PERSONALITY AND DECISION BEHAVIOR

APPROVED:

[Signatures]

Major Professor
Z L Acheson

Minor Professor

Director of the Department of Education and Psychology
Robert Foulmuse

Dean of the Graduate School
PERSONALITY AND DECISION BEHAVIOR

THESIS

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

Jerry Paul Scarborough, B. A.
Denton, Texas
August, 1969
TABLE OF CONTENTS

LIST OF TABLES ......................................................... iv
LIST OF ILLUSTRATIONS ............................................... v

Chapter

I. INTRODUCTION ...................................................... 1
II. THEORETICAL BACKGROUND ........................................ 9
III. PERSONALITY AND DECISION EXPERIMENTS ..................... 21
IV. THE MODIFIED TWO-CHOICE EXPERIMENTAL DESIGN ............. 27
V. METHODOLOGY AND RESULTS OF THE EXPERIMENT ............... 38
VI. DISCUSSION OF EXPERIMENTAL FINDINGS ..................... 51

BIBLIOGRAPHY .......................................................... 73
LIST OF TABLES

Table                                         Page

I. Acquisition and Utilization Possibilities  31
II. Summary of the Results of the Multiple Correlation Analysis  48
III. Summary of the Results of the Multiple Regression Analysis  50
IV. Personality Characterizations of Individuals at the Extremes of the Decision Behavior Continua  54
# LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A Diagrammatic Illustration of a</td>
<td>Simple Two-choice Situation</td>
<td>12</td>
</tr>
<tr>
<td>2. The Expected Value in the Two-choice</td>
<td>Illustration as a Function of the</td>
<td>14</td>
</tr>
<tr>
<td>2. The Expected Value in the Two-choice</td>
<td>Response Probability Associated with choosing the More Frequent Event</td>
<td></td>
</tr>
<tr>
<td>3. The Total Subjective Expected Utility</td>
<td>and Its Two Components Shown as a Function of p</td>
<td>17</td>
</tr>
<tr>
<td>5. Dial Settings on the Three-source</td>
<td>Information Box</td>
<td>39</td>
</tr>
<tr>
<td>6. Diagram of a Binary-choice Situation</td>
<td>with Reinforcement</td>
<td>62</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

For a number of years, there have been two major approaches to the study of human decision-making behavior. Investigators in the field of economics have tended to approach the problem from the standpoint of game theoretic considerations. Since their primary interest has been the testing of assumptions or predictions of the theory, they have tended to focus on the product of decision-making, the decision itself, rather than the process that precedes the decision. Experimental psychologists, on the other hand, have tended to view decision behavior from the standpoint of statistical learning theory, with major emphasis upon the learning processes operating within the decision-maker.

More recently, a number of investigators have developed theoretical models of decision-making which are based upon conceptual considerations encompassing both learning and game theory. This combined approach, which considers choice behavior as a function both of objective situational conditions and subjective learning conditions, has provided considerable insight into choice behavior. Unexplained differences are, however, often observed in the behavior
of individuals under the same decision-making conditions. These differences may suggest the influence of additional factors in the decision-making process. For this reason, a consideration of personality variables seems relevant not only to the investigation of possible sources of this unexplained variation, but also to the pursuit of a broader understanding of the nature of decision-making processes.

The purpose of this study is to investigate the relationship between personality and certain characteristics of decision-making behavior in a modified two-choice probability learning situation. More specifically, this study addresses itself to the following questions: (1) Can personality correlates of the decision-making process be demonstrated? (2) Are personality factors related to individual differences in maximizing tendency, risk-taking, and decisiveness? (3) If such relationships exists, how do they fit into the framework of existing decision-making theory?

The first major assumption of this investigation is that decision behavior in a two-choice experiment is a function of prior response and prior reinforcement. The second major assumption is that rationality of choice is a function of two factors. The first factor is information concerning which of the two choices is the most probable. Such information may be gained through probability learning based on prior response and prior reinforcement, or by providing the
subject with this information, or both. The second factor involves personality variables operating within the individual making the choice decisions. Such variables determine, at least in part, how the information concerning choice probability is utilized in the decision-making process.

The present study focuses on the personality variables that influence the degree of rationality from the standpoint of maximizing tendency, risk-taking, and degree of decisiveness. "Personality" is operationally defined in this study as that set of traits measured by eleven experimental scales of the *Minnesota Multiphasic Personality Inventory* (MMPI) and the four scales of the *Gordon Personal Profile* (GPP).

This investigation deals with probability learning in a two-choice experimental situation. The basic design of this type of binary choice experiment, where only one of two choices is correct, is a variation of the classic experimental situation devised by Humphreys in 1939 (4). Briefly, the experiment uses a series of plusses and checks which the subject is asked to predict. The two symbols, either + or V, are printed on glass slides and placed in a slide projector tray in a random order, with the probabilities of occurrence of each symbol being selected by the examiner. The subject simply predicts which of the two symbols will be next projected. As soon as a prediction is made, the symbol is projected, revealing whether the
prediction was correct or incorrect. The subject is given a monetary reward for each correct prediction.

During the course of a series of trials, subjects are provided an opportunity to learn the nature of the probabilities of the two symbols on the basis of prior response and prior reinforcement. Once this learning has occurred, it might be expected that subjects would tend to conform to a normative model of rational choice in their predictions. That is, a given subject might be expected to tend toward the selection of the higher probability symbol on each trial, once the identity of the most probable symbol was learned. (A normative model would suggest the selection of the most probable symbol on every trial.) However, this expectation has not been confirmed. Previous binary-choice experiments have shown that even when subjects were made aware of the random nature of the event series, their selections did not conform to the normative model prediction (1, 3). One interpretation of this finding is that in these experiments rationality in choice decisions was influenced by some factor, or factors, in addition to probability learning through prior response and reinforcement. This observation led to the first of two experiments which preceded the present investigation.

The initial investigation (2) utilized an experimental design similar to that previously described, but involving an important innovation. Information concerning probabilities
of occurrence of the two symbols was given to the subject in the form of messages printed on cards. The number of messages (and, therefore, the amount of information) was systematically varied among several groups of subjects. It was hypothesized that the more information given a decision-maker, the more likely he is to make a series of rational decisions. Rationality was conceived in terms of a normative model, such that a subject predicting the most probable symbol on every trial was said to demonstrate completely rational decision behavior. The fewer the predictions of the most probable symbol, the less rational the decision behavior.

The results of the experiment indicated that

... even if subjects are aware of the randomness of symbol occurrence, they do not make predictions which are consistent with the normative model. Rather than adopting a pure strategy by predicting the most probable symbol on every trial, subjects tend to employ a mixed strategy .... Subjects seem to be influenced by symbol probability information, but there is considerable evidence of irrational behavior in terms of the normative model. (2, p. 5)

In general, subjects who received information predicted the most probable event more often than those receiving no information, but marked variations in rationality of decision were found to occur within groups.

This finding of intrasubject variation in degree of rationality of decision within groups receiving the same amount of information caused the investigators to speculate that personality might play an important role in choice
decisions. This speculation led to a second investigation which took the form of a pilot study (5) in which an attempt was made to identify the relevant personality variables and to correlate them with specific decision behavior sets, or strategies. The experimental design was identical in form to that of the first investigation, except that MMPI scores were obtained for each subject. Attempts to demonstrate personality correlates of decision behavior were unsuccessful. Personality seemed not to be related to the end product of choice behavior. However, certain individual differences in decision making were observed which were not reflected in the experimental data, i.e., the series of recorded choices. One observation was that subjects seemed to vary considerably in the degree of decisiveness associated with choosing. Some subjects progressed through the series of trials at a fairly rapid, even pace, making predictions in a confident manner. Other subjects labored through the series with much hesitancy and uncertainty in their decision making.

In addition, subjects reported differences in the degree to which they engaged in risk-taking. Some subjects stated that they always attempted to follow the information given in the messages, but others reported that they tended to disregard this information, preferring instead to base their predictions on "hunches." Even though risk conditions were not included in the experimental situation, subjects seemed to project their own risk-taking attitudes onto the
objective situation, some behaving as if to assume risk, and others behaving as if to avert risk. Thus, it was recognized that differences in decisiveness and perceived risk might represent the influence of personality on decision-making.

