabilities. This reasoning was adopted in this study. When the experimental subjects failed to perform the decision-making task accurately, this indicated they were either unable to accurately perceive the correct relationships involved or they were unable to incorporate five weighted criteria into their decision-making processes.

The experimental subjects made substantial errors when they attempted to incorporate the relative importance

of organizational goals specified by their senior executives into their own decision-making. Although no attempt has been made to categorize these errors as either perceptual errors or cognitive errors, in some instances the appropriate classification seems apparent.

In general, those subjects who received a policy statement (which specified the relative importance of the five organizational goals) and who also received corroborating feedback information performed best. They placed approximately the same relative weights on two of the five criteria as those specified, and shifted the relative weights they placed on two additional criteria in the direction of the relative weights specified. Those subjects who received the policy statement and who did not receive feedback information were the next best performers. They placed approximately the same relative weights on two of the five criteria as those specified, and shifted the relative weight they placed on one additional criterion in the direction of the specified relative weight.

Those subjects who received the policy statement and conflicting feedback information were influenced by this feedback information. They placed the same relative weights on four of the five criteria as those they <u>perceived</u>

the feedback information to indicate their senior executives placed on the criteria. (However, they made substantial errors in estimating these relative weights.) Those subjects who received the policy statement and random feedback information largely ignored the random feedback information. Their decision-making behavior did not differ from those who received no feedback information.

A greater percentage of those subjects who perceived their senior executives to utilize all five criteria in reaching their decisions also placed some (significant) relative weight on all five criteria in reaching their own decisions than was the case in the control group. This evidence indicates that the number of criteria the subjects utilized in reaching their decisions was influenced by their senior executives. It also suggests that, when no consideration is given to placing specific relative weights on the criteria, the subjects were capable of utilizing as many as five criteria in arriving at decisions.

The evidence summarized above indicated that the subjects encountered perceptual and/or cognitive difficulties which prevented them from accurately incorporating the specified relative importance of organizational goals into their decision-making processes. As a result of this

evidence, the validity of the second assumption--that middle-level managers are capable of accurately perceiving and incorporating the importance of multiple organizational goals into their decision-making processes--seems questionable.

A possible explanation of the failure of the experimental subjects to accurately incorporate the relative importance of organizational goals specified by their senior executives into their own decision-making is provided by the Newell and Simon (1972) human information system model. The features of this model considered relevant to this study were summarized in Chapter II. The Newell and Simon human information system model makes use of the analogy between computer processing and human information processing. The human information processing system is considered to consist of receptors, which receive input from the environment, a processor, memory, and motor output via its effectors.

Newell and Simon (1972, pp. 787-809) characterized the human information processing system as an adaptive system that shapes itself to its environment during the problem-solving process. However, when the capabilities of the system are exceeded, adaptation breaks down, and

problems are solved inadequately or incompletely. One of the system's limiting characteristics that is believed to remain constant over different types of problems is the small capacity of short-term memory. The basic capacity of short-term memory is believed to be about five to seven chunks of information. However, almost all those tasks which require attention for their accomplishment contain elements which seem to subtract from the effective capacity of short-term memory.

The decision-making performance of the experimental subjects may be largely explained within the framework of the Newell and Simon human information processing model. When no consideration was given to placing specific relative weights on the criteria, the subjects were capable of utilizing five decision criteria. This corresponds with the believed capacity of short-term memory (around five to seven chunks of information). The subjects were able to shift the relative weights placed on four criteria in the direction of those specified. This suggests that associating numerical weights with the criteria decreased the effective capacity of short-term memory to about four chunks of information. The subjects were able to place approximately the same relative weights as those specified

on only two of the five criteria. This suggests that some element involved in the process of matching relative weights limits the effective capacity of short-term memory to about two chunks of information when exact relative weights are required to be used. It should be kept in mind that the evidence in this area should be considered as suggestive, rather than conclusive, as relatively little is known about human capabilities in the areas involved.

Summary of Findings

The research findings discussed above are briefly summarized below.

The evidence provided by the behavioral experiment supported the validity of the assumption that the decision-making behavior of middle-level managers is influenced by organizational goals whose importance is prescribed by their senior executives. Since the behavior predicted by this assumption may be considered a subset of that predicted by the Monsen and Downs (1965) theory, the empirical evidence also supports that portion of this theory which predicts the behavior of middle-level managers.

The evidence provided by the behavioral experiment contradicts the assumption that middle-level managers

are capable of accurately perceiving and incorporating the importance of multiple organizational goals into their decision-making processes. As a result, the validity of this assumption seems questionable.

Some Limitations upon the Findings

The research findings presented above must be interpreted with caution. The primary focus of the experimental design was upon achieving a high level of internal validity. However, since the subjects of the experiment were selected randomly from among the middle-level staff officers assigned to the Air Training Command headquarters, the results of the experiment may reasonably be considered as applicable to that organization.

From the results of the experiment, it seems apparent that the subjects were highly motivated to incorporate the relative importance of organizational goals specified by their senior executives into their own decision-making processes. The Monsen and Downs (1965) theory of large managerial firms contends that such behavior should be expected, and that relationships which normally exist within the environment of an organization act to motivate individuals in middle-management roles to exhibit

decision-making behavior in consonance with that specified by their senior executives. Although the results of the experiment support the Monsen and Downs (1965) predictions about middle-management decision-making behavior, this does not prove the generalizability of this theory. An alternate explanation might be to attribute the high level of motivation displayed by the subjects to favorable management practices which exist solely within the Air Training Command headquarters, or solely within the Air Force.

Although Newell and Simon (1972) presented a large body of empirical evidence which supports their theory of human information processing, they indicated that this evidence does not prove the generalizability of their theory. The evidence provided by this study adds to the available evidence which supports the Newell and Simon theory. However, the human limitations suggested by the perceptual and cognitive difficulties encountered by the subjects of the experiment must also be interpreted within the framework of the experiment. This evidence suggests that middle-level managers acting within an organizational environment would encounter similar difficulties, but it does not prove this would be the case.

Some Implications of the Research Findings

This section considers some possible implications of the research findings. These implications stem from the empirical evidence presented in evaluating the validity of the two major assumptions about middle-management decision-making this study investigated. They are general, rather than specific, in character. They involve the conceptual framework described by Anthony (1965), and consequently are related to the design of planning and control systems.

