

(FINAL REPORT)

PREDICTING DECISION MAKING BEHAVIOR
FROM PERSONALITY AND COGNITIVE VARIABLES

TECHNICAL DOCUMENTARY REPORT NO. ESD-TDR-64-619

NOVEMBER 1964

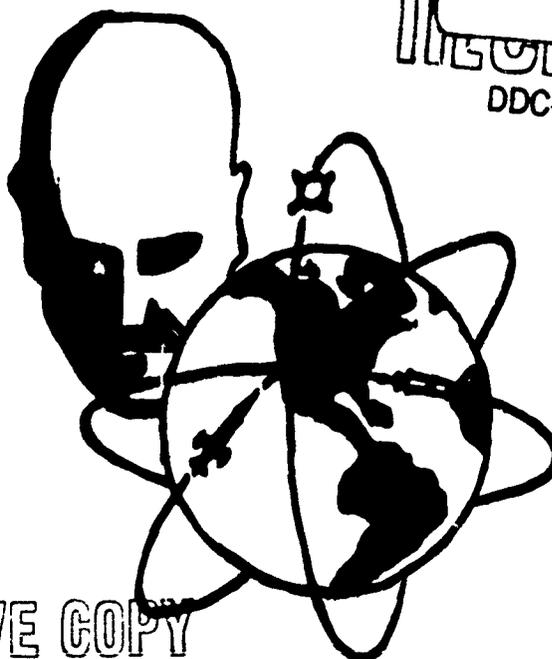
John C. Townsend
Walter J. Smith

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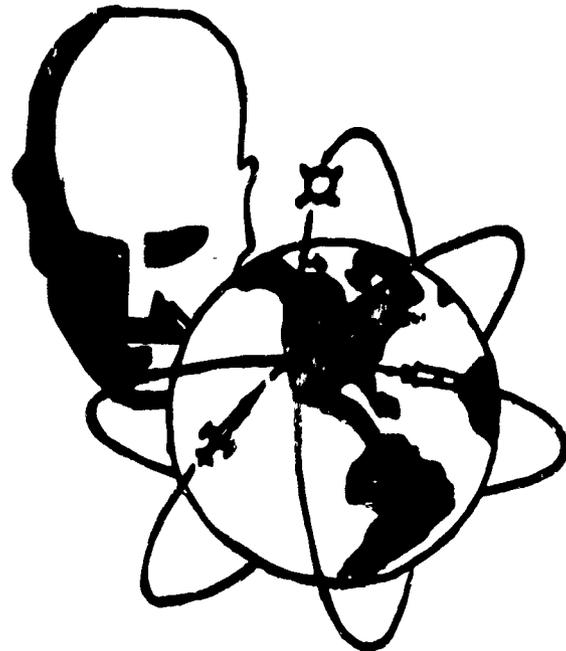
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(Prepared under Contract No. AF 19 (628)-2822 by the Catholic University of America,
Washington, D. C.)

FOREWORD

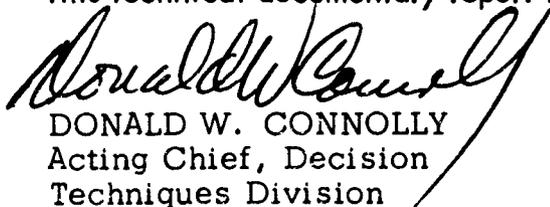
The authors wish to express their appreciation to the following individuals who either served as research assistants or gave research assistance during the data collection phases of this study: Mr. Charles M. Friel, Mr. Cornelius J. Feehley and Mrs. Mary J. Lukins - all of the Department of Psychology, The Catholic University of America.

ABSTRACT

In an attempt to write multiple regression equations predicting decision making behavior from personality and cognitive variables, a pilot study (N=60) and a main study (N=201) were conducted. Unselected, undergraduate college males and females from two separate universities served as subjects. Predictor groups of variables for each of 13 categories of decision making criteria were hypothesized. The results indicated that seven of the multiple regression equations through their beta coefficients yielded multiple correlation coefficients significant at $P < .01$, three at $P < .05$ and three at $P > .05$. All of the multiple correlations related to the prediction of "goodness" of decision were significant beyond the .01 level. The least profitable predictions resulted from attempts to predict decision time. Predictions of confidence in decision were intermediate. The largest amount of criterion variance accounted for was 16 percent. Low multiple correlation coefficients were expected due to the restricted range of personality and cognitive scores in persons normal in personality and above average in intelligence. Similar research in which normal individuals would be subjected to stress to reveal underlying personality differences is indicated.

REVIEW AND APPROVAL

This technical documentary report has been reviewed and is approved.


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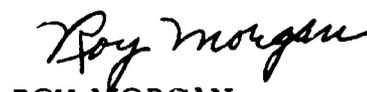

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Predicting Decision Making Behavior From Cognitive and Personality Variables

I. Introduction

The increasing importance of decision making ability in modern industry, military and other aspects of our civilization has created a need for decision makers to replace the skilled craftsmen of the pre-automation era. This changing picture is well known and need not be discussed here. However, identifying and predicting the decision making ability of individuals is not so well known and is the basis of this report.

Interest in the relationship of the decision making process to psychological variables was considerably stimulated by the work of Edwards (1954) wherein he suggested that the expected utilities of the von Neumann and Morgenstern model are developed more on subjective than on objective bases. Although Edwards' subjectively expected utility or "SEU" has not held up as well as expected, he has shown (1953, 1954, 1954a, 1954b, 1954c) that the decision making process is very complex and that the previous models were too simple to effect an adequate fit. Because subjects who did not decide so as to maximize their expected winnings varied as to their preferences and expectations it became clear that the degree of possession of psychological variables by the subject was in some way related to the decisions he would make. This pointed up the role of individual differences in decision making, and, of course, the possibility of establishing a basis for the selection of decision makers by measuring their degree of possession of the pertinent psychological characteristics.

Block and Peterson (1955), attempting to relate decision making ability to personality factors, found that speed and confidence were related to a

number of psychological traits. Fast deciders appeared to belong to a group which was passive, suggestible and conforming, while ascendency, humor and self-assurance characterized the group of slow deciders. Overly confident subjects were dogmatic and rigid while extremely cautious subjects tended to be introspective and self-abasing.

Further support was lent to the importance of the relationship of personality traits to decision making behavior by the work of Scodel, Ratoosh and Minas (1959). A conclusion of their study was that low pay-off bettors were a more other-directed, more socially assimilated and more middle class oriented group.

In addition to the work of these investigators, further evidence for the relationship of personality factors to decision making is found in the writings of Atkinson (1957, 1960), Festinger (1943, 1943a), Rotter (1954), Anker, Townsend and O'Connor (1963), Atthowe (1960), Liverant and Scodel (1960), and Feather (1959).

As one attempts to organize the results of these studies he finds that the only thing they appear to have in common is a consistent relationship between some measures of personality and some measure the authors of the articles have chosen as being indicative of either decision making ability, decision time, or confidence in one's decisions. Most of the investigators have used ad hoc tests of decision making and sometimes a standardized but often a newly developed ad hoc test of personality variables.

Because of the unstructured approach which has seemed to characterize much of the research in decision making, it is hazardous to formulate generalizations based on the relationships reported in the literature. It would appear that the time is ripe for an investigation of the relationships between personality factors and decision making behavior which uses well known tests of personality

and which uses reliable tests of decision making ability. Such tests should be based on a defensible rationale, have respectable reliabilities, and be designed to cover general rather than specific areas of decision making ability.

A. Purpose of the Study

Specifically, this study attempted to identify, measure and predict from particular cognitive and personality variables certain scores on a criterion test of decision making ability.

B. Value of the Present Research

While the present study was designed specifically to assemble a battery of personality and cognitive tests predictive of decision making ability in the broadest sense, a spin-off of the study is knowledge concerning the ability of commonly used standardized tests of personality and cognitive factors to predict decision making behavior. It was felt that unless relationships could be found using such well accepted tests, the present knowledge of the supposed relationships, presented in the literature and based upon ad hoc tests, could be in doubt when applied to the prediction of general decision making behavior.

The present research attempts to make available a battery of tests capable of aiding the researcher in his selection of subjects for investigations in the decision making area. Thus the researcher will have data available which will permit him to assign subjects to experimental and control groups in terms of personality and cognitive variables associated with good and poor decision making ability.

Additional modifications of a test of decision making ability took place during this research project. The test was developed as a criterion measurement in the prediction of decision scores from a cognitive and personality

battery and was investigated statistically in order to evaluate its ability per se to measure general decision making ability. Thus, this research study provides not only a means of predicting decision making ability from personality and cognitive tests, but also a means of securing direct measurement of decision making ability.

II. Method

A. General Approach

Any one wishing to identify good decision makers may take one of at least two approaches. He could devise a valid test of decision making ability and administer it to his prospective decision makers. By choosing those who were at or near the top of the test he could select the best decision makers of his sample. The difficulty is that if decision making is an ability rather than an aptitude, and if the test is to be valid, it would almost certainly have to be specific to the area wherein the decision making is to take place, viz., business, military, etc. If, on the other hand, decision making is an aptitude which depends upon the intellectual and personality traits of the decision maker, then the use of a test in a specific area would be only directly applicable to that area, and would certainly less efficiently predict the general decision making ability of the individual. Thus, the use of such direct tests of decision making would necessitate the development of a different test for each area of interest to decision making.