These observations led to the speculation that if personality factors influence decision making, this influence is exerted during the process of deciding between alternatives; it is not revealed in the series of recorded choices simply because it is masked by other subjective factors, such as those associated with learning. Even though personality correlates of decisiveness, risk-taking, and maximizing tendency were considered likely, further efforts to identify them were futile. Because of design inadequacies, data relating to the degree of decisiveness, degree of risk assumption, and degree of maximizing tendency could not be obtained from the experiment. Attempts to correct these inadequacies led to the development of the present design modification, based on certain conceptual considerations presented below. A brief historical view of decision behavior research facilitates the development of these concepts.
CHAPTER BIBLIOGRAPHY


5. Schkade, L. L., and J. P. Scarborough, "Personality Correlates of Decision Making," unpublished pilot study, Department of Business Administration, North Texas State University, Denton, Texas, December, 1967.
CHAPTER II
THEORETICAL BACKGROUND

Widespread interest in decision behavior began in 1944 as an outgrowth of the development of game theory by Von Neumann and Morgenstern (9). In essence, this theory is applied to well defined conflict situations and attempts to prescribe rules of behavior which result in the most favorable outcome. As Simon states it:

It was shown by Von Neumann and Morgenstern, as a byproduct of their development of the theory of games, that if the choice situation were extended to include choices among uncertain prospects—among lottery tickets, say—cardinal utilities could be assigned to the outcomes in an unequivocal way. Under these conditions, if the subject's behavior was consistent, it was possible to measure cardinally the utilities that different outcomes had for him.

A person who behaved in a manner consistent with the axioms of choice of Von Neumann and Morgenstern would act so as to maximize the expected value—the average, weighted by the probabilities of the alternative outcomes of a choice—of his utility. The theory could be tested empirically, however, only on the assumption that the probabilities assigned to the alternatives by the subject were identical with the "objective" probabilities of these events as known to the experimenter. (7, p. 204)

Numerous investigations based on game theory and related principles have examined decision behavior under various situational conditions, such as risk, certainty of outcome, and uncertainty of outcome. Typically, behavior is
predicted on the basis of normative probabilities, utilizing an assumption of objective rationality, generally referred to as "maximization of expected utility." According to this view of rationality, provided that the relationship between alternatives and outcomes is known, the decision maker always chooses the alternative offering the highest payoff. To the extent that he does not follow this utility principle, his choice behavior is considered irrational, therefore unpredictable.

In contemporary psychology, interest in choice behavior as a stochastic process followed the development of statistical learning theory principles by William K. Estes, in 1950 (4), and later, by Bush and Mosteller (1). The statistical treatment of learning behavior derives its qualitative orientation from behavioral psychology and utilizes five basic concepts of association psychology to develop a quantitative approach. The five concepts include the three categories of stimulus, response, and reinforcement, and the two processes of stimulus conditioning and stimulus sampling (6).

Application of probability learning principles to decision processes in a game theoretic context led to the development of probabilistic models of decision making embodying the concept of maximization of subjective expected utility, or SEU (2, 3). In contrast to the earlier utility principle, this subjective approach to utility views
rationality from a subjective, rather than objective, standpoint. That is, rationality of choice behavior is defined, not from the actual conditions concerning alternatives and outcomes, but from the subjective perception and evaluation of these conditions.

The inclusion of subjective utility in probability learning models has led to better understanding of decision-making processes. In addition, choice behavior predicted by such models corresponds more closely to observed behavior. Variability in choice behavior between individuals exposed to the same experimental conditions is commonly observed. From the standpoint of both the game theoretic approach and the statistical learning approach, such variability is considered as error. However, decision-making theories incorporating SEU principles can account for part of this variability, thus, reducing the error term.

Because of its relevance to this investigation, the decision-making theory developed by Siegel bears further consideration. The basic concepts of the theory can best be demonstrated in a two-choice probability learning situation by comparing the choice behavior predictions of the Siegel model with those of the utility (game theoretic) model and the Estes (probability learning) model. The simple two-choice situation may be represented diagrammatically, as shown in Figure 1.
In such a situation, the subject is asked to predict the occurrence of two mutually exclusive events. The two events, $E_1$ and $E_2$, occur with fixed but unequal probabilities $\pi$ and $1-\pi$, and are generated randomly over a series of trials. For each correct prediction, the subject receives monetary reinforcement. The values, $p$ and $1-p$, represent the response probabilities for $E_1$ and $E_2$, respectively, and are the unknowns which each of the models will attempt to predict. Subjects are allowed to gain experience over a number of practice trials.

The utility model and the Estes model yield conflicting predictions concerning the choice behavior of subjects in this situation. According to the utility model, the subject will maximize the expected frequency of correct predictions; i.e., he will adopt the strategy which yields the highest monetary payoff. Therefore, he will choose $E_1$, the more
frequent event, on every trial. According to the Estes model, the subject will choose on the basis of prior response and prior reinforcement. Consequently, he will tend to vary his choices. For example, if the value of \( \pi \) selected by the examiner is 0.75, and if the subject happens to choose such that \( E_1 \) and \( E_2 \) are reinforced in the same proportions as their probabilities of occurrence, then he will choose \( E_1 \) and \( E_2 \) in the percentages of 75 and 25, respectively. In summary, the utility model predicts that the subject will follow a "pure" strategy by choosing the same event on every trial, whereas the Estes model predicts that the subject will tend to vary his choices.

Despite the differences in their predictions, these two models share a common feature in that each predicts only one kind of choice behavior for all subjects under the same experimental conditions. Under the utility model, the expected value, \( EV \), for any response probability, \( p \), is equal to the sum of the products of the probability and the value of each outcome (the outcome value of an event being equal to the product of the probability of its occurrence and its payoff value). The expected value of the two-choice illustration may be shown as follows:

\[
EV = p\pi(1\xi) + (1-p)(1-\pi)(1\xi)
= (1.0)(0.75)(1\xi) + (0)(0.25)(1\xi)
= 0.75\xi \text{ per trial}
\]
By using different values for $p$ in the above equation, EV can be plotted as a function of $p$, as shown in Figure 2.

![Graph showing Expected Value (EV) as a function of Response Probability (p)]

It can be seen from Figure 2 that EV is a linear function of $p$ and, therefore, has no internal maximum; the maximum value occurs at the response probability of unity for the more frequent event and zero for the less frequent event.

Similarly, under the Estes model, it can be shown that the response probabilities of $E_1$ and $E_2$ on any given trial are either one and zero or zero and one. Hence, under the same conditions of prior response and prior reinforcement,
the response probability for any group of subjects on a given trial will always be unity for one event and zero for the other event.

The difficulty, then, is that the predictions of these two models are frequently at variance with observed behavior. As Restle notes: "... if subjects are given many repeated choices in a situation like the one being discussed [two-choice, uncertain outcome with reinforcement], they almost always find a stable asymptote of $p$ between zero and one." (6, p. 287) Similarly, if a number of subjects are given the same choice (all subjects having been exposed to the same conditions of prior response and prior reinforcement), their responses will almost always vary, with a peak average response falling somewhere between zero and unity.

The first observation contradicts the utility model prediction; the second observation contradicts both the utility model and the Estes model predictions. Furthermore, neither model accounts for observed individual variation between subjects under the same conditions.

Choice behavior models derived from the decision-making theory developed by Siegel yield predictions which are more in agreement with observed choice behavior. The essential features of Siegel's decision-making theory are well stated by Radlow:

Decision-making theory is a mathematical theory for behavior. What makes this theory different from other mathematical theories which
have arisen during the last decade is a primitive assumption that it is meaningful and convenient to separate out as major theoretical variables the concepts of subjective probability and utility. Subjective probability is a measure for a particular individual of the likelihood that an event will occur. Utility is a measure of the value to that individual of the occurrence of the event. The definition of these fundamental concepts makes it possible to state the central postulate of decision-making theory. This postulate asserts that subjects will (or in some cases that they should) behave in such a way as to achieve for themselves the maximum value for the product of their subjective probability and their utility. (5, pp. 268-269)

It is important to note that both subjective probability and utility represent derived subject variables. Therefore, they may differ in magnitude from individual to individual. It is by virtue of this potential variation between individuals that the Siegel model accounts for differences in choice behavior between subjects under the same experimental conditions.

In the two-choice situation previously described, the predicted choice behavior of a given subject depends upon two elements of subjective utility. These two elements are the utility of success and the utility of variability. Utility of success is a function of the perceived probabilities of occurrence of $E_1$ and $E_2$, and the perceived value attached to each outcome. Utility of variability represents the subjective value attached to response alternation. Siegel considered response alternation to be the result of boredom or of trying to "outwit" the event series. He arbitrarily made this utility value proportional to the
product of the probabilities of choosing the two events, i.e., $p(1-p)$. The sum of the values of these two sources of utility yields the total subjective expected utility. The Siegel model, then, predicts that the subject will choose $E_1$ and $E_2$ in the proportions which will result in the maximum value of the total SEU.

For ease of comparison, assume that as a result of long practice the perceived and actual probabilities of event occurrence are equal and that a correct prediction has a perceived value of one cent. Utility of success, $U_s$, utility of variability, $U_v$, and the total SEU in this situation are illustrated in Figure 3.