The Management Control Process

Anthony (1965, pp. 32-33) felt that the decision-making which occurs during the management control process is constrained by the framework of organizational goals and policies established during the strategic planning process. This generalization implicitly assumes that the decision-making behavior of an organization's middle-level managers is strongly influenced by goals and policies whose relative importance is prescribed by the organization's senior managers. The empirical evidence presented in this study supported the validity of this assumption. This

indicates that the management relationships Anthony thought to predominate during the management control process do exist in actual organizations. As a result, the research findings are considered to support Anthony's (1965, pp. 24-68) description of the management control process.

The Design of Management Control Systems

A management control system is that portion of an organization's planning and control system which focuses upon providing managers with information related to the management control process. Anthony (1965, pp. 113-114) felt the management control system to be the logical starting point when designing an organization's planning and control system, and that such a system should be designed to guide and assist managers to make decisions which are consistent with the primary goals of the organization. These generalizations about management control systems have been adopted for the discussion which follows.

Central Function of a Management Control System. Anthony concluded that the central function of an organization's management control system should be to

motivate managers to make decisions which are consistent with the goals of the organization (1965, p. 113). This opinion seems widespread (Becker and Green, 1962; Benston, 1963; Horngren, 1972, p. 171). It seems to be based on the belief that the primary reason why managers reach decisions which seem inconsistent with the goals of their organization is because they lack the motivation to make decisions which are consistent with their organization's goals. This position implicitly assumes that managers are capable of accurately incorporating the relative importance of multiple organizational goals into their decision-making processes. The empirical evidence presented in this study contradicts the validity of this assumption. This evidence indicates that, even though the experimental subjects exhibited the desire to incorporate the prescribed relative importance of organizational goals into their decision-making, they made substantial perceptual and/or cognitive errors when they attempted to do so.

With this evidence in mind, there seems little justification for concluding that, when middle-level managers make decisions which appear inconsistent with the goals of their organization, such decisions primarily result from a lack of motivation. Instead, an alternative

explanation is indicated. The research findings presented in this study suggest that it is more likely that such decisions result from the perceptual and/or cognitive limitations of these managers--that they are unable to incorporate the relative importance of organizational goals into their decision-making processes.

Let us consider the implications of adopting this alternative viewpoint. When this viewpoint is adopted, the designer of an organization's management control system would normally expect relationships to exist within the internal environment of the organization which act to motivate individuals in middle-management roles to make decisions which are consistent with the goals specified by top management. As a result, providing middle-level managers with motivation becomes a secondary aim when designing a management control system. Instead, the research findings presented in this study suggest that the central function of a management control system should be to provide managers with information which <u>enables</u> them to make decisions which are consistent with the primary goals of the organization. This means that the information provided to managers should be structured in such a way that it does not exceed their perceptual and/or cognitive capabilities.

Considering human limitations. The human limitations suggested by the perceptual and/or cognitive difficulties encountered by the experimental subjects during the decision-making task should be considered with caution. This evidence should be considered as suggestive, rather than conclusive, as relatively little is known about human capabilities in the areas involved. With this note of caution clearly in mind, let us now speculate how some of the perceptual and/or cognitive difficulties the subjects encountered might influence the design of a management control system.

The subjects made substantial errors when they estimated the relative importance their senior executives placed on the organization's goals from the feedback information which was provided to them. Yet, when this feedback information was perceived as meaningful (i.e., nonrandom), it significantly affected the subjects' decision-making behavior. These findings suggest that great care should be taken to make certain that middle-level managers understand exactly what is being communicated by the feedback information they receive. For example, it should be explained to a middle-level manager whose unit utilized excessive labor hours (and consequently incurred an unfavorable labor efficiency variance) that the decision which led

to this difficulty probably resulted from placing undue importance upon achieving a particular goal (e.g., product quality) and too little importance upon achieving some other goal (e.g., efficiency). If the relative importance placed on achieving these organizational goals is explained, the manager will have some basis for future decisions. It should not be assumed that he will be able to estimate these relationships accurately from feedback information which indicates unfavorable variances.

The experimental subjects were able to place approximately the same relative weights as specified on two decision criteria. In addition, they were able to shift the relative weights they placed on two additional criteria in the direction of the specified relative importance of organizational goals. This suggests that middle-level managers are probably capable of incorporating about four explicitly weighted organizational goals into their decision-making processes. The subjects, however, placed some (significant) relative weight on all five decision criteria when they perceived their senior executives to place some (significant) level of importance on all five organizational goals. This suggests that middle-level managers are capable of taking as many as five organizational

goals into some account in reaching their decisions--although perhaps only when no particular relative importance of organizational goals is specified. The exact number of goals they are capable of giving some level of consideration to is, of course, not known. The experimental subjects only had an opportunity to consider five organizational goals.

Since very large organizations sometimes have numerous goals, this suggests the possibility that only about four of an organization's goals should be considered as the primary goals of the organization, and that the remaining goals should be considered as secondary goals. The relative importance of only the organization's primary goals should be specified, and the managers of the organization should be expected to incorporate this relative importance of organizational goals into their decision-making. No particular relative importance should be specified for the secondary goals of the organization, and the managers of the organization would only be expected to place some (significant) relative weight on these goals in arriving at decisions.

The use of managerial decision models. Simon (1969, pp. 52-54) has suggested that human beings, when

viewed as behaving systems, are much simpler than has previously been believed. He proposed that many of the perceived complexities of human behavior are the result of the inability of individuals to completely adapt to complexities which exist in their environment. The theory of human problem solving proposed by Newell and Simon (1972, pp. 787-868) adopts this same approach.

Although situations frequently occur in actual organizations where multiple criteria must be considered in order to arrive at the best decision, the research findings presented in this study suggest that middle-level managers can only incorporate a small number of weighted criteria accurately into their decision-making processes. This suggests that if management decision-making is to be greatly improved in complex situations, an increased emphasis must be placed upon incorporating management decision models into the organization's management control system.

An American Accounting Association committee (Horngren, Anton, Bierman, Brooks, Firmin, Morse, Williams, and Zannetos, 1969) reviewed the standard managerial decision models most frequently incorporated into planning and control systems. The Committee indicated that, when

these models are correctly used, the decisions that are reached are more consistent with the organization's goals than those reached without such models. The Committee also indicated that a greater variety of such models should be expected to come into use in the future.

Although most of the managerial decision models considered by the Committee were fairly complex mathematical models, it should be kept in mind that managerial decision models need not be complex in order to be useful. Even fairly simple models seem to outperform human decision-makers. Dawes and Corrigan (1974) have pointed out that a large number of situations exist in which simple linear models consistently outperform human decision-makers. When multiple criteria are involved and when (1) the input variables have a conditionally monotonic relationship with the output variables, (2) there is error of measurement, and (3) small deviations from optimal weightings don't make large practical differences, then linear models consistently outperform human decision-makers.