A second approach, therefore, would be to concern oneself with decision making as an aptitude rather than an ability. By so doing one would be answering the question "to what degree does a particular individual possess the basic ingredients from which good decision making behavior would emerge with proper experience in any given area?" Such an approach would be of most use to large organizations in which it is desirable to select decision makers

in a general sense and not to have their decision making abilities restricted to particular areas of previous training. To measure such an aptitude one would not want a test of decision making, per se, but would need to measure subjects' possession of those characteristics which are known to be related to decision making behavior as aptitude is to ability.

The second approach is the one which was taken in the present research. In carrying through such an approach, several problems become immediately apparent. First, one must select a criterion of good decision making. Second, one must determine just what are the prerequisite cognitive and personality traits which are associated with an aptitude for good decision making. Third, one must discover valid means of measuring both the psychological traits and the criterion. Fourth, one must relate the predictors to the criterion using the best weighted values in doing so. The carrying out of these four steps constituted the approach to the solution of the problem. Each of these steps will now be discussed in detail.

B. Definition of Criteria of Decision Making

1. Development of Tests

The Townsend-Smith Test of Decision Making Ability was modified, improved, and used to yield criterion scores in this study. In order for the reader to evaluate the use of scores on this test as criteria measures of decision making ability, it will be necessary to discuss the development of the test in terms of a definition of decision making ability, the rationales behind the test, its physical aspects, the types of subscores yielded, and the results of the test's cross validation, reliability and validity studies.

The test was developed to yield measures in three broad areas of decision making: risk, uncertainty, and certainty. For the section of the test dealing with decision making under risk the rather traditional approach of using a betting situation was chosen. By use of the rationale that the

best choice in a decision made under risk is that alternative which maximizes the probability of achieving the desired goal, matrices were devised which presented alternative choices of probability of winning, value bet, and payoff in case of a win. Sixteen such matrices of increasing numbers of alternatives were presented the subject, and his performance was scored in terms of good, fair, and foolish bets. A fair bet was that combination of value bet and odds of winning which had the probability of a calculated payoff allowing the subject to neither win nor lose in the long run. A good bet was one yielding twice the payoff of a fair bet. A foolish bet was one which would pay one-half the amount of a fair bet. Scores showing confidence on a percent scale were obtained as were overall decision time scores for each section of the test.

The second section of the test dealt with decision making under uncertainty, which is defined as choosing among alternatives wherein the probability of success of any given alternative is unknown. The rationale behind the items of the uncertainty test was established as follows. Through expert opinion employing logical methods and the research of other investigators, seven general principles of good decision making under uncertainty were agreed upon. In line with and exemplifying each of these principles, seven test items were written for each of the seven principles. Each of the seven groups of seven items consisted of situations which might commonly occur and demand a decision in the everyday life of an individual; i.e., home, health, business, sports, academic, professional, executive, respectively. Thus, a 49 item test was devised. The scoring consisted of determining if the subject decided in each case in a way consistent with the appropriate principle of decision making. If he did his answer was scored as correct. Scores for confidence and decision time were also recorded.

The third section of the test dealt with decision making under certainty.

Such decisions are those which are made when a choice among alternatives leads invariably to the goal related to the choice. Life situations demanding a decision and presented in the test items placed the subject in conflict with a value system commonly accepted in Western culture. The subject was asked, after a description of each set of circumstances, what the person in the hypothetical decision situation should have done, and what he, the subject, would have done in the situation. The highest score was given to the answer which showed that the subject had chosen in a way consistent with a commonly accepted value system usually governing such a situation. A lower score was assigned for a choice which showed that the subject knew what was expected but chose in a way inconsistent with the prevailing value system. The poorest score assigned indicated that the subject did not know what was expected in terms of the prevailing system of values. Decision time and confidence scores also were gathered for each item of this section of the test.

All three of the sub-tests were administered in paper and pencil form. Composite scores as well as sub-scores were secured for the goodness of the decision, decision time and decision confidence.

2. Statistical Evaluation of the Townsend-Smith

Items used in the three sections of the test discussed above were those which had survived a cross validation. The cross validation consisted of administering a large number of test items to two separate groups of undergraduate college students. Tetrachoric r 's were computed between performance on an item and performance on the total test. Only those items which yielded coefficients significantly different from zero ($P < .05$) on both samples of subjects were chosen for inclusion in the resulting Townsend-Smith Test of Decision Making Ability.

Reliability coefficients of the Townsend-Smith test are shown in Table I.

TABLE I

Ranges of Reliability Coefficients for scores of
the Townsend-Smith Test of Decision Making Ability

Type of Score	Split Half	Test-Retest
Goodness	.69 to .93	.41 to .84
Decision Time	. none	.07 to .62
Confidence	.78 to .96	.75 to .87

In accordance with Contract provisions (Part II - Statement of Work; Section A; subsection c.), an attempt was made to validate the tests made by staff-level Air Force officers with their Officer Effectiveness Ratings (OER's). The item selected for Company Grade officers was #5. "Judgement", described as "ability to grasp a situation, think clearly, and develop correct and logical conclusions," and which refers to "right decisions," "accurate decisions", and "decisions ... often wrong and ineffective", as guides for the evaluating officer. For Field Grade officers the item selected was also #5. "Executive Judgement," which gives the direction "assess his ability to make sound recommendations and decisions in normal situations as well as in situations in which he is faced with relatively unusual new problems for which answers are not readily available from experience or job knowledge."

Subjects were obtained from among the officers assigned to Headquarters, Air Force Systems Command, at Andrews Air Force Base, Washington, D. C. The sample was selected randomly from the files so as to yield sufficient subjects with ratings of "3" who could be compared with subjects with ratings of "5" on the tests of decision making. The OER rating scale ranges from a low of 1 to a top rating of 5.

Headquarters, Air Force Systems Command requires that its officer personnel be highly selected. As a consequence, only 10 officers with ratings as low as "3" were to be found in the personnel files, and of these only six were available for testing at the time the validation study was being conducted. When these were compared with 18 randomly selected officers with ratings of "5" on the Townsend-Smith Test of Decision Making Ability, the biserial r between their combined Goodness of Decision Scores and their OER's was .30, which though not statistically significant, is in the expected direction.

A further attempt was made to introduce more variability into the criterion variable by having the officers who were available for testing evaluated, by the same superior officer who had made out their OER's, on a 10 item Rating Scale of Decision Making Behavior specially devised for this purpose. The highest possible score on this measure is 60, the lowest, 10. The scores attained by the 25 officers for whom scores were available on both the rating scale and the decision making tests ranged from 35 to 55. The Pearson Product-Moment r between their scores on the rating scale and their combined Goodness of Decision scores was .37, which is significant at the .05 level of confidence, and in the expected direction.

In view of the fact that as greater variability was achieved with the sample of Air Force officers used in the validation study, the validity coefficient rose to significance at the .05 level of confidence, it seems likely that were the variability further increased the coefficient would be further enhanced, perhaps even to a value where individual prediction might be feasible. In order to do this a sample of Air Force officers from an installation or a combination of installations with less highly selected personnel would have to be obtained. If a sample were secured which showed wide

variability in ratings on item #5 for both Company Grade and Field Grade officers, and a sufficiently large number of officers in each rating category could be made available for evaluation on the Townsend-Smith Test of Decision Making Ability, bi-serial r's could be computed which would be likely to be highly significant.

An additional effort to widen the variability of this kind of sample could be made by having their superior officers re-evaluate the decision making behavior on the rating scale described above. Product-Moment r's between these ratings and scores on the Townsend-Smith Test of Decision Making Ability would also be likely to be sufficiently high to warrant some individual prediction.

C. Definition of Predictors

The predictors planned for use in this study were those which could be categorized as measures of cognitive and personality variables. In the case of the cognitive variables, the researchers essentially meant intelligence. It was planned to use measures from some test of intelligence or some test which had a high correlation with intelligence measures, i.e., the SCAT, which correlates well with the Weschler-Bellevue. Thus it was thought that three possible scores for intelligence would be available: total, quantitative, and verbal.

As a test of additional cognitive variables, the Watson-Glaser Critical Thinking Appraisal was selected. This test has high face validity for dealing with the logical elements of decision making behavior.

It was much more difficult to settle on the predictors from the area of personality. An exploration of the pertinent literature revealed several studies of interest, all of which were mentioned in the introduction of this report.

A study performed by Anker, Townsend and O'Connor (1963) provided the only

relevant factor analytic information located in the literature. From this study it was possible to come to several conclusions concerning the prediction of decision making ability from personality and cognitive factors. First, the use of the Minnesota Multiphasic Personality Inventory (MMPI) revealed no consistent relationship with any of the parameters of decision making investigated. The decision making scores used by Anker et al were yielded by a decision making apparatus which utilized some of the same decision making problems as were planned to be used in the present study. Second, the apparent reason for the low correlations found by Anker et al. was the fact that in using normal populations, as was done in their study, one does not expect to see the variance in personality characteristics which would support substantial correlations. Thus it would appear reasonable to expect that any study which plans to use standardized personality tests in predicting decision making ability in normal subjects is doomed to reap only low to medium range correlations in any consistent fashion.