![Diagram](image)

**Fig. 3**--The total subjective expected utility and its two components shown as a function of $p$. 
\( U_s \) is a linear function of \( p \) for all perceived probabilities and outcome values. In this example, \( U_s \) has a maximum value of 0.75. Since the actual and perceived decision-making situations are equivalent, for all values of \( p \), \( U_s \) of the Siegel model and EV of the utility model are equal, with the maximum values occurring at \( p = 1.0 \). In contradistinction to utility of success, \( U_v \) is a curvilinear function of \( p \), with a maximum at \( p = 0.5 \). The total SEU is equal to the sum of the utilities of success and variability, as shown in Figure 3. It can be seen that the total SEU has an internal maximum, which, in this case, occurs at \( p = 0.68 \). Thus, the Siegel model predicts that, in order to maximize his subjective expected utility, the subject will choose \( E_1 \) and \( E_2 \) in the percentages of sixty-eight and thirty-two, respectively.

The Siegel model, then, is able to account for differences in choice behavior between individuals under the same experimental conditions on the basis of subjective factors. That is, the choices made by a given subject are a reflection of his own particular utility of being correct and his own particular utility of varying his responses.

Despite the potential advantages resulting from its superior ability to account for observed choice behavior, Siegel's decision-making theory suffers a major limitation. Prediction of choice behavior is possible only if subjective
utilities are known for each subject. However, the theory makes no provision for the external assessment of these values. As Radlow states:

The decision-making analysis of repetitive-choice behavior appears to be quite accurate and essentially valid. It leads to the prediction of approximately correct asymptotes of choice behavior and to an approximately correct evaluation of the effect of magnitude of reinforcement. These results are not conclusive, but they certainly encourage a closer examination of the theory.

One significant gap continues to exist. Although it has been shown that the acquisition of subjective probability appears to be a distinguishable process, as the formalization of the subjective utility models discussed here would require, a theory for the acquisition of subjective probability is not included. (5, p. 273)

The implication of Radlow's statement is that Siegel's decision-making theory, although valid from the standpoint of its concepts, is incomplete. It is in the context of this viewpoint that the present investigation has its foundations. The consideration of personality variables as relevant to the study of choice behavior is intended not as a departure from, but as an extension of, existing decision-making theory.
CHAPTER BIBLIOGRAPHY


CHAPTER III

PERSONALITY AND DECISION EXPERIMENTS

In recent years, considerable research effort has been directed toward the demonstration of personality effects in choice behavior. A measure of success in this area has been achieved through two types of investigational approaches. The first type involves studies of personality as it influences interactions between individuals in bargaining and group decision situations. The second type is concerned with demonstrating differences in personality trait clusters between groups of decision makers. Typically, decision makers are grouped on the basis of overall similarities in strategies; then, by averaging personality traits of individuals, a composite group personality type is obtained which is shown to vary between strategy groups. Although these two types of studies are of interest and value to decision research in general, neither is pertinent to the present investigation.

Within the framework of existing decision-making theory, attempts to demonstrate the influence of personality in a quantitative sense, have met with little or no success. This point has been make by Kernan, who states:
In many past studies, attempts have been made to find significant correlations between specific personality traits and specific strategies. These attempts have proven to be spectacularly unsuccessful. No sensible personality-trait-to-decision-behavior relationship could be established. Multiple correlation procedures have also produced insignificant results. (1, p. 3)

It is important to note that these studies have all involved attempts to relate personality traits directly to the end product of decision behavior—the alternative chosen by the individual. Herein lies the difficulty.

The viewpoint, here stated, is that this end product, the recorded choice, is the result of the interaction of many factors, some existing in the external situation, and others existing within the decision-maker. These factors could be expected to mask any influence of personality on the final outcome of the decision process. It is suggested that personality exerts its primary influence, if any, on the process of decision making, not on the product.

It is especially important to this study that the elements of the decision-making process be defined clearly and in conceptual terms before the relationship between personality factors and the decision-making process is examined. Decision behavior may be said to occur when an individual is confronted with a conflict situation in which two or more alternative courses of action are perceived, and one of these alternatives is chosen as a satisfactory response. It is important to note that three criteria must be met in order to satisfy this definition of decision behavior.
First, the stimulus situation must be such that the individual perceives at least two response alternatives. Second, the individual must discriminate between and evaluate these perceived response alternatives. Third, he must select one of the alternatives as a satisfactory response.

This definition suggests that the decision-making process includes three major elements: (1) perception of tentative alternatives, (2) discrimination-evaluation of alternatives, and (3) selection of an alternative. These represent the three elements common to any decision.

The first element is based upon the decision-maker's perception of what possible courses of action are open to him. Whether the actual and perceived alternatives are equivalent, depends upon objective factors in the situation and upon subjective factors operating within the decision maker. Objective factors might include such things as the number and complexity of alternatives and the degree to which the alternatives are defined by the situation. Subjective factors might include intellectual ability to comprehend complex alternative situations or to recognize subtle alternatives, and emotional needs to perceive, not to perceive, or to misperceive alternative courses of action.

The second element pertains to the function of relating alternatives to outcomes. This stage in the decision-making process involves the two closely related components of discrimination and evaluation. Discrimination refers to the
process of refinement and clarification of perceived tentative alternatives based upon the recognition of differences in their outcomes. Evaluation refers to the differentiation of alternative-outcome relationships based upon differences in their subjective worth or utility.

The final stage in decision making involves the selection of a satisfactory response. This selection is made in terms of a rationale that may be viewed as representing a compromise between satisfying the perceived objective conditions of the decision situation and satisfying the subjective needs of the decision maker.

Each element, then, can be considered as a function of objective factors existing in the decision situation and subjective factors operating within the decision maker. Frequently in decision behavior research, these subjective factors are obscured either partially or completely at the first two stages, by providing subjects with perfect information concerning the objective situation. That is, at the outset of the experiment, subjects are given information which specifies all possible alternatives and differentiates the outcome values. As a result, the influence of subjective factors involved in discovery and discrimination of alternatives is negated. In effect, the original three stages of the decision-making process are reduced by one-half, leaving alternative-outcome evaluation and alternative selection. Typically, alternative-outcome evaluation is
then ascribed to the process of learning, as evidenced by the alternatives chosen. In research, if the primary interest is the investigation of learning processes, this kind of experimental design is not only beneficial, but necessary in order to exert experimental control over confounding subject variables. However, if the primary interest is the investigation of the decision-making process from the standpoint of subjective factors in addition to learning, then such a design has severe limitations. In short, in order to examine the effects of personality, decision making must be investigated within a framework which permits these effects to be exhibited.

The conceptual foundations of this study have been presented in this chapter. The more specific considerations of this investigation can now be undertaken.
CHAPTER BIBLIOGRAPHY

CHAPTER IV

THE MODIFIED TWO-CHOICE EXPERIMENTAL DESIGN

In decision-making situations outside the experimental laboratory, information concerning alternatives and outcomes is often readily obtainable from a number of sources. Rarely is the information acquired from any single source as complete and reliable as that provided in most experimental situations. Rather, sources tend to vary in the quality and reliability of their information, with no source supplying perfect information. Consequently, in most non-experimental situations, the decision maker exercises considerable control over both information acquisition and information utilization.

It seems reasonable to propose that if personality factors influence decision behavior, this influence will be reflected in the way information is acquired and utilized. However, if this influence is to be observed experimentally, then the experimental situation must be such that the subject is allowed not only to evaluate alternative-outcome relationships, but also to participate in the discovery of alternatives and the differentiation of outcomes.
This investigation seeks to demonstrate that personality factors are related to three characteristics of decision-making behavior associated with individual differences in information acquisition and utilization. These three characteristics—decisiveness, risk assumption, and maximizing tendency—are conceived as subjective factors describing different facets of decision behavior.

As stated earlier, in order to identify and obtain quantitative measures of these three characteristics, certain modifications were made in the two-choice probability learning situation which had been used previously. These modifications primarily involve the introduction of information sources, which provide a means whereby individual differences in information acquisition and utilization can be measured experimentally. A brief description of the modified experimental situation will facilitate further discussion.

As before, on each of a series of trials the subject is asked to predict the occurrence of two symbols, \( \lor \) or \( + \), which represent mutually exclusive, randomly generated events. However, prior to each prediction the subject is given an opportunity to obtain symbolic advice from three information sources, referred to as A, B, and C. The subject is told that A, B, and C represent three consultants, each giving his opinion concerning which of the two symbols, \( \lor \) or \( + \), will be next projected. It is explained that just
as consultants in real life are not always correct in their opinions, some being correct more often than others, so it is with the three consultants, A, B, and C. Thus, the subject is allowed to base his predictions on the information provided by the three consultants. In addition to the three consultant sources, the event series can be considered an information source. If the subject chooses not to base his predictions on information supplied by A, B, or C, the only additional information available to him is that supplied by the event series itself, i.e., through probability learning based upon prior response and prior reinforcement. This fourth source of information shall be referred to as "N".