A decision model should, in many instances, be used to structure information to facilitate the tasks of human decision-makers even in fairly simple decision-making situations. As an illustration of this, let us consider

how a linear model could be used to structure the performance evaluation information that was presented to the subjects during the experimental decision-making task that was used for the behavioral experiment.

The experimental subjects were asked to use information about five criteria to judge the overall performance of several hypothetical pilot training wings. In practice, the purpose of such a judgement would be to decide whether some corrective action might be required. For example, if a wing's performance was considered to be quite low, changes might be recommended in the wing's senior management personnel, or a staff assistance team might be dispatched from the headquarters to the wing's location until some deficiency was corrected. What is really needed in such a decision-making situation is an overall evaluation score for each wing which considers the relative importance of organizational goals specified by the senior executives of the organization.

The linear multiple regression equation that was used to calculate the feedback information (see Chapter II and Appendix C) that was provided to some of the subjects might also be used as a performance evaluation model for the hypothetical pilot training wings. With this model,

the human decision-maker would be required to specify what evaluation criteria should be used, and the relative importance to be placed on each of these criteria. The performance evaluation information for each of the criteria selected could be processed with a computerized management decision model (the linear multiple regression equation) which would then calculate an overall evaluation score for each of the wings.

The human decision-maker could base his decision about whether a wing's overall performance was poor enough to require corrective actions based upon the overall evaluation score provided by the management decision model. This example illustrates how a relatively simple managerial decision model might be used to structure information so that human decision-makers are provided with the information that enables them to make decisions which are consistent with the goals of the organization.

Summary of Research Implications

In general, the research findings tend to support the conceptual framework described by Anthony (1965). The empirical evidence provided by the behavioral experiment indicates that middle-level managers are strongly influenced

by organizational goals whose relative importance is prescribed by the senior managers of the organization. This indicates that the management relationships Anthony felt to predominate during the management control process actually do influence middle-management decision-making in real organizations.

The research findings do not, however, support Anthony's conclusion that the central function of an organization's management control system should be to motivate managers to make decisions which are consistent with the goals of their organization. Instead, the research findings suggest that motivation should be a secondary aim. The central function of a management control system should be to provide managers with information which enables them to make decisions in consonance with the primary goals of their organization. In order to do this, the organization's management control system should be designed to alleviate the perceptual and/or cognitive difficulties managers encounter when they attempt to incorporate multiple organizational goals into their decision-making processes.

The evidence about the perceptual and/or cognitive limitations of middle-level managers suggests that an increased emphasis should be placed upon incorporating

managerial decision models into the organization's planning and control system if management decision-making is to be substantially improved in complex situations. Managerial decision models need not be complex to be useful. Even simple linear models consistently outperform human decision-makers in many situations. Whenever possible, managerial decision models should be used to structure information so it is transformed into a form where in it can be effectively used by human decision-makers.

Further Research

The research findings presented in this study raise a number of questions which may be answered only with further research. This section will briefly consider some of these questions, along with the difficulties such research would involve.

The experimental subjects in the behavioral experiment this study described were all members of the same military organization. The results of this experiment were implicitly considered to be generalizable to other organizations when the implications of the research findings were described in the preceding section. Further research is needed to determine the degree to which this is actually

true. Such a research project would involve performing a number of experiments using the middle-level managers of a number of quite different organizations as experimental subjects. It would not be necessary to replicate the entire experiment performed here. Probably the posttest only-control group design described by Campbell and Stanley (1963, pp. 25-27) could be used instead. This experimental design would involve a considerable savings of time for the experimental subjects, as no pretest would be used. Accordingly, the experiment would only require about half as much time to complete as this one required.

Further research is also needed to determine more exactly what the perceptual and/or cognitive limitations of managers are. For example, would middle-level managers be capable of incorporating the specified relative importance of organizational goals into their decision-making behavior if only four organizational goals were involved? If not, then if only three organizational goals were involved? Probably some form of repeated measures experimental design could be used for such a study. The experimental subjects might be required to perform essentially the same experimental decision-making task--with a suitable time interval between performances--using a smaller number of decision criteria in each case until the exact number which could

be incorporated into the subjects' decision-making was determined. The results of such a study would have considerable practical usefulness, as it would allow the designers of management information systems to avoid providing a manager with information about more decision criteria than he was capable of incorporating into his decisions. Managers could also be made aware of their personal limitations with such an approach, and this would allow them to be aware of those situations where the use of some formal or informal managerial decision model was advisable.

Horngren (1972, pp. 155-156) has stated that an important function of an organization's planning and control system is to communicate the goals of the organization to its members, so that goal congruence is facilitated. The research approach described here might be used to determine if goal congruence exists within a particular organization. Essentially, this would involve using the primary goals of the overall organization as decision criteria in some decision-making task. The members of various management groups within the organization would be asked to complete this decision-making task, and the relative weights they placed on these goals during their decision-making could be calculated. If goal congruence existed within

the organization, then the members of the various management groups should be expected to place approximately the same relative weights on the organization's goals during the decision-making task.

The suggestions that have been presented above are indicative of the large number of studies which might be performed using the same general research approach that was used in this study. A strong note of caution should, however, be interjected at this point. The individual who contemplates using the research approach that was used for this study should examine his situation carefully. Some stringent requirements must be met if the computation of the relative importance of the decision variables is to be meaningful. If this calculation is to be correct, the variables that are used as decision criteria must be uncorrelated with each other (Ward, 1962; Darlington, 1968). It follows logically from this that these decision criteria should also be independent of each other. The first requirement may be met in an experimental study by deliberately choosing uncorrelated predictor vectors. The latter requirement, however, is difficult to comply with in most practical situations.

A P P E N D I C E S

A P P E N D I X A

THE EXPERIMENTAL MATERIALS

Copies of the materials used for the behavioral experiment are presented in this Appendix. During the pretest and posttest experimental tasks, the subjects were required to evaluate a number of hypothetical pilot training wings using the information indicated about whether the five decision criteria had been either satisfactorily or unsatisfactorily met. Since the criteria were categorized as either satisfactory or unsatisfactory, and five criteria were used, only 32 ($2^5 = 32$) distinct combinations of these criteria exist. In the experiment, all 32 instances were presented. However, only one instance is presented here for the pretest and one instance for the posttest in the interests of brevity.

CONTENTS

Name_____ AFSN_____

Rank_____ Date of Rank_____

Duty Title_____

Staff agency or directorate_____

_____

When assigned to Air Training Command headquarters?_____

_____

Previous assignment and major command_____

_____

ALL INFORMATION WILL BE KEPT CONFIDENTIAL!