Other studies have reported correlations between personality and decision making variables, as mentioned earlier in this report. However, since nearly every investigator used different tests of personality and different types of decision criteria, there is no bundle of research which can be considered mutually supportive and internally consistent. The only impression or interpretation possible from which a generalization can be made is this: there appears to be a general picture of a consistent relationship between personality and decision making measures which is small in normal populations but is probably larger in populations having more variance in personality scores or in normal populations when the individuals are under stress.

The next step is obvious. A large study should be performed which would demonstrate on a single large population the ability of well selected

groups of well known personality measures to predict valid decision making scores. In this manner a picture of the interrelationships among all of the variables utilized could be determined. Further, the amount of decision making variance accounted for by the best weighted personality and cognitive measures used could be determined for a normal population. Finally, one should not expect high correlational values.

D. Selection of Predictors

Rather than administer a large variety of personality tests and then hope to find some correlation between their scores and decision making scores, it was, of course, thought to be better to hypothesize those relationships which one might expect on the bases of existing theories relating certain kinds of personality variables and decision making scores. This would minimize the likelihood that chance correlations would be accepted as factual. To accomplish this, a list of personality variables was selected which had either an empirical or rational a priori basis for serving as predictors of decision making ability.

Attention was then directed to the selection of standard personality tests which purported to measure the variables chosen. There was no scarcity of tests in this regard. However, in attempting to choose which test among several to use in the measurement of a particular variable much difficulty was encountered. As a means of selecting the measuring instrument, Buross' Mental Measurement Yearbook, among other source literature was consulted. Only those tests which were most favorably reviewed were chosen. The final decision was always in terms of the value of the test in light of its statistical evaluation. Low validities or low reliabilities immediately excluded a test from further consideration. Thus as each personality variable was chosen for use as a predictor in the study, an attempt was made to find a measuring instrument for it.

Obviously too large a number of tests was involved. The total number of personality variables and tests to measure them was reduced by application of the principle of the maximum number of variables measured by the minimum number of tests. The particular tests chosen for either the pilot or the main study and the full or part scores used in the analysis will be discussed under the pilot or main study sections, respectively, of this report.

III. Pilot Study

A. Purpose and Method

It was decided to perform the research covered by this report in two phases. The first phase was a pilot study involving a sample of 60 subjects from the undergraduate population of one university. As a result of this phase certain decisions were to be made based upon the analysis of the data. The a priori hypotheses of certain relationships between the selected cognitive and personality variables were to be either supported or rejected by the data. Those hypotheses which were not supported permitted the elimination of certain of the personality and decision variables and the substitution of others before the main study was begun. The second phase, the main study, was a repetition of the first with changes in certain variables being made and with a different university undergraduate student body providing the subjects. The two universities from which the subjects were drawn were The Catholic University of America and The George Washington University. It was felt that there might be some reason for questioning the generality of results based solely on Catholic University students. Repeating the study on the George Washington University students permitted these differences to become apparent if present and if there were no differences, to permit a pooling of information. Thus the use of the undergraduate samples from the two schools made more safe the generalizations to other undergraduate populations and similar individuals at large. Although intercorrelations were, of necessity, com-

puted among all of the pilot study variables, it was not planned to write multiple regression equations or to compute multiple correlations for all variables. Rather in both the pilot and main studies the procedure to be used in the selection of predictor and criterion variables was as follows:

1. The two major researchers involved in the study each independently selected from the entire list of possible predictors those which each thought from other research and from a theoretical view point would best predict the decision making criteria. Regression equations were planned for each set of variables each of the researchers had chosen independently.

2. Regression equations were planned for each of the combination of variables upon which the two investigators had concurred in their independent selection.

Although the two methods of selecting the variables indicated above represents an a priori approach and is the safest to employ, it was thought that as an added safeguard certain other valuable information should not be overlooked simply because neither of the investigators had predicted that a particular variable or combination of variables would be of value. Thus in a posteriori manner the matrices of inter- and cross-correlations were carefully studied to identify those variables which were not selected by either investigator but which had produced a correlation with decision making variables at or beyond the .05 level of confidence for the hypothesis that $r = 0$. Since the pilot study was repeated in its essentials in the main study to follow, the a posteriori hypotheses of the pilot study became the a priori hypotheses of the main study. Thus, no methodological problems of interpretation were anticipated.

B. Tests Administered and Scores Used

TABLE II

Predictor and Criterion Variables Utilized

Test	Pilot Study Variable Number	Main Study Variable Number	Variable (V)	High Score	Low Score
California Psychological Inventory	1	1	Dominance	Aggressive	Lacks Confidence
	2	2	Well Being	Energetic	Unambitious
	3	3	Tolerance	Tolerant	Suspiciousness
	4	4	Intellectual Efficiency	Efficient	Confused
	5	5	Good Impression	Cooperative	Inhibited
	6	6	Capacity for status	Ambitious	Apathetic
	7	7	Responsibility	Planful	Immature
	8	8	Communality	Dependable	Impatient
	9	9	Psychological Mindedness	Observant	Apathetic
	10	10	Sociability	Outgoing	Awkwardness
16 Personality Factor Test Form C.	11	11	MD		
	12	12	A	Warm	Aloof
	13	13	B	Bright	Dull
	14	14	C	Calm	Unstable
	15	15	E	Dominant	Submissive
	16	16	F	Enthusiastic	Glum
	17	17	G	Conscientious	Undependable
	18	18	H	Adventurous	Timid
	19	19	I	Sensitive	Tough

	20	20	L	Suspecting	Trustful
	21	21	M	Bohemian	Conventional
	22	22	N	Sophisticated	Simple
	23	23	O	Insecure	Confident
	24	24	Q ₁	Radicalism	Conservatism
	25	25	Q ₂	Self Sufficient	Dependent
	26	26	Q ₃	Exact	Unsure
	27	27	Q ₄	Excitable	Composed
School and College Aptitude Test	28		Total		
	29		Verbal		
	30		Quantitative		
Henmon-Nelson Test of Mental Ability, College Level, Form A		28	Total		
		29	Verbal		
		30	Quantitative		
California Test of Personality	31	31	Self reliance		
	32	32	Sense of Personal Worth		
	33	33	Sense of Personal Freedom		
	34	34	Feeling of Belonging		
	35	35	Withdrawing Tendencies		
	36	36	Variety of Physical Symptoms		
	37	37	Personality Adjustment		

	38	38	Understands Rights of Others		
	39	39	Shows a Liking for Others		
	40	40	Anti-social Tendencies		
<hr/>					
Watson-Glaser Critical Thinking Appraisal	41		Raw Score		
<hr/>					
California Psychological Inventory	42	41	Socialization	Conscientious	Rebellious
	43	42	Achievement and Conforming	Cooperative	Stubborn
	44	43	Flexibility	Observant	Apathetic
	45	44	Social presence	Imaginative	Self Restrained
	46	45	Achievement v. Independence	Mature	Inhibited
	47	46	Femininity	Appreciative Patient	Outgoing Hard Headed
	48	47	Self Acceptance	Aggressive	Self Abusing
	49	48	Self Control	Calm	Impulsive
<hr/>					
California Test of Personality	50	49	Feels Loved and Well Treated		
	51	50	Good School Relations		
	52	51	Good Community Relations		
	53	52	Social Adjustment		
	54	53	Total Adjustment		

Townsend-Smith	55	54	Goodness of Decision under Risk
Test of Decision Making			
	56	55	Confidence in Decision under Risk
	57	56	Decision Time under Risk
	58	57	Goodness of Decision under Uncertainty
	59	58	Confidence in Decision under Uncertainty
	60	59	Decision Time under Uncertainty
	61	60	Goodness of Decision under Certainty
	62	61	Decision Time under Certainty
	63	62	Lack of Confidence in Decision
	64	63	Confidence in Decision under Certainty
		64	Composite Goodness of Decision Score
		65	Composite Decision Time Score
		66	Composite Decision Confidence Score

Fifty-four of the variables utilized in the pilot study were cognitive and personality predictors and 10 were the criterion measurements of decision making performance. The variables were measured by eight tests with the final regression equations of the pilot study being based on selected scores from each.

Eighteen of the personality and cognitive variables were from the California Personality Inventory, 15 from the California Test of Personality, 17 from the 16 Personality Factor Test, 3 from the School and College Achievement Test and 1 from the Watson-Glaser Critical Thinking Appraisal. In measuring the decision making performance of the subjects, all scores were achieved on the Townsend-Smith with the following 10 sub-scores utilized as criteria to be predicted by the personality and cognitive variables: 1 score for Goodness of Decision under each section of the test dealing with risk, uncertainty and certainty, respectively; 1 score for Decision Time under each section of the test dealing with risk, uncertainty and certainty, respectively; 1 score each for Confidence in Decision under each section of the test dealing with risk, uncertainty and certainty, respectively; and, 1 score for a special lack of confidence variable.