The experiment is designed so that the probability of correspondence, i.e., the probability of the information source being correct on any given trial, for A = 0.60, for B = 0.40, and for C = 0.80. Whether the information provided is correct on a given trial is randomly and independently determined for each of the three consultants. The series of events actually projected (✓ or +) is generated randomly with the probabilities of occurrence being equal. Therefore, the probability of correspondence for N = 0.50.

A series of fifty practice trials is administered, allowing the subject to compare and evaluate the overall quality and reliability of the information given by A, B, C, and the various combinations thereof. For each correct prediction, he receives monetary reinforcement. The fifty
test trials which follow are similar to the practice trials in all respects, except that consultant advice is no longer given on a cost-free basis. On every test trial, the subject is permitted to buy information from one, two, or three consultant sources, if he so desires. For each source he chooses to consult, the subject must pay a sum equivalent to twenty percent of the expected payoff value.

This experimental arrangement results in a shifting of emphasis from the end product of event selection to the process of acquisition and utilization of information upon which event selection is based. Furthermore, the experiment yields trial-by-trial data on information acquisition, information utilization, and event selection. On each trial, the examiner records the source(s) consulted, the source(s) utilized, and the event selected in separate columns, labeled I, II, and III, respectively. More specifically, Column I data reveals which, if any, of the information provided by A, B, and C was acquired. Column II data reveals which, if any, of the information sources was utilized; and Column III reveals which of the two events, ✓ or +, was predicted.

On a given trial, information may be acquired from one or more of the consultant sources or from N, indicating that information was not obtained from any consultant source. Information utilization is dependent upon information acquisition; that is, the subject must first acquire information
from a particular source in order for that source to appear in Column II. The eight acquisition possibilities and the respective utilization possibilities are shown in Table I.

**TABLE I**

**ACQUISITION AND UTILIZATION POSSIBILITIES**

<table>
<thead>
<tr>
<th>Acquisition Possibilities</th>
<th>Utilization Possibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Single Acquisition</strong></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>A, N</td>
</tr>
<tr>
<td>B</td>
<td>B, N</td>
</tr>
<tr>
<td>C</td>
<td>C, N</td>
</tr>
<tr>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td><strong>Multiple Acquisition</strong></td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td>AB, N</td>
</tr>
<tr>
<td>AC</td>
<td>AC, N</td>
</tr>
<tr>
<td>BC</td>
<td>BC, N</td>
</tr>
<tr>
<td>ABC</td>
<td>ABC, N</td>
</tr>
</tbody>
</table>

Table I indicates that information acquired from source A may be accepted by the subject as valid, so that A's information is utilized, or it may be rejected and not utilized. Similarly, the information provided by B or C may or may not be utilized. When more than one source is consulted on the same trial, utilization possibilities depend
upon whether there is agreement among the sources as to the information provided. For example, if the subject consults AB, and the information provided is concordant (++ or ✓✓), then the combination, AB, becomes as a single source supplying information which may be accepted or rejected. If, on the other hand, the information supplied by AB is conflicting (+✓ or ✓+), the subject must utilize one and only one of the two sources. That is, in accepting the one, he rejects the other, and, in rejecting the one, he accepts the other. The relationships between information acquisition, information utilization, and event selection are fully elaborated in Figure 4.

Columns I and II provide the data which make possible the quantification of the three decision-making characteristics under consideration. The decisive-indecisive characteristic represents the extent to which the subject tends to exhibit trial-to-trial variability in acquisition and utilization of information. The more decisive subject tends to acquire information from the same source(s) and utilize that information in the same way on each trial. On the other hand, the more indecisive subject behaves in a manner which suggests that he is uncertain as to which of the sources provides the best and most reliable information. He vacillates in the acquisition and utilization of information. This vacillation is shown as alternating between two or more of the eight possibilities in Column I and in
Fig. 4—Depiction of deterministic demonstration of the sequential process of information acquisition, information utilization, and event selection at any given trial. N.
Column II on consecutive trials. Thus, "degree of indecisiveness," is operationally defined as the sum of the alternations in Columns I and II.

Risk-taking tendency is related to the degree of subjective need for acquiring information, based on perceived risk. This tendency, like the other characteristics being discussed, is conceived as a series of points falling along a continuum. "Risk-assumers" and "risk-aversers" are terms used to describe individuals at opposite extremes of the continuum. Risk-aversers feel the need to obtain as much information as possible before making a decision, so that they tend to buy information from all three sources on every trial. Risk-assumers, on the other hand, tend not to buy any information, preferring instead to base their decisions on intuitive feelings, or hunches concerning the event series. The extent to which a given subject tends towards one or the other of these extremes is revealed by the total number of sources he consults over the entire series of trials. Thus, "degree of risk-aversion" is operationally defined as the total sum of A, B, and C in Column I.

"Maximizing tendency" is operationally defined as the sum of the products of the Column II totals of A, B, C, and N, and their respective probabilities of correspondence. That is, maximizing tendency is defined by the following equation:
where $M$ represents maximizing tendency and $T_A$, $T_B$, $T_C$, and $T_N$ represent the Column II totals of $A$, $B$, $C$, and $N$, respectively.

Maximizing tendency is related to the subject's ability to correctly discriminate the objective conditions of the decision-making situation. This tendency represents the extent to which information is utilized in order to maximize expected utility under a criterion of objective rationality. The probabilities of correspondence reflect the difference in quality and reliability of the information sources. It can be seen that in order to tend toward maximization of expected frequency of correct information, the subject must utilize information in the following preferential order:

$$C > A > N > B$$

The upper extreme of the maximizing continuum, then, describes subjects who utilize information from "C" on every trial, and lower extreme describes those who utilize information from "B" on every trial. The greater the tendency for a subject to reverse this preferential order of information utilization, the lower is his position on the maximization continuum.

To summarize briefly, this study seeks to demonstrate that personality and decision making are related, and that this relationship is quantifiable. Earlier in this presentation, it was shown that a current decision-making theory
employing subjective utility concepts had laid the groundwork for including personality variables in probability learning models. Using the fundamental ideas of this theory, an expanded theoretic conception of the process of decision making was presented. It was suggested that personality exerts its primary influence, if any, on the process, rather than the end product of decision making. More specifically, it was proposed that personality factors are related to the information acquisition and utilization stage of the decision-making process. Using information gained from an earlier pilot study, an experiment was designed as a rudimentary test of the conceptual validity of the expanded theory. Based upon differences between individuals in information acquisition and information utilization, three characteristics of decision-making have been described and operationally defined, such that individual differences can be measured quantitatively for each of the three characteristics. In addition, "personality" has been operationally defined as that set of traits measured by the four scales of the GPP and eleven experimental scales of the MMPI.

The general hypothesis of this investigation is that personality factors influence decision-making behavior at that stage of the process referred to as information acquisition and utilization. The specific hypothesis is that personality factors are related to degree of decisiveness,
degree of risk-aversion, and maximizing tendency; and that quantitative differences between individuals on each of these three characteristics are proportional to quantitative differences in their personalities.

This investigation, then, represents an attempt not only to demonstrate that personality and decision making are related, but also to determine the nature of the relationship, and to distinguish quantitative differences between individual decision-makers.
CHAPTER V

METHODOLOGY AND RESULTS OF THE EXPERIMENT

Method

A detailed description of the method used in conducting the experiment is given below. Following this description, the results obtained from the investigation are presented.

Subjects

The subjects consisted of fifty-two male and female North Texas State University undergraduate and graduate student volunteers, primarily from the School of Business Administration.

Apparatus

Two pieces of equipment were used in the experiment—an automatic slide projector and an apparatus referred to as the three-source information box. The projector, a Kodak Carousel model 650, was used to project the series of events that the subject was asked to predict. Fifty glass slides, on which either a check or a plus had been printed, were placed in each of two slide trays. Using a table of random numbers, the trays were loaded with check and plus slides in a random order, with the probabilities of occurrence of the two symbols being equal.
The three-source information box was constructed with three doors, labeled A, B, and C, and a dial with settings numbered from one through eight. Using the dial, the examiner was able to select any combination of plusses and checks to appear behind the three doors. The combinations corresponding to each dial setting are shown in Figure 5.