The data gathered here will be analyzed statistically and summarized in a Ph.D. dissertation to be written by an Air Force officer studying under the Air Force Institute of Technology (AFIT) program. Permission has been obtained to collect this data. You will not be identified in the final report, and your identity will be kept confidential.

You are about to participate in an exercise designed to investigate certain aspects of your decision-making behavior. During the exercise, you will be asked to evaluate the overall performance of a number of hypothetical pilot training wings using only the information that is supplied to you. First, you will be informed whether each wing's performance was either "Satisfactory" or "Unsatisfactory" in each of five critical management areas. Next, using only the information that has been provided, you will be asked to evaluate each wing's overall performance.

If you wish, an analysis of your decision-making performance will be provided to you at a later date. Do you wish to have such an analysis provided to you? (Circle one) Yes No

INSTRUCTIONS

During the following exercise, you will be provided with information which indicates if each hypothetical pilot training wing satisfactorily or unsatisfactorily achieved each of the five management goals indicated below.

1. The average cost per pilot graduated.

2. The overall quality of the pilots graduated.

3. Attaining a highly competent all-volunteer force.

4. Compliance with Air Force and Air Training Command regulations and directives.

5. Attaining an effective aircraft maintenance program for the primary mission aircraft.

These five management goals are to be considered independent of each other. The satisfactory achievement of any single goal is in no way related to whether or not any of the other goals were satisfactorily achieved. You are to use only the information provided to you about these five management goals to categorize each wing's overall performance as one of the following.

1. Highly Satisfactory. Minor deficiencies exist. Some minor corrective action is needed.

2. Satisfactory. A few significant deficiencies exist. Some corrective action is needed. Some monitoring by Air Training Command staff is needed.

3. Unsatisfactory. Some major deficiencies exist. Immediate corrective action is required. Some on-site Air Training Command staff assistance is required. The replacement of at least one key member of management should be considered.

4. Highly Unsatisfactory. Many major deficiencies exist. Immediate corrective action is mandatory. Extensive on-site Air Training

Command staff assistance is mandatory. The replacement of at least one key member of management is recommended.

Refer to the example on the following page. If you have any questions, ask them of the person monitoring the exercise. You may refer backward to examine previously completed evaluations at any time during the exercise. However, you should not change an evaluation that has already been completed. You may remove this page and refer to it during the exercise if you wish.

OVERALL PERFORMANCE EVALUATION OF WING 9

S = Satisfactory U = Unsatisfactory

1. A Comand analysis was made of the relationship between total costs (including personnel costs and support costs) and the number of pilots produced. The average cost per pilot graudated by this Wing was evaluated as. . . . . S

2. The effectiveness of the academic and flying training programs was examined during an IG inspection. The overall quality of the pilots graduated by this Wing was evaluated as. . . . . U

3. A Command analysis was made of personnel programs aimed at developing a highly competent all-volunteer force. The effectiveness of such programs for this Wing was evaluated as. . . . . U

4. Compliance with Air Force and Air Training Command regulations and directives was examined during an IG inspection. This Wing's level of compliance was evaluated as. . . . . S

5. A Command inspection was made of the primary mission aircraft maintenance program. The effectiveness of all efforts in the Wing aimed at maintaining the primary mission aircraft in the best possible flying condition was evaluated as. . . . . U

The overall performance of this pilot training wing should be evaluated as:

Highly Unsatisfactory		Unsatisfactory		Satisfactory		Highly Satisfactory	

INSTRUCTIONS FOR PART TWO

You will perform the same decision-making task during the second part of the exercise as during the first part. Once again, you will evaluate the overall performance of a number of hypothetical pilot training wings using information supplied about five critical management goals.

INSTRUCTIONS FOR GROUP TWO

You will perform the same decision-making task during the second part of the exercise as during the first part. Once again, you will evaluate the overall performance of a number of hypothetical pilot training wings using information supplied about five critical management goals. However, this time you will also be provided some additional information which you may consider in arriving at your decisions.

Recent budget reductions have increased the importance placed upon efficiency and cost control within the Air Force. Similarly, the expiration of the draft law has increased the importance placed upon personnel programs aimed at attaining a highly competent all-volunteer force. During the following decision-making task, you are to consider that the senior executives of the Air Training Command have formulated specific policies in response to these and other factors in the Air Force environment. As a staff officer, you are expected to implement the policies of these senior executives.

Assume that you have received an official policy statement which directs that the relative importance to be placed upon each of the management goals indicated below is shown by the relative size of the numbers on the right, as follows:

Relative Importance of Management Goals

1.	The average cost per pilot graduated	25
2.	The overall quality of the pilots graduated	25
3.	Attaining a highly competent all-volunteer force.	20
4.	Compliance with Air Force and Air Training Command regulations and directives.	15
5.	Attaining an effective aircraft maintenance program for the primary mission aircraft.	15
	TOTAL	100

If you wish, you may remove this page and refer to it during the exercise which follows.

After you complete your evaluation of each of the following hypothetical pilot training wings, you may turn the page and find out how that wing was evaluated by the senior executives of the Air Training Command. You may consider this feedback information (if you wish to do so) in subsequent evaluations, but you may not change any evaluation that has already been completed. You should not, under any circumstances, look ahead to see how a wing was evaluated by the senior executives of the Air Training Command before you complete your own evaluation.

In summary, you will have two kinds of information available to you during the second part of the exercise that were not available during the first part. First, you will have an official policy statement which indicates the relative importance the senior executives of the Air Training Command place upon the five management goals. Second, immediately following your evaluation of each wing you will be provided feedback information which indicates how the senior executives of the Air Training Command evaluated that wing.