Using the methods of selecting the predictor and criterion variables outlined previously, beta weights were secured and regression equations written for each combination of predictors and criterion selected a priori. Multiple R's were then derived for each combination of predictors and criterion chosen.

C. Subjects

Sixty undergraduate students at The Catholic University of America served as subjects in the Pilot Study. All data were collected during the Spring semester, 1963. Twenty-seven of the 60 students were males and 33 females. Their ages ranged from 17-11 to 23-4 with a mean age of 19.58 years. No attempt was made to select students from any class but rather a general

selection of undergraduates from a number of classes representing various liberal arts subjects was undertaken. All testing was accomplished during a single day.

D. Results: Pilot Study

Presented in Appendix A are (1) all of the correlations computed in the pilot study relating the predictors to the criteria, and (2) the criteria intercorrelations. Predictor intercorrelations are not included in this report but are available from the authors. The IBM 1620 computer was used in the processing of the data.

The pilot study was conducted mainly to provide correlations between the predictors and criterion variables. This information permitted the selection, for investigation in the main study, of those variables most highly related to the criteria. It was decided to write multiple regression equations and to compute multiple correlations for each cluster of variables hypothesized to predict the criteria. Since some of the variables were chosen on the basis of a posteriori hypotheses and the N was small for the calculation of beta weights, it was decided not to make too much of the weights of the variables used in the equations. Thus more interest was taken in the identification of a group of variables which yielded a significant multiple correlation with the criteria and the level of significance of that correlation, than in the actual pilot study beta weights per se. Information in line with this interest and concerning only the 14 surviving equations is presented below.

P-1. Criterion Predicted: Goodness of Decision under Risk, Variable 55 (V55)

Predictors: Capacity for Status, CPI (V6)

Bohemian vs. Conventional, 16PF (V21)

Femininity (Patient vs. Hardheaded), CPI (V47)

Multiple R = .40¹ P<.01

P-2. Criterion Predicted: Goodness of Decision under Uncertainty (V58)

Predictors: Dominance, CPI (V1)

MD, 16PF (V11)

Conscientiousness, 16PF, (V17)

Liking for Others, CTP (V39)

Multiple R = .44 P<.01

P-3. Criterion Predicted: Goodness of Decision under Certainty (V61)

Predictors: Responsibility, CPI (V7)

Dominance, 16PF (V15)

Self Control vs. Impulsivity, CPI (V49)

Good School Relations (Individual feels that he counts
for something in the institution), CTP (V51)

Multiple R = .43 P<.01

P-4. Criterion Predicted: Decision Time under Risk (V57)

Predictors: Insecurity, 16PF (V23)

Sense of Freedom, CTP (V33)

Flexibility, CPI (V44)

Sense of Personal Worth, CTP (V32)

Good Impression, CPI (V5)

Bohemian vs. Conventional, 16PF (V21)

Femininity (Patient vs. Hardheaded), CPI (V47)

Multiple R = .50 P<.01

¹ No corrections of any kind were applied to the multiple R's found in this study.

P-5. Criterion Predicted: Decision Time under Uncertainty (V60)

Predictors: Exactness, 16PF (V26)

Total Adjustment, CTP (V54)

Social Adjustment, CTP (V53)

Multiple R = .37 P<.05

P-6. Criterion Predicted: Decision Time under Certainty (V62)

Predictors: Excitability, 16PF (V27)

Total Adjustment, CTP (V54)

Social Adjustment, CTP (V53)

Multiple R = .66 P<.01

P-7. Criterion Predicted: Confidence under Risk (V56)

Predictors: Tolerance, CPI (V3)

Capacity for Status, CPI (V6)

Communality, CPI (V8)

Brightness, 16PF (V13)

Bohemian vs. Conventional, 16PF (V21)

Physical Complaints, CTP (V36)

Anti-social Tendencies, CTP (V40)

Multiple R = .54 P<.01

P-8. Criterion Predicted: Confidence under Uncertainty (V59)

Predictors: Achievement via Independence, CPI (V46)

Social Presence, CTF (V45)

Sense of Personal Freedom, CTP (V33)

Total Score on SCAT (V28)

Sociability, CPI (V10)

Socialization, CPI (V42)

Anti-social Tendencies, CTP (V40)

Multiple R = .60 P<.01

P-9. Criterion Predicted: Confidence under Certainty (V64)

Predictors: Dominance, CPI (V1)

Dominance, 16PF (V15)

Exact, 16PF (V26)

Personal Adjustment, CTP (V37)

Social Adjustment, CTP (V53)

Total Adjustment, CTP (V54)

Multiple R = .53 P<.01

P-10. Criterion Predicted: Confidence under Certainty (V64)

Predictors: Tolerance, CPI (V3)

Withdrawing, CTP (V35)

Observant, CPI (V9)

Good Impression, CPI (V5)

Capacity for Status, CPI (V6)

Enthusiastic, 16 PF (V16)

Sociability, CPI (V10)

Adventurous, 16PF (V18)

Sense of Personal Worth, CTP (V32)

Social Presence, CPI (V45)

Good School Relations, CTP (V51)

Physical Complaints, CTP (V36)

Multiple R = .58 P<.01

P-11. Criterion Predicted: Confidence under Certainty (V64)

Predictors: Dominance, CPI (V1)
Personal Adjustment, CTP (V37)
Dominance, 16PF (V15)
Exact, 16PF (V26)
Social Adjustment, CTP (V53)
Total Adjustment, CTP (V54)

Multiple R = .40 P<.05

P-12. Criterion Predicted: Decision Time under Uncertainty (V60)

Predictors: Dominance, CPI (V1)
Tolerance, CPI (V3)
Good Impression, CPI (V5)
Responsibility, CPI (V7)
Sociability, CPI (V10)
MD Score, 16PF (V11)
Conscientiousness, 16PF (V17)
Withdrawing, CTP (V35)
Physical Complaints (V36)
Flexibility, CPI (V44)
Good School Relations, CTP (V51)

Multiple R = .56 P<.01

P-13. Criterion Predicted: Decision Time under Certainty (V62)

Predictors: Dominance, CPI (V1)
Observant, CPI (V9)
Suspicious, 16PF (V20)
Self-sufficient, 16PF (V25)
Exactness, 16PF (V26)
Total Score, SCAT (V28)
Sense of Personal Worth, CTP (V32)
Withdrawing Tendencies, CTP (V35)
Understanding of Others' Rights, CTP (V38)
Patient, CPI (V47)
Good Community Adjustment, CTP (V52)

Multiple R = .60 P<.01

P-14. Criterion Predicted: Lack of Confidence (V63)

Predictors: Responsibility, CPI (V7)
Dominance, 16PF (V15)
Adventurous, 16PF (V18)
Flexibility, CPI (V44)
Patient, CPI (V47)
Capacity for Status, CPI (V6)
Bohemian, 16PF (V21)
Socialization, CPI (V42)

Multiple R = .52 P<.01

E. Discussion and Conclusions: Pilot Study

The selection procedure employed for determining the variables entering into the prediction had resulted in 48 regression equations and, of course, an equivalent number of multiple correlations. Thirty-eight R's were found using the variables whose relationships were predicted a priori. Of these, 12 were significant at or beyond the .01 level and 2 were significant at the .05 level. Thus a total of 14 of the 38 variables based on a priori hypotheses were significant at or beyond the .05 level. Of the 12 significant at the .01 level, 3 involved a prediction of the criterion "goodness of decision," one each from the areas of risk, uncertainty, and certainty.

Ten R's were found by selecting cross correlations significant at the .05 level under a posteriori hypotheses. Of these, nine of the R's were significant at the .01 level and one at the .05 level. The variables yielding the significant multiple correlations were earmarked either for testing in an a priori manner or to aid in the selection of variables for the main study.

The multiple R's calculated ranged from .37 to .66 with more than half of them above .50. It had been expected that the correlations would be low due to the lack of much variability of personality scores in the normal population used in the study. Considering the percent of variance accounted for by the personality and cognitive predictors, one sees that some of the variables in combination accounted for as much as 44% and some as little as 14% of the variance of the decision making scores. More than half of the separate multiple regression equations had Coefficients of Determination showing that they accounted for at least 25% of the decision making variance.

All of this appeared rather promising and offered hope that some definite contribution to the understanding of the role of personality in decision making could be made by the main study to follow. It was, of course, noted

that because of the rather small N of 60, there was every chance that the R's had been inflated by chance deviations and might shrink when exposed to the larger N of 200 planned for the main study. For instance, when a bias correction was applied to the highest R found in the pilot study, it was found that cR^2 for an R of .66 with an N of 60 reduced the multiple correlation to $R = .43$. Thus it was expected on this basis that the multiple correlations would be lower in the main than in the pilot study.

Selecting the variables and their combinations from the pilot study so as to set up the best predictive equations was accomplished in the following fashion.