<table>
<thead>
<tr>
<th>Dial Setting</th>
<th>A</th>
<th>Doors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>□</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>+</td>
<td>□</td>
</tr>
<tr>
<td>4</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>6</td>
<td>□</td>
<td>+</td>
</tr>
<tr>
<td>7</td>
<td>+</td>
<td>□</td>
</tr>
<tr>
<td>8</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

Fig. 5--Dial settings on the three-source information box.

The correct dial setting for each trial was printed on the response sheet. Whether the symbol behind a given door corresponded to that of the actual event to be next projected was determined randomly and independently for A, B, and C, such that for the entire series, their respective probabilities of correspondence on any given trial were 0.60, 0.40, and 0.80.
Test Materials

Prior to the experimental session, the Gordon Personal Profile and the Minnesota Multiphasic Personality Inventory were administered to each subject. The GPP was hand-scored, yielding measures of ascendency, responsibility, emotional stability, and sociability.

The MMPI answer sheets were scored by National Computer Systems, yielding four validity scales, ten clinical scales, and eleven experimental scales.

Only the experimental scales were utilized for the purposes of this investigation. These eleven scales and their standard abbreviations are: anxiety (A), repression (R), ego strength (Es), low back pain (Lb), caudality (Ca), dependency (Dy), dominance (Do), social responsibility (Re), prejudice (Pr), social status (St), and emotional control (Cn).

Procedure

Each subject was run individually. For the experimental session, the subject was seated at the side of a desk with the examiner seated behind the desk, both facing a small projection screen placed approximately six feet in front of the desk. The slide projector was placed toward the front of the desk, and focused on the screen. The information box was placed near the subject, and was situated so that the three doors were visible to both the subject and the examiner, but the dial could be seen only by the examiner.
Each subject was seen at an individual testing session in which a fifty-trial practice series and a fifty-trial test series were presented. Each such session required approximately forty-five minutes.

Standard instructions were given to all subjects. At the beginning of the session, the subject was asked to read the following written instructions:

You are asked to predict which of two symbols—a check or a plus—will be projected on the screen in front of you. The order of occurrence of the two symbols has been determined randomly; that is, the series of plusses and checks are projected in a random order. Before each prediction, you will be given information from three different sources—A, B, and C. These sources represent three consultants, each giving his opinion concerning which of the two symbols, ° or +, will be next projected. Just as doctors, lawyers, stock market advisors, and other consultants in real life are not always correct in their opinions, some being correct more often than others, so it is with the three consultants, A, B, and C.

You may base your prediction on the information provided by any one, or more than one of the three consultants. After deciding which of the two symbols you believe will be projected, you should state your prediction and also indicate which one or combination of A, B, and C most influenced your prediction. (Several examples will be given before we begin.)

As soon as your prediction has been made, the symbol will be projected, thus revealing whether your prediction was correct or incorrect. This will also be stated aloud by the Examiner—he will say, "right" or "wrong."

Having read the above instructions, additional verbal instructions were given to the subject in conjunction with five examples. In order to standardize these instructions, they were given according to the following explicit directions:
Example 1.—The dial on the information box is set at 3; all three doors are opened to reveal:

\[ A = +; \ B = \checkmark; \ C = +. \]

The examiner then states the following:

The plus or check appearing behind each of the three doors labeled A, B, and C, represents the opinion of each source concerning which of the two symbols, check or plus, will be next projected. In this first example, A's opinion is that a plus will be projected next; B disagrees, saying that it will be a check; C, like A, believes that the symbol I am about to project will be a plus.

Each of the three consultants has access to certain information about the series of actual events, and they each base their opinions on that information. However, some have more information than others, and just as in real life, some are better able to utilize the information given them. This explains why the three consultants do not always agree in their opinions.

The examiner projects Example Slide No. 1 (which is \( \checkmark \)), and says:

In this first example, the actual event is a check, so that B's opinion was the correct one.

Example 2.—Dial setting = 7 \((A = +; \ B = \checkmark; \ C = \checkmark)\); Example Slide No. 2 = \( \checkmark \).

In this second example, if you thought that a plus was going to be next projected because of A's opinion, you would say "plus A." If you thought that check was coming up next, you could say "check B" or "check C;" however, if you decided on check because of the combined opinions of B and C, you would say "check BC."

The examiner projects Example Slide No. 2, and says, "B and C were both right."
Example 2.--Dial setting = 4 (A = +; B = +; C = ✓); Example Slide No. 3 = ✓.

What might you say on this example? (Make sure that the subject names all the possibilities, i.e., plus A, plus B, check C, and plus AB.)

Example 4.--Dial setting = 2 (A = ✓; B = +; C = +); Example Slide No. 4 = +.

What about this one? (Again, make sure that the subject can list all the possibilities.)

Example 5.--Dial setting = 1 (A = +; B = +; C = +); Example Slide No. 5 = ✓.

This last example represents a special case. A, B, and C all say that a plus will be next projected. However, if you thought that a check were coming up next, you would say "check none."

The examiner projects the fifth example slide and says:

As you can see, they were all wrong that time. This illustrates a point I want to call to your attention. That is, that no single one, or combination of A, B, and C is going to be correct on every trial. We all know that no one can be right all the time, however, some people are right more often than others, and so it is with A, B, and C. That is, considering the entire series of trials, some one, or some combination of, A, B, and C will be correct more frequently than the others.

Perhaps the best approach to this experiment is to think of A, B, and C as being three different stock market advisors, each with his own opinion about imminent changes in the value of certain stocks. For example, the symbol "plus" might mean that the market value of a particular stock is about to go up, so buy; "check" might mean that the value is about to go down, so sell.

Let's suppose that you have a substantial sum of money which you are planning to invest about a year from now. Further, suppose that A, B, and C
are the only stock market consultants available to you. Since you know nothing about the capabilities of any of these consultants, during the year prior to making your large investments you are going to make a number of very small investments with each of the three, in order to find out which one or combination of A, B, and C gives the best advice most consistently. It is important for you to determine this so that you will know whose advice to take when you make the larger investments later on.

The first fifty trials represent the period of a year during which time small investments are made with each of A, B, and C, in order to find out how well they perform in their capacity as stock market consultants. On these learning trials, you will be paid two cents for each correct prediction that you make.

The last fifty trials represent the period at the end of the year at which time you will begin making larger investments. Consequently, the payoff for each correct prediction will be considerably greater.

On the first fifty trials, A, B, and C are going to give you their advice free of charge. However, on the last fifty trials, you will have to buy their advice if you want it; that is, you will have to pay a fee to each advisor you consult. Your task, then, on the first fifty trials is to find out which one or combination of A, B, and C gives the best advice most consistently, so that you will know whose advice to buy on the last fifty trials.

Learning Trials.—The first fifty trials are administered. The examiner dials the correct setting on the information box for each trial. The subject receives the information by pulling down one or more of the doors (most subjects look behind all three of the doors, since it cost nothing to do so on the first fifty trials). The subject states his prediction, and which of the consultants most
influenced his prediction. The examiner then projects the event, thus revealing whether the subject's prediction was correct or incorrect.

**Test Trials**—The examiner says:

Keep in mind everything you have learned about A, B, and C, so that you will know whose advice to buy on these last fifty trials. You should buy advice from that one or combination of consultants who gave the best advice most consistently on the first fifty trials. The same ones who gave good advice before will continue to do so on these last fifty trials.

For the first forty of the last fifty trials, the pay-off is five cents for each correct prediction, but it will cost you one cent for each of A, B, and C you choose to consult. On any trial you may buy the advice of any one, any two, or all three of the consultants; or you may choose not to buy information from any of them. By way of illustration, let us say that on a given trial you pulled down all three doors, and that your prediction was correct. You would be paid five cents for the correct prediction; however, you would be charged one cent for each door you pulled down, so that the net pay-off on that trial would be two cents. Now, if your prediction were incorrect, you would still be charged three cents in consultant fees.

On the last ten of these fifty trials, the pay-off is increased to twenty-five cents for each correct prediction, so that it is possible to earn more on the last ten trials than on all the other trials put together.

On these last fifty trials, it is not necessary for you to say which of A, B, and C most influenced your prediction; I will simply note which doors you pull down. All you have to do is state your prediction, either check or plus.

After giving the above instructions, the fifty test trials were administered. On each trial, the source(s) consulted, the source(s) utilized, and the event predicted were
recorded in separate columns, labeled I, II, and III, respectively.