OVERALL PERFORMANCE EVALUATION OF WING 11

S = Satisfactory U = Unsatisfactory

1. A Command analysis was made of the relationship between total costs (including personnel costs and support costs) and the number of pilots produced. The average cost per pilot graduated by this wing was evaluated as . . . . . U

2. The effectiveness of the academic and flying training programs was examined during an IG inspection. The overall quality of the pilots graduated by this Wing was evaluated as. . . . . S

3. A Command analysis was made of personnel programs aimed at developing a highly competent all-volunteer force. The effectiveness of such programs for this Wing was evaluated as. . . . . S

4. Compliance with Air Force and Air Training Command regulations and directives was examined during an IG inspection. This Wing's level of compliance was evaluated as. . . . . S

5. A Command inspection was made of the primary mission aircraft maintenance program. The effectiveness of all efforts in the Wing aimed at maintaining the primary mission aircraft in the best possible flying condition was evaluated as. . . . . S

The overall performance of this pilot training wing should be evaluated as:

Highly Unsatisfactory		Unsatisfactory		Satisfactory		Highly Satisfactory	

Group #3 Feedback

The senior executives of the Air Training Command evaluated the overall performance of the preceding wing as:

Highly Unsatisfactory		Unsatisfactory		Satisfactory		Highly Satsifactory	

Group #4 Feedback

The senior executives of the Air Training Command evaluted the overall performance of the preceding wing as:

Highly Unsatisfactory		Unsatisfactory		Satisfactory		Highly Satisfactory	

Group #5 Feedback

The senior executives of the Air Training Command evaluated the overall performance of the preceding wing as:

Highly Unsatisfactory		Unsatisfactory		Satisfactory		Highly Satisfactory	

FEEDBACK INFORMATION

Considering only the feedback information you received after you evaluated each of the pilot training wings, which of the following statements best describes the manner in which the senior executives of the Air Training Command evaluated the wings? (Circle only one answer)

1. In general, the senior executives of the Air Training Command systematically incorporated the relative importance of management goals described in their policy statement into their actual evaluations.

2. In general, the senior executives of the Air Training Command systematically incorporated a different relative importance of management goals into their actual evaluations than was described in their policy statement.

3. In general, I could not perceive any meaningful pattern or systematic method about the manner in which the senior executives of the Air Training Command evaluated the wings.

Answer the question below only if you selected #2 above.

Considering only the feedback information you received after you evaluated each of the pilot training wings, indicate your opinion of the relative importance the senior executives of the Air Training Command placed upon each of the management goals when they evaluated the wings. Indicate the relative importance of each management goal by distributing 100 points over all five management goals in such a way that the more important goals receive the most points.

1. The average cost per pilot graduated. . . . . _____

2. The overall quality of the pilots graduated . . . . . _____

3. Attaining a highly competent all-volunteer force. . . . . _____

4. Compliance with Air Force and Air Training Command regulations and directives. . . . . _____

5. Attaining an effective aircraft maintenance program for the primary mission aircraft. . . . . _____

TOTAL 100

PLEASE!!

The results of exercises such as this one are changed if the individual who participates has any detailed knowledge in advance about how the exercise works. Many of your fellow officers will participate after you have finished, so please don't discuss any details of the exercise with them.

I honestly appreciate your participation. Many thanks.

ADRIAN M. HARRELL
(Major, USAF)

APPENDIX B

SUMMARY OF THE EXPERIMENTAL DATA

The information provided by the behavorial experiment is summarized in this appendix. In addition, some information about the experimental subjects is presented.

The relative weight each subject placed on each of the five decision criteria during both the pretest and posttest is presented for each of the five comparison groups. Each subject's squared multiple correlation coefficient for both the pretest and posttest is presented. Where appropriate, the answer each subject indicated to the questions after the posttest is shown. The relative weights which the subjects in Group Three perceived their senior executives to place on the five decision criteria are indicated.

The names of the subjects who participated in the behavorial experiment have been withheld. However, each subject's rank, flight rating, education level, duty unit, and military component are presented.

COMPARISON GROUP ONE

Relative Weights	Subject Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pretest Relative Weights															
Efficiency	11	10	02	08	14	02	09	04	01	06	02	01	16	11	05
Effectiveness (Pilot Quality)	56	58	43	30	20	66	41	40	58	26	52	94	45	31	41
Personnel Retention	04	10	02	19	18	09	09	06	07	04	02	01	02	06	13
Compliance with Directives	04	00	10	13	14	02	09	23	13	16	03	03	30	01	13
Aircraft Maintenance	25	22	43	30	34	21	32	27	21	48	41	01	07	51	28
Value of R^2	.95	.94	.88	.92	.91	.87	.85	.84	.93	.81	.85	.87	.98	.71	.83
Posttest Relative Weights															
Efficiency	08	09	01	04	27	00	07	10	01	08	02	00	16	03	06
Effectiveness (Pilot Quality)	56	58	41	45	23	66	44	40	58	29	42	99	45	35	38
Personnel Retention	01	09	00	09	10	15	07	10	06	04	03	00	02	29	14
Compliance with Directives	03	00	11	06	13	01	04	13	13	21	02	01	30	04	09
Aircraft Maintenance	32	24	47	36	27	18	38	27	22	38	51	00	07	29	33
Value of R^2	.95	.97	.92	.89	.84	.91	.89	.91	.93	.84	.93	.95	.98	.71	.84

COMPARISON GROUP TWO

Relative Weights	Subject Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pretest Relative Weights															
Efficiency	12	08	03	10	07	02	16	16	11	15	04	05	08	18	09
Effectiveness (Pilot Quality)	56	44	64	44	57	78	23	58	60	45	55	65	62	46	46
Personnel Retention	05	02	02	04	06	02	14	11	11	02	06	06	10	04	07
Compliance with Directives	06	11	07	15	03	02	14	04	09	17	14	03	12	07	12
Aircraft Maintenance	21	35	24	27	27	16	33	11	09	21	21	22	08	25	26
Value of R^2	.96	.88	.86	.98	.90	.92	.93	.95	.94	.92	.91	.93	.90	.89	.95
Posttest Relative Weights															
Efficiency	28	10	25	32	08	03	34	31	30	33	14	18	25	30	39
Effectiveness (Pilot Quality)	36	51	44	32	51	69	38	27	43	33	31	53	46	30	40
Personnel Retention	21	07	25	12	14	05	15	20	09	25	03	17	21	15	18
Compliance with Directives	06	07	03	12	03	07	07	11	09	07	26	02	06	10	02
Aircraft Maintenance	09	25	03	12	24	16	06	11	09	02	26	10	02	15	01
Value of R^2	.94	.92	.82	.98	.91	.92	.92	.97	.94	.91	.60	.80	.84	.96	.96