Variables which appeared to be insignificantly correlated with the decision making variables in the pilot study were excluded. This procedure immediately eliminated the Watson-Glaser from any further consideration as a predictor of decision making ability as measured by the Townsend-Smith. In fact, because the test did not correlate significantly with Goodness of Decision, no use was made of its scores even in the equations developed in the pilot study.

Although SCAT scores were used in the pilot study equations, their low correlation with the decision making criterion of goodness did not warrant their use in the main study. Instead, the Henmon-Nelson was substituted because it appeared to be a test more suited to measuring the above average intelligence of the population to be utilized.

Actually, many of the decisions made concerning the variables to be investigated in the main study were based upon the intercorrelations yielded by the pilot study. As a result of the selection of the variables in this manner, attention was turned to re-grouping the predictors so that on the basis of good rationale supported by good correlations both inter- and

multiple, the chances of securing the highest multiple R's in the main study would be enhanced.

The final analysis of the statistics of the pilot study, plus the use of a priori hypotheses yielded the following plan for the main study. It was decided to predict 12 decision making variables from 16 different numbers and combinations of 37 personality and cognitive variables. These equations are found in the main study which follows.

IV. Main Study

A. Method

Based upon the data resulting from the pilot study, the following tests were administered during this phase: California Psychological Inventory, 16 Personality Factor Test, Form C, Henmon-Nelson Test of Mental Ability, College Level, Form A, California Test of Personality, and the Townsend-Smith Tests of Decision Making Ability.

The predictors and the criteria were all intercorrelated and multiple regression equations written for those groupings of predictors previously selected. The only differences between the Pilot and Main Studies were that the Henmon-Nelson was substituted for the SCAT, the Watson-Glaser was eliminated in the Main Study and George Washington University rather than Catholic University students were used as subjects. The methodology was otherwise the same in the two studies.

B. Subjects

Complete data were secured on 201 subjects. The subjects were undergraduate male and female students at The George Washington University during the fall term of 1963. Ninety-two men and 109 women constituted the N. Their ages ranged from 17-4 to 34-5 years with a mean age of 19.87. The subjects were recruited from a variety of classes and were paid for serving in the

study. Tests were administered to a subject during a single day but several sessions covering a period of two months were required to secure complete and useable data on the large N desired.

C. Results: Main Study

In Appendix B one may find a listing of the correlations between the predictors and the criteria, and the intercorrelations between criterion measures. As in the case of the pilot study, intercorrelations between the various predictors in the main study are not presented in this report but are available from the authors.

Given on the following pages are the criteria predicted, the specific groups of predictors chosen, the beta coefficients, b weights, multiple regression equations, multiple correlation value, levels of significance, the standard errors of multiple estimate, and the mean and standard deviation of each of the criteria predicted.

M-1. Criterion Predicted: Goodness of Decision under Risk (V54)

Predictors: Intellectual Efficiency CPI (V54)

Ambitious, CPI (V6)

Observant, CPI (V9)

Henmon-Nelson Total IQ (V28)

Feels Loved and Well Treated, CTP (V49)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
4	.165	.276
6	.017	.041
9	.077	.255
28	.267	.217
49	-.011	-.016

K, constant (a coefficient) = 21.73

Multiple Regression Equation:

$$X'_{V54} = 21.73 + .276X_{V4} + .041X_{V6} + .255X_{V9} + .217X_{V28} - .016X_{V49}$$

Multiple correlation (R) = .39 P < .01

Standard error of multiple estimate (S.E. Mul.Est.) = 9.94

(Mean = 50.4; S.D. = 10.8)

M-2. Criterion Predicted: Goodness of Decision under Risk (V54)

Predictors: Ambitious, CPI (V6)

Bohemian, 16PF (V21)

Aggressive, CPI (V47)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
6	.110	.274
21	.221	1.254
47	.186	.398

K = 25.08

Multiple Regression Equation:

$$X'_{V54} = 25.08 + .274X_{V6} + 1.254X_{V21} + .398X_{V47}$$

R = .33 P < .01

S.E. Mul.Est. = 10.15 (Mean = 50.4; S.D. = 10.8)

M-3. Criterion Predicted: Goodness of Decision under Uncertainty (V57)

Predictors: Dominance, CPI (V1)

MD, 16PF (V11)

Conscientious, 16PF (V17)

Shws a Liking of Others, CTP (V39)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
1	-.143	-.055
11	.179	.165
17	.210	.213
39	.025	.265

K = 11.08

Multiple Regression Equation:

$$X'_{V57} = 11.08 - .055X_{V1} + .165X_{V11} + .213X_{V17} + .265X_{V39}$$

R = .32 P < .01

S.E. Mul.Est. = 2.37 (Mean = 12.1; S.D. = 2.5)

M-4. Criterion Predicted: Goodness of Decision under Uncertainty (V57)

Predictors: Dominant, 16PF (V15)

Conscientious, 16PF (V17)

Sophisticated, 16PF (V22)

Cooperative, CPI (V42)

Social Adjustment, CTP (V52)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
15	-.082	-.084
17	.151	.153
22	-.143	.193
42	.051	.035
52	-.176	-.112

K = 15.08

Multiple Regression Equation:

$$X'_{V57} = 15.08 - .084X_{V15} + .153X_{V17} + .193X_{V22} + .035X_{V42} - .112X_{V52}$$

R = .37 P < .01

S.E. Mul.Est. = 2.30 (Mean = 12.1; S.D. = 2.5)

M-5. Criterion Predicted: Goodness of Decision under Certainty (V60)

Predictors: Responsibility (planful), CPI (V7)

Dominant, 16PF (V15)

Patient, CPI (V48)

Good School Relations, CTP (V50)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
3	.091	.690
15	-.166	-.281
38	.062	.118
44	.183	.069
46	-.054	-.034

K = 9.96

Multiple Regression Equation:

$$X'_{V60} = 9.96 + .690X_{V3} - .281X_{V15} + .118X_{V38} + .069X_{V44} - .034X_{V46}$$

R = .34 P < .01

S.E. Mul.Est. = 3.9 (Mean = 14.3: S.D. = 4.2)

M-6. Criterion Predicted: Goodness of Decision under Certainty (V60)

Predictors: Tolerance, CPI (V3)

Dominant, 16PF (V15)

Understands Rights of Others, CTP (V38)

Imaginative, CPI (V44)

Patient, CPI (V46)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
3	.091	.690
15	-.166	-.281
38	.062	.118
44	.183	.069
46	.054	-.034

$$K = 9.96$$

Multiple Regression Equation:

$$X'_{V60} = 9.96 + .690X_{V3} - .281X_{V15} + .118X_{V38} + .069X_{V44} - .034X_{V46}$$

$$R = .34 \quad P < .01$$

$$S.E. \text{ Mul. list.} = 3.9 \quad (\text{Mean} = 14.3; \text{S.D.} = 4.2)$$

M-7. Criterion Predicted: Composite Goodness of Decision (V64)

Predictors: Tolerant, CPI (V3)

Planful, CPI (V7)

Dominant, 16PF (V15)

Conscientious, 16PF (V17)

Cooperative, CPI (V42)

Imaginative, CPI (V44)

Patient, CPI (V46)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
3	.069	.200
7	.046	.124
15	-.105	-.684
17	.142	.917
42	.126	.549
44	.078	.113
46	.055	.133

K = 91.95

Multiple Regression Equation:

$$X'_{V64} = 91.95 + .200X_{V3} + .124X_{V7} - .684X_{V15} + .917X_{V17} + .549X_{V42} + .113X_{V44} \\ + .133X_{V46}$$

R = .38 P<.01

S.E. Mul.Est. = 14.8 (Mean = 118.3; S.D. = 16.00)

M-8. Criterion Predicted: Decision Time under Risk (V56)

Predictors: Cooperative, CPI (V5)

Insecure, 16PF (V23)

Sense of Personal Worth, CTP (V32)

Flexibility, CPI (V43)

Patient, CPI (V46)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
5	-.011	-.012
23	-.172	-.671
32	.044	-.094
43	.072	.108
46	.192	.798

K = 12.64

Multiple Regression Equation:

$$X'_{V56} = 12.64 - .012X_{V5} - .671X_{V23} - .094X_{V32} + .108X_{V43} + .798X_{V46}$$

R = .19 P < .05

S.E. Mul.Est. = 7.06 (Mean = 12.2; S.D. = 7.2)

M-9. Criterion Predicted: Decision Time under Uncertainty (V59)

Predictors: Outgoing, CPI (V10)

Enthusiastic, 16PF (V16)

Exact, 16PF (V26)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
10	-.090	-.091
16	-.121	-.260
26	-.152	-.355

K = 21.57

Multiple Regression Equation:

$$X_{V59} = 21.57 - .091X_{V10} - .260X_{V16} - .355X_{V26}$$

R = .27 P < .01

S.E. Mul.Est. = 5.1 (Mean = 14.8; S.D. = 5.3)

M-10. Criterion Predicted: Decision Time under Certainty (V61)

Predictors: Excitability, 16PF (V27)

Social Adjustment, CTP (V52)

Total Adjustment, CTP (V53)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
10	.094	-.091
16	-.129	-.260
26	.060	-.355