Utilizing the data in Columns I and II, three separate scores were obtained for each subject. The first score, representing a measure of risk-aversion, was determined by the number of sources consulted, and was obtained from the Column I data by means of the following equation:

$$R_{av} = n_1 + 3n_2 + 8n_3,$$

where $R_{av}$ = degree of risk-aversion

- $n_1$ = number of sources consulted on trials one through twenty-five
- $n_2$ = number of sources consulted on trials twenty-six through forty
- $n_3$ = number of sources consulted on trials forty-one through fifty

The second score, a measure of decisiveness, was determined by the number of alternations in Column I and the number of alternations in Column II. An alternation was counted each time the subject consulted (Column I) or utilized (Column II) a different source from that consulted or utilized on the previous trial. The subject's score on the decisiveness scale was then obtained by means of the following equation:

$$D = 300 - (a_1 + 3a_2 + 8a_3),$$

where $D$ = degree of decisiveness

- $a_1$ = the sum of the Column I and Column II alternations on trials one through twenty-five
- $a_2$ = the sum of the Column I and Column II alternations on trials twenty-six through forty
- $a_3$ = the sum of the Column I and Column II alternations on trials forty-one through fifty
The third score, a measure of maximizing tendency, was determined by the sum of the products of the Column II totals of A, B, C, and N, multiplied by their respective probabilities of correspondence, as shown by the following equation:

\[ M = T_A(.60) + T_B(.40) + T_C(.80) + T_N(.50), \]

where \( M \) = maximizing tendency

\( T_A \) = total of A in Column II
\( T_B \) = total of B in Column II
\( T_C \) = total of C in Column II
\( T_N \) = total of N in Column II

These three scores, representing measures of risk-aversion, decisiveness, and maximizing tendency, served as the three dependent variables in the multiple correlation analysis of the data. For each dependent variable, scores obtained on the eleven experimental scales of the MMPI served as the independent variables.

Results

The results of the multiple correlation analysis carried out on the data obtained from the experiment are summarized in Table II.

For each of the three dependent variables shown in Table II, the corresponding independent variables are listed in decreasing order of significance in the step-wise correlation. Only those independent variables having partial
**TABLE II**

**SUMMARY OF THE RESULTS OF THE MULTIPLE CORRELATION ANALYSIS**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Independent Variable</th>
<th>R²</th>
<th>Multiple F</th>
<th>Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decisiveness</td>
<td>Anxiety</td>
<td>0.77231</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prejudice</td>
<td>0.79376</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Emotional Control</td>
<td>0.81096</td>
<td>68.43</td>
<td>0.001</td>
</tr>
<tr>
<td>Risk Aversion</td>
<td>Emotional Control</td>
<td>0.19707</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Responsibility</td>
<td>0.31819</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prejudice</td>
<td>0.39834</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anxiety</td>
<td>0.45521</td>
<td>9.82</td>
<td>0.001</td>
</tr>
<tr>
<td>Maximizing Tendency</td>
<td>Dependency</td>
<td>0.54956</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prejudice</td>
<td>0.68010</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dominance</td>
<td>0.70609</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Caudalility</td>
<td>0.73055</td>
<td>31.85</td>
<td>0.001</td>
</tr>
</tbody>
</table>
correlation coefficients which are significant at the five per cent level are included in the table. The remainder of the independent variables were found not to be significant.

Multiple regression analysis of the data was performed, since one of the major requirements for meeting the objectives of this study is the prediction of the three criterion variable scores. The three regression equations resulting from this analysis are given in Table III.
### TABLE III

**SUMMARY OF THE RESULTS OF THE MULTIPLE REGRESSION ANALYSIS**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Regression Equation</th>
<th>Standard Error of Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decisiveness</td>
<td>$\hat{y}_D = 466.27 - 5.51(A) - 1.72(Pr) + 0.86(Cn)$</td>
<td>33.74</td>
</tr>
<tr>
<td>Risk Aversion</td>
<td>$\hat{y}_{Rav} = 224.05 + 4.89(Re) + 1.95(A) - 3.54(Pr) - 2.03(Cn)$</td>
<td>57.56</td>
</tr>
<tr>
<td>Maximizing Tendency</td>
<td>$\hat{y}_M = 82.98 - 0.13(Ca) - 0.35(Dy) - 0.17(Do) - 0.27(Pr)$</td>
<td>3.11</td>
</tr>
</tbody>
</table>
CHAPTER VI

DISCUSSION OF EXPERIMENTAL FINDINGS

An examination of the experimental results reveals that slightly more than eighty-one per cent of the total variation in the decisiveness measure is associated with a weighted linear combination of the scores obtained on the A, Pr, and Cn scales of the MMPI. Of the total variation in the second measure, risk-aversion, approximately forty-six per cent is associated with the scores on the Cn, Re, Pr, and A scales. Slightly more than seventy-three per cent of the total variation in the third measure, maximizing tendency, is associated with the combined variations in the Dy, Pr, Do, and Ca scales of the MMPI.

For each of the three criterion variables, the significance of the multiple correlation coefficient was tested by means of the variance ratio. In each case, the multiple correlation coefficient is significant at the .001 level, making it possible to reject the null hypothesis in favor of the alternative hypothesis that the value of the multiple correlation coefficient in the population represented by the sample is significantly different from zero. Thus, the experimental data support the hypothesis that personality
factors are related significantly to the three decision-making characteristics of decisiveness, risk-aversion, and maximizing tendency.

In recent years, considerable research effort has been directed toward the demonstration of personality effects in choice behavior. Success in this area has been limited to those studies utilizing an investigational approach designed to yield descriptive results. Typically, decision makers are grouped on the basis of overall similarities in strategies; then, by averaging personality traits of individuals, a composite group personality type is obtained which is shown to vary between strategy groups. Such an arrangement permits each decision behavior category to be described by a list of personality traits.

This study was not designed for the purpose of ascertaining personality descriptors of the various characteristics of decision behavior. Nevertheless, the experiment does yield several interesting findings which are of a descriptive nature. Each of the decision-making characteristics considered in this investigation is conceived as a series of points falling along a continuum. The three characteristics can be described and measured in terms of either extreme of their respective continua, that is, decisiveness or indecisiveness, risk-aversion, or risk-assumption, and maximization or minimization. Because "minimization" is not as meaningful, in a descriptive
sense, it was decided to measure the latter scale in terms of maximization. Both extremes of the other two scales are equally meaningful. In order to facilitate comparison with the maximization scale, it was arbitrarily decided to measure the scales in terms of decisiveness and risk-aversion, respectively. The point is that the linear combination of personality variables associated with each of the three characteristics of decisiveness, risk-aversion, and maximization, is equally, but inversely, associated with the respective alternative measures representing indecisiveness, risk-assumption, and minimization. Therefore, individuals at the extremes of each of the three continua can be described in terms of personality trait combinations. Personality trait characterizations of such individuals are shown in Table IV.

It should be noted that the relationships given in Table IV hold only if two requirements are met. First, the personality traits appropriate to each of the decision characteristics must be considered in combination. For example, the extreme risk-assumer cannot be characterized by low anxiety alone; rather, he is characterized by low anxiety in combination with high emotional control, high prejudice, and low responsibility. The second requirement is that the relationships hold only for the extremes of each continuum. It should also be noted that the traits are not equally important as descriptors of decision behavior;
### TABLE IV
PERSONALITY CHARACTERIZATIONS OF INDIVIDUALS
AT THE EXTREMES OF THE THREE
DECISION BEHAVIOR CONTINUA

<table>
<thead>
<tr>
<th>Personality Trait</th>
<th>Highly Decisive</th>
<th>Highly Indecisive</th>
<th>Extreme Risk-Averter</th>
<th>Extreme Risk-Assumer</th>
<th>Extreme Maximizer</th>
<th>Extreme Minimizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional Control</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prejudice</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Responsibility</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Dominance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Caudality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
rather, they differ in relative importance according to their individual contribution to the predictability of each criterion variable.

Of considerable interest is the highly significant relationship between anxiety and decisiveness. The experimental results reveal that seventy-seven per cent of the total variation in the decisiveness measure is associated with the variation in scores on the A scale. That is, the degree of linear relationship between the criterion variable, decisiveness, and the single predictor variable, A, is expressed by a product-moment correlation coefficient value of $r = -0.88$. The discovery of a high degree of relationship between anxiety and the decisiveness characteristic is particularly noteworthy. The concepts of maximization and risk are used commonly in decision behavior research, in contrast to the decisiveness concept, which reflects the extent to which an individual vacillates between alternatives in the decision-making situation. Such vacillating behavior, although commonly observed, has not been explained adequately.

Before proceeding, it is necessary to examine in conceptual terms the characteristic of decisiveness in the context of the experimental situation utilized in this investigation. In this study, the measure of decisiveness is related to the number of alternations or vacillations between the three information sources during information
acquisition and utilization. The relationship is such that the higher the number of alternations, the lower the degree of decisiveness.

On every trial, each subject is faced with essentially the same decision situation. In effect, the subject is confronted with two questions: "Which, if any, of the information sources do you choose to consult?", and "Of the ones consulted, which source, if any, has provided information which you choose to utilize?".