COMPARISON GROUP THREE

Relative Weights	Subject Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pretest Relative Weights															
Efficiency	17	28	00	01	21	08	07	00	01	05	00	06	38	19	15
Effectiveness (Pilot Quality)	36	24	60	35	21	44	32	51	78	74	63	78	30	66	42
Personal Retention	12	16	05	06	21	06	21	07	16	02	02	05	18	10	18
Compliance with Directives	20	04	04	13	21	05	15	10	02	05	14	03	10	03	10
Aircraft Maintenance	15	28	31	45	16	40	24	32	03	14	21	08	04	02	05
Value of R^2	.94	.90	.82	.84	.94	.85	.94	.84	.93	.85	.85	.98	.96	.88	.93
Posttest Relative Weights															
Efficiency	27	28	28	12	31	16	33	26	04	23	49	38	32	27	23
Effectiveness (Pilot Quality)	27	28	40	41	31	43	25	30	62	39	20	26	26	45	32
Personnel Retention	30	20	14	15	18	27	22	20	32	27	14	18	26	24	31
Compliance with Directives	07	09	10	09	10	04	13	13	01	06	08	11	08	03	08
Aircraft Maintenance	07	15	08	23	10	10	07	11	01	05	09	07	08	01	06
Value of R^2	.97	.96	.97	.88	.96	.84	.92	.97	.92	.95	.85	.94	.98	.93	.95
Questions after Posttest	1	1	2	1	1	1	1	1	3	1	1	1	2	1	1

COMPARISON GROUP FOUR

Relative Weights	Subject Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pretest Relative Weights															
Efficiency	07	19	22	09	03	08	04	14	05	23	02	27	01	15	16
Effectiveness (Pilot Quality)	62	36	29	48	68	49	48	37	38	18	92	39	60	44	63
Personnel Retention	02	06	08	01	09	14	02	05	05	18	00	09	06	15	06
Compliance with Directives	01	13	12	36	15	11	04	20	28	06	01	05	21	08	09
Aircraft Maintenance	28	26	29	06	05	18	42	24	24	35	05	20	12	18	06
Value of R^2	.91	.89	.70	.70	.83	.89	.88	.92	.89	.76	.98	.97	.78	.95	.80
Posttest Relative Weights															
Efficiency	02	07	40	14	01	13	07	23	03	34	01	08	06	27	03
Effectiveness (Pilot Quality)	84	60	40	63	94	48	51	38	90	34	94	80	79	36	84
Personnel Retention	02	13	08	07	03	16	02	23	02	15	01	05	06	17	05
Compliance with Directives	03	04	08	14	01	03	00	07	02	10	02	02	06	09	06
Aircraft Maintenance	09	16	04	02	01	20	40	09	02	08	02	05	03	11	02
Value of R^2	.95	.93	.89	.85	.97	.90	.90	.95	.94	.92	.98	.97	.93	.97	.91
Questions after Posttest	2	2	1	2	1	2	2	2	2	2	2	2	2	2	2
Perceived Relative Weights															
Efficiency	12	10		20		10	30	15	05	15	10	10	05	20	10
Effectiveness (Pilot Quality)	50	50		60		60	40	40	80	35	60	60	70	50	75
Personnel Retention	11	10		03		08	07	15	05	10	10	15	05	05	05
Compliance with Directives	15	05		07		07	08	15	05	15	10	05	10	05	05
Aircraft Maintenance	12	25		10		15	15	15	05	25	10	10	10	20	05

COMPARISON GROUP FIVE

Relative Weights	Subject Number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pretest Relative Weights															
Efficiency	19	20	04	33	04	10	08	21	08	10	06	02	02	03	14
Effectiveness (Pilot Quality)	36	20	80	37	51	35	53	16	62	43	58	55	58	76	69
Personnel Retention	16	20	06	10	02	19	05	21	05	30	22	05	08	04	06
Compliance with Directives	10	20	04	10	11	10	12	21	02	10	03	07	14	04	05
Aircraft Maintenance	19	20	06	10	32	26	22	21	23	07	11	31	18	13	06
Value of R^2	.91	.98	.90	.99	.91	.87	.94	.94	.94	.87	.96	.82	.87	.86	.96
Posttest Relative Weights															
Efficiency	23	60	11	23	28	33	14	34	13	37	31	05	02	11	29
Effectiveness (Pilot Quality)	37	09	66	37	31	28	54	13	62	37	27	74	59	51	38
Personnel Retention	15	01	08	23	15	10	09	27	09	14	23	05	13	13	25
Compliance with Directives	10	29	04	07	15	14	09	13	03	07	08	05	09	06	05
Aircraft Maintenance	15	01	11	10	11	15	14	13	13	05	11	11	17	19	03
Value of R^2	.92	.46	.86	.89	.95	.81	.94	.94	.95	.90	.96	.95	.84	.93	.98
Questions after Posttest	3	1	3	3	3	2	3	3	3	3	3	3	3	2	2

INFORMATION ABOUT THE SUBJECTS

GROUP ONE

Subject	Rank	Flight Rating	Education Level	Duty Unit	Component
1	04		B	DP	R
2	05		B	XP	R
3	03		M	RS	V
4	03		B	TT	V
5	03		B	TT	R
6	04		M	IG	R
7	03		B+	IG	V
8	04	P	B	DO	R
9	03		M	LG	R
10	05		P	JA	R
11	04		B	TT	R
12	04	P	M	IG	R
13	04	P	H+	DO	R
14	04	P	B	DP	R
15	04		B+	RS	R

Key to symbols used is on pages 267-268.

INFORMATION ABOUT THE SUBJECTS

GROUP TWO

Subject	Rank	Flight Rating	Education Level	Duty Unit	Component
1	04		M	XP	R
2	04		M	TT	R
3	04		M	TT	V
4	03		M	TT	R
5	04	P	M	TT	R
6	04	P	B	LG	R
7	04		B	LG	R
8	03		B	XP	R
9	03		B	LG	V
10	03		M	DE	R
11	03		M	IG	R
12	03		B+	IG	R
13	03	P	B	TT	V
14	04		B	TT	V
15	04	P	B	AC	R

Key to symbols used is on pages 267-268.

INFORMATION ABOUT THE SUBJECTS

GROUP THREE

Subject	Rank	Flight Rating	Education Level	Duty Unit	Component
1	03		M	AC	R
2	05		M	DP	R
3	04		B	TT	R
4	03		B	TT	V
5	04		B	TT	R
6	03		B	RS	R
7	05		M	DE	R
8	02		B	TT	V
9	04		M	IG	R
10	04	P	B	DO	R
11	03		B	LG	R
12	05		B	FA	R
13	04	P	B	XP	R
14	04	N	B	DP	R
15	03	P	B	DO	R

Key to symbols used is on pages 267-268.

INFORMATION ABOUT THE SUBJECTS

GROUP FOUR

Subject	Rank	Flight Rating	Education Level	Duty Unit	Component
1	04	N	M	AC	R
2	05		B	DP	R
3	04	N	M	DP	R
4	03	P	B+	XP	R
5	04		B	TT	R
6	03		M	DE	R
7	03	N	B+	DP	R
8	03		M	XP	R
9	02		M	AC	V
10	03		M	DP	R
11	03		B	LG	R
12	04		M	IG	R
13	03	P	B	IG	R
14	04		B+	RS	R
15	03	P	B	IG	R

Key to symbols used is on pages 267-268.