K = 21.57

Multiple Regression Equation:

$$X'_{V61} = 21.57 - .091X_{V10} - .260X_{V16} - .355X_{V26}$$

R = .18 P > .05

S.E. Mul.Est. = 5.98 (Mean = 13.1; S.D. = 6.1)

M-11. Criterion Predicted: Decision Time under Certainty (V61)

Predictors: Dominance, CPI (V1)

Suspecting, 16PF (V20)

Exact, 16PF (V26)

Excitable, 16PF (V27)

Total IQ, Henmon-Nelson (V28)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
1	-.036	-.034
20	.028	.081
26	-.111	-.294
27	.020	.051
28	-.036	-.016

K = 16.59

Multiple Regression Equation:

$$X'_{V61} = 16.59 - .034X_{V1} + .081X_{V20} - .294X_{V26} + .051X_{V27} - .016X_{V28}$$

R = .15 P>.05

S.E. Mul.Est. = 6.04 (Mean = 13.1; S.D. = 6.1)

M-12. Criterion Predicted: Composite Decision Time (V65)

Predictors: Tolerant, CPI (V3)

Outgoing, CPI (V10)

Bright, 16PF (V13)

Enthusiastic, 16PF (V16)

Exact, 16PF (V26)

Excitable, 16PF (V27)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
3	.167	.400
10	-.234	-.581
13	.047	.434
16	-.014	-.756
26	-.116	-.668
27	-.016	-.090

$$K = 49.62$$

Multiple Regression Equation:

$$X'_{V65} = 49.62 + .400X_{V3} - .581X_{V10} + .434X_{V13} - .756X_{V16} - .668X_{V26} - .090X_{V27}$$

$$R = .29 \quad P < .01$$

$$\text{S.E. Mul.Est.} = 12.63 \quad (\text{Mean} = 40.1; \text{S.D.} = 13.2)$$

M-13. Criterion Predicted: Confidence under Risk (V55)

Predictors: Tolerant, CPI (V3)

Bright, 16PF (V13)

Bohemian, 16PF (V21)

Variety of Physical Symptoms, CTP (V36)

Anti-social Tendencies, CTP (V40)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
3	-.208	-.706
13	.048	.620
21	-.019	-.191
36	.156	1.14
40	.139	1.13

K = 51.15

Multiple Regression Equation:

$$X'_{V55} = 51.15 - .706X_{V3} + .620X_{V13} - .191X_{V21} + 1.14X_{V36} + 1.13X_{V40}$$

R = .21 P > .05

S.E. Mul.Est. = 18.31 (Mean = 62.9; S.D. = 18.7)

M-14. Criterion Predicted: Confidence under Uncertainty (V58)

Predictors: Dominance, CPI (V1)

Outgoing, CPI (V10)

Enthusiastic, 16PF (V16)

Exact, 16PF (V26)

Shows a Liking of Others, CTP (V39)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
1	.037	.064
10	.196	.412
16	-.035	-.157
26	.042	.210
39	.051	.243

$$K = 60.94$$

Multiple Regression Equation:

$$X'_{V58} = 60.94 + .064X_{V1} + .412X_{V10} - .157X_{V16} + .210X_{V26} + .243X_{V39}$$

$$R = .26 \quad P < .05$$

$$S.E. \text{ Mul.Est.} = 5.09 \quad (\text{Mean} = 14.8; \text{S.D.} = 5.3)$$

M-15. Criterion Predicted: Confidence under Certainty (V63)

Predictors: Dominance, CPI (V1)

Outgoing, CPI (V10)

Enthusiastic, 16PF (V16)

Self-reliant, CTP (V32)

Sense of Personal Worth, CTP (V33)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
1	.122	.267
10	-.086	-.230
16	.101	.581
32	.136	.856
33	.065	.344

$$K = 55.24$$

Multiple Regression Equation:

$$X'_{V63} = 55.24 + .267X_{V1} - .230X_{V10} + .581X_{V16} + .856X_{V32} + .344X_{V33}$$

$$R = .26 \quad P < .05$$

$$S.E. \text{ Mul.Est.} = 13.63 \quad (\text{Mean} = 74.9; \text{S.D.} = 14.2)$$

M-16. Criterion Predicted: Composite Confidence (V66)

Predictors: Dominance, CPI (V1)

Outgoing, CPI (V10)

Enthusiastic, 16PF (V16)

Feels Loved and Well Treated, CTP (V49)

<u>Variables</u>	<u>Beta Coefficients</u>	<u>b weights</u>
1	.028	.153
10	.021	.141
16	-.030	-.424
31	.121	1.91
49	.136	.650

$$K = 162.87$$

Multiple Regression Equation:

$$X'_{V66} = 162.87 + .153X_{V1} + .141X_{V10} - .424X_{V16} + 1.91X_{V31} + .650X_{V39}$$

$$R = .24 \quad P < .05$$

$$S.E. \text{ Mul.Est.} = 34.5 \quad (\text{Mean} = 213.2; \text{S.D.} = 35.6)$$

D. Discussion and Conclusions: Main Study

Including repeats, 16 multiple regression equations were finally written. Nine of the 16 multiple correlation coefficients computed from the beta coefficients of these equations were significantly different from zero at the .01 level; 3 were significant at the .05 level; and 4 were not significant. For each of the 13 different categories of criteria of decision making behavior used, 7 of the multiple R's were significant beyond the .01 level, 3 beyond .05 and 3 were not significant at .05. The R's were low when considered in light of their Coefficients of Determination. However, they were no lower than expected for normal populations or for the combinations of N and numbers of variables used in the main study.

Goodness of Decision under Risk appears to be best predicted by Equation M-1 and particularly the variables of Intelligence. This is the same picture presented by previous work around the use of the Townsend-Smith. An even clearer role of Intelligence was evidenced in the earlier machine version of the test where a time limit for the selection of the matrices (decision) was observed and all solutions were accomplished without the use of scratch paper. Correlations of the machine version of Decision Making under Risk with the SCAT total score ran in the low .70's. In addition to Intelligence, it appears that Unconventionality and an Ambitious Aggressiveness is likewise involved in Decision under Risk. Either Equation M-1 or M-2 may be used to select decision makers under risk by making use of the relative roles of the intellectual and personality predictor variables. However, not more than 16% of the variance of decision making under risk is accounted for by the best of the regression equations identified. It is doubtful whether much more than this can be expected to be due to cognitive and, particularly, personality factors in normal "above average intelligence" college students.

To predict decision making scores under the condition of Uncertainty, certain variables and combinations seem best. Such combinations appear to involve a mixture of low Dominance and high Conscientiousness. Equation M-4, which includes these variables, does better than any other investigated.

Goodness of Decision under Certainty again requires low Dominance and low Patience but good Imagination. Equation M-6 appears to be the better of the two presented.

Predicting composite Goodness of Decision, which is a summed combination of a subject's goodness scores under Risk, Uncertainty and Certainty with each part weighted equally, depends on Conscientiousness, Cooperativeness and little else, although high Tolerance, Planfulness, Imaginativeness and Patience coupled with low Dominance yielded the best combination of predictors and the second highest multiple correlation coefficient of the main study.

In predicting Goodness of Decision in a general situation, Intelligence, lack of Dominance, and Conscientiousness appear to be those cognitive and personality factors most clearly involved.

The prediction of Decision Time from personality variables proved to be the most difficult. Lower multiple correlations were secured between Decision Time and the predictors under each of the conditions of Risk and of Certainty, than under any other criterion such as Goodness of Decision or Confidence in one's decision. However, although insignificant multiple R's were found for Decision Time under Risk and under Certainty, a multiple R significant at the .01 level was found for Decision Time under Uncertainty. Strangely enough, beta weights for the three variables predicting this criterion were all negative and were attached to the personality

variables: Outgoing, Enthusiastic and Exact. Thus the inference is that the opposite ends of these variables predict Decision Time under Uncertainty. According to the tests involved, which were the CPI and the 16PF, the opposite ends of the variables are defined so as to lead to the inference that an unsure, unenthusiastic, awkward and unsociable individual will take more time in making a decision than one possessing the opposite of these traits. It is to be noted, however, that the beta coefficients are small in all cases and particularly in the case of the CPI variable: Outgoing. When composite Decision Time, i.e., sum of time spent on all parts of the test, was predicted from six personality variables, strongest among which were Non-Sociability, Tolerance and Unsureness, a multiple R significant at the .01 level was achieved.

It is most interesting to note that where the best predictions of Decision Time were made it was invariably found that Unsureness, Unsociability and other negative traits were involved. This was the rationale which had precipitated the selection of the personality variables for the a priori hypotheses originally.

Four of the five multiple correlation coefficients relating personality variables to Confidence in one's decisions were significant at the .05 level while the fifth was non-significant. The latter poor showing dealt with the prediction of Confidence in Decision under Risk. One of the variables which seemed to hold some promise was from the CPI and has been referred to as Tolerance. Actually high scores on this variable are referred to as Tolerant, and low as Suspiciousness. Taking this as a beginning point, it would appear, since a negative beta coefficient was achieved, that Suspiciousness is related to low Confidence under Risk. Two other variables which carried the next highest weights in the prediction

of Confidence under Risk were Variety of Physical Symptoms and Anti-social Tendencies, from the CTP. It is possible that this rather "sick" picture of suspiciousness, a variety of physical symptoms and anti-social tendencies point up the direction in which future attempts at predicting decision making under risk should take.