During the learning trials, all subjects would be expected to exhibit vacillating behavior, since they have no prior knowledge concerning differences between the three sources as to the quality and reliability of the information provided. However, as the experiment progresses, subjects gain experience with the three information sources through prior response and prior reinforcement. This experience allows the subject to gradually eliminate individual sources or combinations of sources from his consideration, so that vacillation decreases. Through the process of elimination of choices, the subject's choice-task, i.e., the amount of work or psychic energy involved in the process of choosing, is reduced.

The highly decisive subject reduces his choice-task to a minimum by eliminating all but one of the perceived possibilities. That is, as he progresses through the series of trials, the highly decisive subject gradually focuses on
that source or combination of sources which he perceives as being of greatest value to him. Having focused on the information source(s), decisive subjects tend not to vary in either the acquisition or utilization of information. The occasional vacillations which do occur may be accounted for in at least three ways. First, such vacillations may represent hypothesis testing by the subject. Second, they may represent the effects of negative recency in the event series. For example, if one of the two events has occurred several times in succession on the trials immediately preceding trial n, and if on trial n the source generally utilized by the subject indicates the occurrence of that same event, then the subject may reject that information and predict the other event. Third, the occasional alternations exhibited by decisive subjects may represent attempts to add interest to the experimental situation through the diversion afforded by novelty.

In contrast to decisive subjects, indecisive subjects do not minimize the choice-task. That is, the vacillating behavior exhibited initially persists throughout the entire series of both learning and test trials. In most cases, the indecisive subject is able to eliminate at least a few of the perceived choice possibilities, but his decision behavior lacks the choice-focus character of the decisive subject.

In attempting to account for the persistent vacillating behavior exhibited by the indecisive subject, the explanations
usually given may be placed into one of the following categories: lack of ego involvement or excessive competitiveness. In the case of the former category, vacillation is said to stem from lack of interest in the experiment, which results in extreme boredom associated with the repetitive choice situation. Thus, the subject attempts to interject novelty into the situation by constantly varying his choices. In the case of the latter category, vacillation is explained as being the result of excessive competitiveness on the part of the subject. Thus, vacillation reflects the subject's attempt to predict the correct event on every trial, thereby "outwitting" the event series.

Both of the explanations presented above seem reasonable and conceptually sound, and doubtlessly, each accounts for the vacillation exhibited by some subjects. However, the results of the present investigation suggest that much of the vacillating behavior exhibited by indecisive subjects is associated with anxiety. The high degree of relationship emphasizes that the extent to which an individual tends toward indecisiveness is directly proportional to his level of anxiety.

Although not supported by experimental evidence, since cause-effect relationships cannot be inferred from correlation results, the findings do suggest that a possible alternative explanation for persistent vacillation is that such behavior reflects the feeling of uncertainty associated
with high levels of anxiety. Such an explanation has considerable appeal from the standpoint of the theory, since it implies that the indecisive subject is able to discriminate between and evaluate alternatives and outcomes on an intellectual level, but, as a result of the feelings of uncertainty associated with high anxiety, his choice-hypotheses are subject to frequent checks. Frequent hypothesis testing would have the effect of inhibiting choice-focus, so that his choice-task would not be minimized. On the contrary, his choice-task might be expected to increase from initial levels as a result of his being confronted with a decision situation of greater complexity. That is, in addition to the task of choosing between alternative events, the indecisive subject might be faced with an internal decision situation which, on every trial, would require an answer to the question: "Should the experience gained over the preceding trials be relied upon?" Having to make two decisions on every trial, rather than one, would account for the previously mentioned observation that indecisive subjects were invariably noted to exhibit much longer response latencies than other subjects.

This paper has presented experimental evidence supporting the hypothesis that personality variables are related significantly to certain decision-making characteristics. There remains the more important task of interpreting these findings within the framework of existing decision-making theory.
Earlier in this paper, it was shown that Siegel's theoretic models of decision making, based on subjective utility concepts, laid the foundations for including personality variables in probability learning models of choice. Using the fundamental ideas of this theory, an expanded theoretic conception of the process of decision making was presented in this paper. In addition, it was suggested that personality exerts its primary influence, if any, on the process, rather than the end product of decision making. More specifically, it was proposed that personality factors are related to the information acquisition and utilization stage of the decision-making process. The experiment served as a rudimentary test of the expanded theory by virtue of the fact that measures of the three decision-making characteristics were obtained exclusively from information acquisition and information utilization data. (Data pertaining to the end product of decision making, the series of events selected, were not utilized in the determination of the three criterion variable scores.)

The results of the multiple correlation analysis suggest that the expanded decision-making theory is valid from the standpoint of its concepts. Furthermore, the findings of this investigation can be shown to fit within the framework of Siegel's theoretic models of choice behavior.

The decision-making theory developed by Siegel (2, 3, 4) holds that in situations involving a choice between
alternatives, an individual chooses so as to maximize subjective expected utility. The more primitive of Siegel's theoretic models, model I, centered upon two concepts: the utility of a correct prediction and the utility of variability. This model and its predictions have been discussed in an earlier section of this paper. A consideration of the more sophisticated model, Siegel's model II, is more appropriate for the purposes of the present discussion.

Model II represents an extension of model I in that it includes the concepts of the first model, and, in addition, model II incorporates the concept of the subjective utility of risk. The formulation of model II can be examined using a simple two-choice situation with reinforcement for purposes of illustration. Such a situation is diagrammed in Figure 6,

where $E_1$=the more frequently occurring event
$E_2$=the less frequently occurring event
$\pi$=the probability of occurrence of $E_1$
$1-\pi$=the probability of occurrence of $E_2$
p =the response probability of $E_1$
$1-p$=the response probability of $E_2$

It should be noted that the two-choice situation illustrated in Figure 6 is identical to the two-choice illustration used earlier in this paper in the discussion of Siegel's model I.
In the two-choice situation illustrated in Figure 6, the subject is asked to predict the occurrence of the two mutually exclusive events, $E_1$ and $E_2$. The two events occur with fixed but unequal probabilities, $\pi$ and $1-\pi$, and are generated randomly over a series of trials. The subject is given monetary reinforcement of one cent for each correct prediction.

The derivation of the model II prediction equation requires that three marginal utilities be specified. The first, "a", represents the marginal utility of a correct prediction when and only when the subject chooses the more frequent event. The second, "b", represents the marginal utility of a correct prediction when and only when the subject chooses the less frequent event. The third, "c", represents the marginal utility of variability.
The three subjective utilities of the model are then defined in terms of the marginal utilities, as follows:

\[ U_s = ap \pi^\theta \quad \text{Utility of success (1a)} \]
\[ U_r = b(1-p)(1-\pi) = \text{Utility of risk (1b)} \]
\[ U_v = cp(1-p) \quad \text{Utility of variability (1c)} \]

The total subjective expected utility represents the sum of the three utilities. That is,

\[ \text{Total SEU} = U_s + U_r + U_v \]

According to the central postulate of the theory, the total SEU will be maximized. The strategy which maximizes the total SEU is given by the prediction equation of model II, which may be stated as follows:

\[ p = \frac{\pi(1-p)c + b(1-\pi)}{2c} \quad (2) \]

Since \( \pi \) represents a known value, the only unknowns to the right of the equality are the values of the a, b, and c terms. Thus, to determine the value of p, the a, b, and c values must be known for each subject. As stated previously, however, the theory makes no provision for the external assessment of these values. Consequently, it was necessary for Siegel to obtain measures of the three by inference, based upon prior observation of each subject's performance in the two-choice situation. Typically, a series of one hundred trials was administered. Then, using the data from the first eighty of these trials to estimate the marginal
utility values, event selection on the last twenty trials was predicted. Thus, lacking an external means of obtaining measures of the three marginal utilities, Siegel was forced to base his choice behavior predictions upon observations of past performance. The difficulty lies in the general observation that one of the best predictors of an individual's behavior in a particular situation is his past behavior in repeated exposures to that same situation. Therefore, by observing the choices made by an individual over a series of eighty trials, it seems likely that his choices on an additional twenty trials could be predicted with reasonable accuracy without utilizing the Siegel model concepts. Thus, the usefulness of the model is severely impaired because the theory underlying the model does not provide for the external assessment of the subjective utility values.