INFORMATION ABOUT THE SUBJECTS

GROUP FIVE

Subject	Rank	Flight Rating	Education Level	Duty Unit	Component
1	05	P	B	AC	R
2	05		M+	DP	V
3	03		M	XP	V
4	05	N	B	XP	R
5	03	N	M	TT	R
6	03		B	TT	R
7	04		B	IG	R
8	02		B	LG	R
9	04		M	IG	R
10	03	P	P	IG	R
11	05		M	DE	R
12	05		H+	LG	R
13	04	P	B	XP	R
14	04		M+	DO	R
15	05	P	B	DO	R

Key to symbols used is on pages 267-268.

KEY TO SYMBOLS USED

Rank	
01	Second Lieutenant
02	First Lieutenant
03	Captain
04	Major
05	Lieutenant Colonel
Flight Rating	
Blank	Not a flying officer
P	Pilot
N	Navigator
Education Level	
H	High School Graduate
H+	Some college work
B	Bachelor's Degree
B+	Some graduate work
M	Master's Degree
M+	Some work towards doctorate
P	Ph.D. or equivalent

Duty Unit	
AC	Comptroller
DA	Administration
DE	Civil Engineering
DO	Operations
DP	Personnel
FA	Foreign Military Affairs
IG	Inspector General
JA	Staff Judge Advocate
LG	Logistics
OI	Office of Information
RS	Recruiting Service
TT	Technical Training
XP	Plans

Component	
R	Regular Officer
V	Reserve Officer

A P P E N D I C C

THE FEEDBACK INFORMATION

The members of Groups Three, Four, and Five were provided feedback information about the decision-making of their senior executives during the posttest decision-making task. This appendix describes how this feedback information was determined.

The same linear multiple regression model that was used to analyze the decision-making behavior of the experimental subjects was also used to calculate the feedback information provided to the members of Groups Three and Four. The members of Group Five were provided with random feedback information.

The model used to determine the feedback information for Groups Three and Four is shown below.

$$Y_m = \bar{b}_{m1}X_1 + \bar{b}_{m2}X_2 + \bar{b}_{m3}X_3 + \bar{b}_{m4}X_4 + \bar{b}_{m5}X_5$$

Where---

Y_m = The overall performance evaluation score awarded a hypothetical pilot training wing when a particular relative importance of decision variables is specified.

$\bar{b}_{mi}$ = The coefficient, or raw weight, associated with each of the independent variables in the linear multiple regression equation.

X_i = The decision variable $\underline{i}$, represented by independent variable $\underline{i}$ in the linear multiple regression equation.

If the numerical values for the coefficients ($\bar{b}_{mi}$) and the independent variables (X_i) are either known or may be determined, these numerical values may be substituted into the equation shown above and the dependent variable, Y_m, may be determined routinely. Under the special circumstances of the behavorial experiment this study reports on, the independent variables (X_i) are known, and the coefficients ($\bar{b}_{mi}$) may be calculated. Let us consider the numerical values to be substituted into the equation for the independent variables (X_i) first.

The independent variables in the equation shown above represent the five decision criteria used for evaluating the overall performance of the 32 hypothetical pilot training wings the subjects evaluated during the pretest and posttest. In each decision-making situation--when the overall performance of a hypothetical pilot training wing was evaluated--each of the five decision criteria was categorized as having been met either satisfactorily or unsatisfactorily. (See Appendix A for an example wing.) This information may be quantified by representing "satisfactory" with a "1" and "unsatisfactory" with a "0." Since these values are known for each

of the hypothetical pilot training wings, a "1" may be substituted into the equation above for the independent variable (X_i) when that decision criterion was categorized as "satisfactory" and a "0" may be substituted into the equation when that criterion was categorized as "unsatisfactory."

The numerical values to be substituted into the equation for the coefficients ($\tilde{b}_{mi}$) must be calculated. Fortunately, as pointed out by Darlington (1968), the dependent variable may be determined even if only the relative values of the coefficients are available, and these relative values are proportional to the individual correlation coefficients (r_{mi}) associated with each of the independent variables (X_i). As a result, the approach taken here involves first determining the individual correlation coefficients (r_{mi}) and then determining the values to be substituted into the equation for the coefficients.

The explanation presented below is dependent upon certain linear multiple regression model relationships that have been described in detail by Darlington (1968). Four prerequisite conditions are involved: (1) The independent variables must not be influenced by the dependent variable; (2) the independent variables must be uncorrelated with each other; (3) the squared multiple correlation

coefficient must equal one ($R^2 = 1.0$); and (4) the numerical values involved must be either positive or zero values.

If conditions (1) and (2) have been met, the relative importance of a variable is indicated by the formula for the relative weight of a variable presented by Hoffman (1960). (This topic is discussed in more detail in Chapter II of this study.) This formula is shown below.

$$RW_i = \frac{r_{mi} \; b_{mi}}{R^2}$$

Where--

r_{mi} = The individual correlation coefficient expressing the relationship between the dependent variable (Y_m) and the independent variable (X_i).

b_{mi} = The standard regression coefficient (beta weight) associated with the independent variable X_i.

R^2 = The squared multiple correlation coefficient.

Darlington (1968) has indicated that when conditions (1) and (2) above have been met, then--

$$r_{mi} = b_{mi}$$

Therefore--

$$RW_i = \frac{b_{mi}^2}{R^2}$$

If, in addition to conditions (1) and (2), condition (3) is met and $R^2 = 1.0$ then--

$$RW_i = b_{mi}^2$$

If, in addition to conditions (1), (2), and (3) above, the numerical values involved are either positive values or zero values, then--

$$r_{mi} = \sqrt{b_{mi}^2}$$

and therefore--

$$r_{mi} = \sqrt{RW_i}$$

All four of the prerequisite conditions mentioned above are met in regards to using the linear multiple regression equation to determine the feedback information provided to the subjects of Groups Three and Four. Consequently, since the relative importance of a variable is synonomous with its relative weight, the relative values of the coefficients ($\tilde{b}_{mi}$) may be calculated when the relative importance of the decision variables is specified. As an example, the overall evaluation provided to the members of Group Three feedback information will be calculated for hypothetical pilot training wing 11 of Appendix A.

The relative importance of decision criteria used to determine the feedback information provided to the members of Group Three is shown below.