The prediction of Confidence under Uncertainty, Confidence under Certainty and Composite Confidence wherein significant R's at the .05 level were achieved revealed little consistency among the predictor variables. Positive beta coefficients appearing in one group of predictors turned up as negative in another which attempted to predict the same criterion.

Although the results of this study are filled with significant correlations, one must not neglect the fact that correlations can be significantly different from zero but of little practical value in immediate prediction. It is the opinion of the authors that in well controlled studies using normal above average intelligence subjects (who, by the way, seem to be the important decision makers in our society) high correlations consistently obtained between personality variables and decision making are most improbable. Having a normal personality speaks against extreme scores on valid personality tests. Thus the range of the scores for personality will be restricted to the extent that the subjects are normal. Using subjects who do not have normal personalities or subjects under stress in order to secure a distribution of personality scores having greater variability would probably enhance the correlations of these with decision making scores. It appears that normal people in normal situations tend to act in a rational, logical, goal oriented way and thus make decisions which are little influenced by personality. However, the individual whose rational processes are taken over by emotional or other behavioral

determinants such as are found in the severely maladjusted person or a normal person under severe stress, has his rational functions clouded and makes decisions consistent with the dictates of his personality and emotions. Thus it is with this kind of individual in such situations where one may find correlations between personality and decision making which will be of practical use. It seems, therefore, that the proper study of the prediction of decision behavior from personality variables with normal subjects should be in a setting involving stress. Stressful situations not only bring out personality differences in ordinarily normal individuals but in addition stress is the climate in which an individual's most important decisions are made.

V. References

1. Anker, J.M., Townsend, J.C., and O'Connor, J.P. A multivariate analysis of decision making and related measures. J. Psychol., 1963, 55, 211-221.
2. Atkinson, J.W., Motivational determinants of risk taking behavior. Psychol. Rev., 1957, 64, 359-372.
3. Atkinson, J.W., Bastian, J.R., Earl R.W., and Litwin, G.A. The Achievement motive, goal setting, and probability preferences. J. Abnorm. Soc. Psychol., 1960, 60, 27-36.
4. Atthowe, J.M. Types of conflict and their resolution: a reinterpretation. J. Exp. Psychol., 1960, 59, 1-9.
5. Block, J., and Petersen, P. Some personality correlates of confidence, caution, and speed in a decision situation. J. Abnorm. Soc. Psychol. 1955, 51, 34-41.
6. Edwards, W. Probability-preferences in gambling. Amer. J. Psychol. 1953, 66, 349-364.
7. Edwards, W. Probability-preferences among bets with differing expected values. Amer. J. Psychol., 1954a, 67, 56-57.
8. Edwards, W. Reliability of probability preferences. Amer. J. Psychol. 1954b, 67, 64-95.
9. Edwards, W. The theory of decision making. Psychol. Bull. 1954, 51, 380-417.
10. Edwards, W. Variance preferences in gambling. Amer. J. Psychol., 1954c, 67, 441-452.
11. Feather, N.T. Subjective probability and decision under uncertainty. Psychol. Rev. 1959, 66, 150-164.

12. Festinger, L. Studies in decision: I Decision time, relative frequency of judgement and subjective confidence as related to physical stimulus difference. J. Exp. Psychol. 1943, 32, 411-423.
13. Festinger, L. Studies in decision: II An empirical test of a quantitative theory of decision. J. Exp. Psychol. 1943a, 32, 411-423.
14. Liverant, S. and Scodel, A. Internal and external control in decision-making. Psychol. Rep., 1960, 7, 59-67.
15. Rotter, J.B. Social Learning and Clinical Psychology. New York Prentice-Hall, 1954.
16. Scodel, A., Ratoosh, P., and Minas, J.A. Some personality correlates of decision making under conditions of risk. Behavioral Sci., 1959, 4, 19-28.

APPENDIX

PILOT STUDY: COEFFICIENTS OF
CORRELATION BETWEEN PREDICTORS
AND CRITERIA

C R I T E R I A

	Variable No.	55	56	57	58	59	60	61	62	63	64
P	1	-04	17	-11	23	-26	33	05	-26	03	20
	2	-05	-05	-03	01	-02	10	14	06	-09	12
R	3	00	24	-02	22	-07	24	-06	-13	-14	26
	4	14	-02	-11	11	-15	00	02	-13	-13	17
E	5	09	10	-27	14	-13	29	04	-16	-08	35
	6	22	20	-19	01	-13	17	04	01	-23	32
D	7	-11	04	-11	11	05	31	26	00	20	16
	8	-07	-22	02	-13	04	05	16	15	01	00
I	9	17	00	-03	09	-08	16	-15	-34	-16	34
	10	05	06	-09	14	-23	26	-02	-07	-11	21
C	11	-01	15	03	30	08	33	-04	-01	08	00
	12	-02	00	-05	-07	-07	05	-06	-14	-15	13
T	13	-05	-26	07	-14	19	-05	00	00	18	-5
	14	01	01	-23	03	13	15	-15	-06	-05	19
O	15	19	17	-01	-01	-15	-16	-35	-07	-23	17
	16	00	00	-19	09	-21	01	09	-18	-13	28
R	17	-14	10	04	31	-09	26	13	15	05	15
	18	-08	-15	-11	07	-11	08	-07	-19	-30	26
S	19	09	04	12	-09	18	-11	11	05	01	-19
	20	09	04	01	-03	06	-05	-11	22	11	-16
	21	21	28	20	-06	-03	-13	08	04	21	-08

C R I T E R I A

	Variable No.	55	56	57	58	59	60	61	62	63	64
	22	07	11	07	-19	-03	-11	-07	01	06	-02
	23	-06	01	21	-09	02	-04	05	-07	00	-03
P	24	02	11	-06	-13	-10	-18	-19	-15	-01	12
	25	07	-07	05	17	-16	11	03	-36	15	02
R	26	-08	-02	-18	11	-23	23	15	-26	01	12
	27	-14	-08	16	-13	02	-14	11	23	00	-13
E	28	14	00	12	00	-22	-12	09	-25	-16	01
	29	-03	-10	-05	09	-03	12	-01	03	03	-11
D	30	00	-04	02	05	-15	-16	00	-18	-19	12
	31	-02	17	-15	06	-05	13	-08	00	-24	30
I	32	-02	-06	-25	17	-13	17	12	-23	-14	24
	33	05	11	-21	15	24	14	-06	18	08	09
C	34	-04	00	-11	13	-07	19	-01	-07	-01	18
	35	-04	16	-08	00	-12	30	03	-27	-11	40
T	36	15	21	-11	05	00	32	05	-16	-17	47
	37	00	12	-24	14	-01	31	00	-12	-14	40
O	38	-10	12	-10	04	09	13	00	31	15	-01
	39	01	-01	-19	20	-06	10	09	04	-02	18
R	40	-03	20	-04	12	10	17	07	02	16	12
	41	24	04	18	15	25	-01	16	12	13	-06
S	42	00	-15	-06	-13	30	11	23	14	25	-12
	43	16	-15	-17	18	07	15	22	-09	04	14
	44	25	12	27	-18	09	-22	-36	-01	-25	09
	45	15	18	-12	-08	-20	03	-14	-19	-42	28

C R I T E R I A

	Variable No.	55	56	57	58	59	60	61	62	63	64
	22	07	11	07	-19	-03	-11	-07	01	06	-02
	23	-06	01	21	-09	02	-04	05	-07	00	-03
P	24	02	11	-06	-13	-10	-18	-19	-15	-01	12
	25	07	-07	05	17	-16	11	03	-36	15	02
R	26	-08	-02	-18	11	-23	23	15	-26	01	12
	27	-14	-08	16	-13	02	-14	11	23	00	-13
E	28	14	00	12	00	-22	-12	09	-25	-16	01
	29	-03	-10	-05	09	-03	12	-01	03	03	-11
D	30	00	-04	02	05	-15	-16	00	-18	-19	12
	31	-02	17	-15	06	-05	13	-08	00	-24	30
I	32	-02	-06	-25	17	-13	17	12	-23	-14	24
	33	05	11	-21	15	24	14	-06	18	08	09
C	34	-04	00	-11	13	-07	19	-01	-07	-01	18
	35	-04	16	-08	00	-12	30	03	-27	-11	40
T	36	15	21	-11	05	00	32	05	-16	-17	47
	37	00	12	-24	14	-01	31	00	-12	-14	40
O	38	-10	12	-10	04	09	13	00	31	15	-01
	39	01	-01	-19	20	-06	10	09	04	-02	18
R	40	-03	20	-04	12	10	17	07	02	16	12
	41	24	04	18	15	25	-01	16	12	13	-06
S	42	00	-15	-06	-13	30	11	23	14	25	-12
	43	16	-15	-17	18	07	15	22	-09	04	14
	44	25	12	27	-18	09	-22	-36	-01	-25	09
	45	15	18	-12	-08	-20	03	-14	-19	-42	28