The most significant feature of the present investigation is, perhaps, that the findings suggest such an external means for obtaining the necessary subjective measures. Before proceeding with the development of the method for obtaining the three subjective measures, it is necessary to point out the conceptual similarities between the three utilities of the Siegel model and the three decision-making characteristics considered in this investigation. Utility of success is the value attached to making correct predictions, which represents the extent to which an individual tends towards
the maximization of monetary return in his choice behavior. Thus, utility of success and maximizing tendency are equivalent terms. Utility of variability represents a measure of the value to an individual of vacillating or alternating between choice alternatives, and is, therefore, equivalent in meaning to the decision characteristic of degree of indecisiveness. The conceptual meaning of the utility of risk, although tentatively given as a measure of the satisfaction inherent in predicting the less frequent event, was never stated explicitly by Siegel. However, for purposes of this discussion, it will be assumed that the concepts of degree of risk assumption and the utility of risk are equivalent.

Stated more precisely, it is suggested that the three utilities are related to the three decision-making characteristics as follows:

\[ U_s = \text{maximizing tendency} \]
\[ U_r = \text{degree of risk assumption} \]
\[ U_v = \text{degree of indecisiveness} \]

The three decision-making characteristics were measured in terms of maximization, risk-aversion, and decisiveness, so that the values obtained for the latter two must be restated in terms of the opposite extremes of their respective continua. Using the symbols, \( R_{as} \), \( R_{av} \), \( I \) and \( D \) to represent risk-assumption, risk-aversion, indecisiveness,
and decisiveness, respectively, the conversions may be shown as follows:

\[ R_s = 450 - R_{av} \]
\[ I = 300 - D, \]

where 450 is the maximum value that can be obtained for the risk-aversion scale, and 300 is the maximum value that can be obtained on the decisiveness scale.

The values of each of the three characteristics measured by the experiment can, therefore, be stated in terms of the corresponding utilities, as follows:

\[ U_s = \frac{M}{48} \tag{3a} \]

where \( M \) is the score obtained on the maximizing scale, and 48 is the maximum value.

\[ U_r = \frac{450 - R_{av}}{450} \tag{3b} \]

\[ U_v = \frac{300 - D}{300} \tag{3c} \]

The denominator in each of the above equations corresponds to the maximum value of the respective scales. By performing the indicated divisions, the utility values are equilibrated to permit summation.

The development of the method for the external assessment of the subjective measures utilized in the model II prediction equation can now be undertaken. The following equations represent the definitions of the utilities of success, risk, and variability, as given by model II:
Solving equations (1a), (1b), and (1c) for the values of the marginal utilities, a, b, and c, the results are as follows:

\[
a = \frac{U_s}{p^{2m}}
\]

\[
b = \frac{U_r}{(1-p)(1-\pi)}
\]

\[
c = \frac{U_v}{p(1-p)}
\]

Substituting these expressions into equation (2), the model II prediction equation, yields:

\[
p = \frac{\frac{U_s}{2} \cdot (\pi) - \frac{U_r}{2} \cdot (1-p)(1-\pi) + \frac{U_v}{p(1-p)}}{2 \left( \frac{U_v}{p(1-p)} \right)}
\]

\[
= \frac{(1-p)U_s - pU_r + U_v}{2U_v}
\]

\[
= \frac{2U_s}{2U_v + U_s + U_r}
\]  \( (4) \)

Thus, \( p \), representing the proportion of times the subject chooses the more frequent event so as to maximize his subjective expected utility, can be predicted by model II from the value of the three utilities, \( U_s \), \( U_r \), and \( U_v \).
These utility values can be derived from the scores obtained on the three decision-making scales of the present experiment, as shown by equations (3a), (3b), and (3c). Substituting these values into equation (4) yields:

\[
p = \frac{2}{2} \left( \frac{300 - D}{300} \right) + \frac{M}{48} + \frac{450 - R_{av}}{450}
\]  

The solution of equation (5) for \( p \) requires that the values of \( M, D, \) and \( R_{av} \) be obtained for each subject. The modified two-choice experiment utilized in the present investigation could be employed for the purpose of obtaining these values. However, such a procedure would possess the same inherent disadvantages as that used by Siegel in the estimation of marginal utilities. That is, it would first be necessary to observe the choice behavior of a given subject over a number of trials in the modified two-choice situation before his choice behavior in the simple two-choice situation could be predicted.

The significance of the relationship of this study to Siegel's decision-making theory is not the development of an experimental procedure for determining the values of the three subjective utilities. Rather, the significance lies in the experimental finding that the values of the subjective utilities of success, risk, and variability can be predicted from personality measures alone. It is suggested,
then, that such personality measures provide an external means of assessing the values of the three subjective utilities, so that the model II prediction equation may be stated as follows:

\[ p = \frac{2 \left( \frac{450-Y_{Rav}}{450} \right) - \frac{Y_M}{48} - \frac{Y_{D}}{300}}{2 \left( \frac{300-Y_{D}}{300} \right) \frac{450-Y_{Rav}}{450}} \] (6)

Thus, by means of the regression equations shown in Table III, the value of \( p \) in the simple two-choice situation can be predicted for a given individual on the basis of his scores on the A, Dy, Do, Ca, Re, Pr, and Cn scales of the MMPI. The degree of accuracy of such predictions, however, cannot be determined from the data obtained from the present investigation. A simple test of the accuracy of the predictions given by equation (6) could be performed by administering the simple two-choice experiment to a number of subjects from whom the appropriate personality measures had been obtained. The degree of linear relationship between the observed and predicted choice behavior would represent an index of the predictive accuracy of equation (6).

The findings of this investigation, then, can be interpreted in terms of the theoretical framework of Siegel's choice behavior models. Siegel postulated that in deciding between alternatives, an individual chooses so as to obtain the maximum value of the sum of the components of the total
subjective expected utility. In experimental tests of model II, Siegel demonstrated that choice behavior in the simple two-choice situation can be predicted for a given individual on the basis of the subjective utility components representing success, risk, and variability. The major limitation, however, is that the theory makes no provision for the external assessment of the three subjective utility values. One of Siegel's co-workers, Robert Radlow (1, p. 273) has referred to this limitation as the "one significant gap" existing in the theory.

The findings of the present investigation suggest that certain personality measures provide this external means of assessing the values of the three subjective utility components. Thus, the experimental results of this study serve to validate the subjective utility concepts of Siegel's decision-making theory. In addition, these results can be interpreted as extending the theory by offering an external means for obtaining the essential subjective utility measures.

Such an interpretation is not without rational foundations. According to Siegel, $U_s$, $U_r$, and $U_v$ are subjective variables which influence the choices of an individual in a decision situation. The present findings suggest, merely, that these same subjective factors that influence the decision behavior of an individual, also influence his answers to certain questions contained in
the MMPI. Consequently, his answers to these MMPI questions can serve as a basis for predicting his choice behavior.

It is necessary to emphasize that it is not the intent of this study to imply that the MMPI scales represent the best personality measures for predicting decision behavior characteristics. It is entirely possible that other personality inventories are better suited to such use. Moreover, it is not the intent of this investigation to suggest that personality variables are the only subjective factors which are relevant to the decision-making process. It seems likely that other subjective factors, ranging from intelligence to indigestion, play significant roles as determinants of choice behavior.


BIBLIOGRAPHY

Books

Abelson, Robert P., "The Choice of Choice Theories,
Decision and Choice, edited by S. Messick and A. H.

Andrews, Julia McMichael, "Individual Choice and Strategy
Behavior," Decision and Choice, edited by S. Messick

Bush, R. R. and F. Mosteller, Stochastic Models for Learning,

Davidson, D., P. Suppes, and S. Siegel, Decision Making: An
Experimental Approach, Stanford, California, Stanford
University Press, 1957.

Feldman, Julian, "Computer Simulation of Cognitive Processes,
Computer Application in the Behavioral Sciences, edited
by Harold Borko, Englewood Cliffs, New Jersey, Prentice-
Hall, 1962.

Fouraker, Lawrence E., "Level of Aspiration and Group
Decision Making," Decision and Choice, edited by
S. Messick and A. H. Brayfield, New York, McGraw-Hill,
1964.

Green, Paul E., "A Behavioral Experiment in the Economics
of Information," The Psychology of Management Decision,
edited by George Fisk, Lund, Sweden, Cwk Gleerup Pub-
lishers, 1967.

Keenan, J. M., and A. H. Hoverland, "The Effect of
Personality in a Management Game Structured as a
Prisoner's Dilemma," The Psychology of Management
Decision, edited by George Fisk, Lund, Sweden, Cwk

Radlow, Robert, "Decision Making and the Theory of Learning,
Decision and Choice, edited by S. Messick and A. H.

Restle, Frank, "Siegel's Contribution to Learning Theory,
Decision and Choice, edited by S. Messick and A. H.


Articles


Unpublished Materials


Schkade, L. L. and J. P. Scarborough, "Personality Correlates of Decision Making," unpublished pilot study, Department of Business Administration, North Texas State University, Denton, Texas, December, 1967.