1.	Efficiency	.25
2.	Effectiveness (pilot quality)	.25
3.	Personnel Retention	.20
4.	Compliance with Directives	.15
5.	Aircraft Maintenance	.15
		1.00

Since these values are equivalent to relative weights, they may be substituted into the equation shown below.

$$r_{mi} = \sqrt{RW_i}$$

This yields the individual correlation coefficients of the five independent variables shown below.

$$r_{m1} = .50$$

$$r_{m2} = .50$$

$$r_{m3} = .45$$

$$r_{m4} = .39$$

$$r_{m5} = .39$$

The relative values of these individual correlation coefficients are proportional to the relative values of the regression coefficients ($\bar{b}_{mi}$). Consequently, they may be expressed as relative values using the eight-point scale used to evaluate the hypothetical pilot training wings, as shown below.

r_{m1}	=	.50	$\bar{b}_{m1}$	=	1.8
r_{m2}	=	.50	$\bar{b}_{m2}$	=	1.8
r_{m3}	=	.45	$\bar{b}_{m3}$	=	1.6
r_{m4}	=	.39	$\bar{b}_{m4}$	=	1.4
r_{m5}	=	.39	$\bar{b}_{m5}$	=	1.4
		2.23			8.0

After the numerical values of the coefficients have been determined, the calculations involved in order to determine the dependent variable are routine. Using example wing 11 in Appendix A, for each decision criterion categorized as "satisfactory" a "1" is substituted in place of the appropriate independent variable (X_i). For each decision criterion categorized as "unsatisfactory" a "0" is substituted in place of the appropriate independent variable (X_i). When the values for the coefficients (b_{mi}) shown above have also been substituted into the linear multiple regression equation, we have the results indicated below.

$$Y_m = 1.8(0) + 1.8(1) + 1.6(1) + 1.4(1) + 1.4(1)$$
$$= 6.2$$

This same procedure may be applied for each of the 32 hypothetical pilot training wings in order to determine the evaluation scores provided as feedback information to the members of Group

Three. These numerical values, which are significant to one digit to the right of the decimal, may be regressed against the same independent variables. If this is done, $R^2 = 1.0$, and the calculated relative weights for each of the independent variables are equal to the numerical values indicated above as the relative importance of the decision criteria. However, if the calculated evaluation scores are rounded to the one-digit accuracy of the eight-point scale used for evaluating the hypothetical pilot training wings, slightly different results are obtained. In this case, $R^2 = .99$, and the calculated relative weights are those shown below.

1.	Efficiency	.26
2.	Effectiveness (pilot quality)	.26
3.	Personnel Retention	.20
4.	Compliance with Directives	.14
5.	Aircraft Maintenance	.14
		1.00

Since the relative weights shown above were obtained using the same scale the experimental subjects used in arriving at their decisions, these relative weights were considered the appropriate relative weights to be used when comparisons were made. However, using these numerical values in place of those indicated earlier did not change the evaluation of any of the hypotheses considered in this study.

The feedback information provided to the members of Group Four was determined in the same manner as that described above for the members of Group Three. The relative importance of decision criteria used for this determination is indicated in Figure 3.3 of Chapter III. The effects of rounding the calculated evaluation scores to one-digit accuracy was also noticeable in Group Four. The calculated relative weights when the evaluation scores were rounded to one-digit accuracy are shown below.

1.	Efficiency	.02
2.	Effectiveness (pilot quality)	.92
3.	Personnel Retention	.02
4.	Compliance with Directives	.02
5.	Aircraft Maintenance	.02
		1.00

Once again, it was considered appropriate to use these relative weights in those instances when comparisons were made.

The feedback information provided to the members of Group Five was obtained by translating numbers from a table of random digits into evaluation scores. No calculations were involved.

The feedback information, along with the independent variables, for all three groups is shown in Figure C.1.

FIGURE C.1

FEEDBACK EVALUATION SCORES

Wing	Group Three	Group Four	Group Five	X_1	X_2	X_3	X_4	X_5
1	3	2	2	1	0	0	0	1
2	6	7	7	0	1	1	1	1
3	3	2	5	1	0	1	0	0
4	1	1	8	0	0	0	1	0
5	5	6	5	1	1	0	1	0
6	2	1	7	0	0	1	0	0
7	5	2	8	1	0	1	1	0
8	5	6	2	0	1	1	0	1
9	3	2	6	1	0	0	1	0
10	2	5	1	0	1	0	0	0
11	5	6	2	1	1	0	0	1
12	4	2	8	0	0	1	1	1
13	3	6	3	0	1	0	0	1
14	5	2	3	1	0	1	0	1
15	2	1	7	1	0	0	0	0
16	7	7	1	1	1	1	0	1
17	3	6	6	0	1	1	0	0
18	7	7	6	1	1	1	1	0
19	3	6	2	0	1	0	1	0
20	3	2	6	0	0	1	1	0
21	5	6	2	0	1	0	1	1
22	8	8	8	1	1	1	1	1
23	3	2	4	0	0	1	0	1
24	4	6	3	1	1	0	0	0
25	5	6	5	0	1	1	1	0
26	1	1	3	0	0	0	0	1
27	3	2	7	0	0	0	1	1
28	5	2	7	1	0	0	1	1
29	1	1	3	0	0	0	0	0
30	6	3	5	1	0	1	1	1
31	5	6	2	1	1	1	0	0
32	6	7	7	1	1	0	1	1

Some comments are appropriate in order for the information presented in Figure C.1 to be best understood. The order in which the wings are presented is that used during the pretest, when only 32 decisions were required of the subjects. In order for an individual to derive useful knowledge from feedback information, a learning process which involves observing several instances in which the feedback information differs from the individual's own judgment must take place. In order to facilitate this process during the posttest, nine wings for which the feedback information provided to the members of Groups Three and Four differed most were selected for special attention. These nine wings were presented initially, and then the 32 wings indicated above were presented. The randomized order in which the nine wings selected for initial presentation were presented was as follows: Wing 13; Wing 19; Wing 24; Wing 30; Wing 7; Wing 14; Wing 23; Wing 17; and Wing 10. All wings were renumbered, so the wings presented during the posttest were numbered one through 41. Although the subjects made 41 decisions during the posttest, the initial nine decisions were presented solely to facilitate the learning process described above, and the analysis was based on the 32 wings shown above.

The categorization of the independent variables (X_1, X_2, X_3, X_4, and X_5) is also shown above. A categorization of "satisfactory" is indicated by a "1" in the appropriate vector, and a categorization of "unsatisfactory" is indicated by a "0."

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