C R I T E R I A

	Variable No.	55	56	57	58	59	60	61	62	63	64
P	46	17	12	06	00	23	13	-15	10	-08	19
	47	-25	-14	21	11	11	07	19	20	34	-15
R	48	02	00	-11	09	-25	08	-17	-09	-02	06
	49	-01	-09	-16	14	07	17	21	-03	15	08
E	50	08	00	-03	13	15	03	08	10	15	-04
	51	14	08	03	05	14	27	24	-12	-08	29
D	52	14	00	-18	-01	19	04	-04	20	04	08
	53	06	10	013	11	17	16	08	14	09	14
I	54	05	12	-18	15	06	30	02	-02	-03	31
	55	100	19	-09	-14	17	-00	01	00	-08	13
C	56		100	00	10	11	32	-08	08	-01	26
	57			100	04	13	-06	-04	07	25	30
T	58				100	-11	31	-12	-08	18	00
	59					100	18	-08	56	18	-09
O	60						100	02	07	-09	42
	61							100	-07	02	10
R	62								100	14	-20
	63									100	-59
S	64										100

MAIN STUDY: COEFFICIENTS OF CORRELATION
BETWEEN PREDICTORS AND CRITERIA

C R I T E R I A

Variable No.	51	52	53	54	55	56	57	58	59	60	61
1	-04	57	03	01	04	-08	-10	19	-09	04	-08
2	-06	11	60	18	-01	12	07	10	01	20	-04
P 3	12	03	70	17	-03	12	03	09	02	24	-03
4	13	26	51	27	-03	04	-06	14	-05	09	-09
R 5	10	-02	74	12	08	03	17	09	-04	19	-06
6	02	47	30	22	12	-05	-14	19	-08	01	-15
E 7	39	-02	65	17	01	16	12	06	07	13	04
8	15	00	27	13	-04	07	16	12	10	08	05
D 9	-07	21	31	23	19	04	-04	18	-03	03	-08
10	-11	63	04	07	10	-10	-11	24	-21	10	-17
I 11	-07	-04	41	02	09	-04	18	10	00	09	-04
12	-06	27	-04	-08	00	03	-01	00	-05	01	01
C 13	10	05	00	08	04	03	02	03	-06	05	13
14	-10	-04	31	08	06	10	06	00	00	01	-04
T 15	-25	39	-39	10	14	-11	-22	17	06	-21	04
16	-16	45	-15	-08	00	-08	-14	13	-18	01	-06
O 17	22	-27	32	-04	-08	04	25	-06	04	23	00
18	-10	28	18	05	07	-05	-08	17	-19	04	-11
R 19	52	04	07	00	-16	00	07	-15	00	-04	-06
20	-13	11	-36	-03	08	00	-09	00	08	-17	04
S 21	-05	11	-23	21	00	-03	-11	01	19	00	09
22	-04	18	-30	04	04	02	-21	-01	-02	-21	-02

MAIN STUDY: COEFFICIENTS OF CORRELATION
BETWEEN PREDICTORS AND CRITERIA

C R I T E R I A

	Variable No.	62	63	64	65	66	67
	1	-22	20	-05	-12	16	-03
	2	-01	00				
P	3	04	-02	25	06	-03	27
	4	-04	02	19	-02	01	09
R	5	-04	10	22	-03	08	19
	6	-15	13	04	-12	14	-04
E	7	08	-04	25	16	-02	19
	8	10	02				
D	9	-07	08	12	00	17	00
	10	-14	16	00	-22	17	04
I	11	-06	08	12	-07	10	07
	12	-12	-07				
C	13	08	-08	07	05	01	06
	14	09	-10				
T	15	-17	11	-20	-03	19	-29
	16	-15	18	-16	-16	09	-05
O	17	13	-02	22	-01	-08	30
	18	-09	14				
R	19	13	-16				
	20	-04	00	-18	03	04	-19
S	21	-07	03	08	10	02	-03
	22	-02	-00	-19	-03	04	-26

C R I T E R I A

Variable No.	51	52	53	54	55	56	57	58	59	60	61
23	13	06	-08	-10	00	-16	-01	04	01	01	-01
24	-09	19	-04	20	00	-07	-13	06	-04	-09	00
25	00	11	12	11	09	05	-08	11	09	-08	06
P 26	-11	13	35	16	00	-03	14	14	-19	18	-13
27	26	-13	-36	-08	-04	-06	-07	-04	19	-06	09
R 28	02	25	03	33	10	02	-21	14	-04	05	-04
29	11	18	06	26	00	06	-11	07	00	-02	01
E 30	-09	22	-01	24	19	-04	-23	18	-08	12	-10
31	-25	37	17	08	11	-05	03	24	-12	07	-09
D 32	03	28	15	09	12	-00	-06	22	-06	12	-06
33	03	05	25	17	07	08	-06	12	05	09	06
I 34	05	29	28	03	00	00	01	12	-10	14	-03
35	-13	27	38	12	15	-04	03	22	-17	16	-10
C 36	-04	14	48	17	12	03	13	15	-14	17	-07
37	-08	28	38	17	14	02	00	24	-11	15	-05
T 38	28	-11	43	01	-01	03	13	-01	-04	24	-02
39	08	36	17	-04	02	-04	03	18	-16	22	-13
O 40	20	-07	62	20	10	09	12	10	04	21	07
41	02	15	39	04	02	-04	06	14	-09	14	-12
R 42	12	00	32	19	-01	03	07	-01	01	13	-02
43	12	-01	42	12	08	07	18	09	05	20	02
S 44	18	09	60	14	06	00	14	13	-05	27	-05
45	06	22	54	16	11	00	09	21	-09	24	-06
46	26	05	44	03	-06	06	26	12	-06	12	-07

C R I T E R I A

	Variable No.	62	63	64	65	66	67
	23	00	03	-06	-13	03	02
	24	-12	09				
P	25	-06	12				
	26	-13	12	20	-14	10	11
R	27	04	-04	-10	06	-07	-05
	28	-07	00	12	-01	09	02
E	29	00	-03				
	30	-12	05				
D	31	-10	20	07	-15	20	04
	32	-02	14	06	-07	18	12
I	33	04	00				
	34	02	04				
C	35	-06	12				
	36	-03	07	22	-06	13	13
T	37	-05	11				
	38	00	-02	19	-01	-05	24
O	39	-01	10	08	-61	08	21
	40	09	-03	32	13	08	28
R	41	-00	10				
	42	02	-08	22	01	-05	-16
S	43	00	-04	26	06	03	22
	44	02	00	29	-03	06	30
	45	00	08				
	46	06	00	21	-04	-03	16

C R I T E R I A

Variable No.	51	52	53	54	55	56	57	58	59	60	61
P 47	15	17	69	22	08	08	12	18	00	25	-03
48	-06	06	-06	08	02	12	-15	-01	-01	-13	02
R 49	-29	55	-07	15	15	-02	-22	26	-11	04	-09
50	21	08	54	24	-05	06	-06	05	-01	05	-01
E 51	100	-03	29	-05	00	-08	11	-07	-04	04	-04
52		100	-22	08	01	-16	-27	17	-14	-04	-05
D 53			100	11	03	13	25	03	07	19	05
54				100	12	17	-02	00	08	-03	-02
I 55					100	-11	-09	43	-01	04	00
56						100	06	-06	21	-12	19
C 57							100	07	15	17	15
58								100	-02	21	-00
T 59									100	-06	39
60										100	-05
O 61											100
62											
R 63											
64											
S 65											
66											
67											

C R I T E R I A

	Variable No.	62	63	64	65	66	67
	47	-03	06	31	04	11	25
P	48	01	-11	-11	09	08	-15
	49	-18	19	-03	-10	21	-04
R	50	09	-07	16	06	-04	11
	51	13	-08				
E	52	-18	16	-11	-19	11	-09
	53	10	-02	30	14	-01	25
D	54	06	-11	65	13	00	00
	55	-12	34	03	-08	79	-02
I	56	14	-15	10	72	-15	-08
	57	04	07	51	15	01	19
C	58	-36	61	07	-08	76	08
	59	04	-00	13	66	-04	00
T	60	-28	31	50	-11	22	90
	61	04	-03	03	68	-02	-03
O	62	100	-62				
	63		100	-03	-14	76	07
R	64			100	14	02	59
	65				100	-11	-03
S	66					100	06
	67						100

DOCUMENT CONTROL DATA - R&D

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		2b GROUP n/a	
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4 DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Report			
5 AUTHOR(S) (Last name, first name, initial) Townsend, John C., Smith, Walter J.			
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13 ABSTRACT In an attempt to write multiple regression equations predicting decision making behavior from personality and cognitive variables, a pilot study (N-60) and a main study (N-201) were conducted. Unselected, undergraduate college males and females from two separate universities served as subjects. Predictor groups of variables for each of 13 categories of decision making criteria were hypothesized. The results indicated that seven of the multiple regression equations through their beta coefficients yielded multiple correlation coefficients significant at $P < .01$, three at $P < .05$ and three at $P > .05$. All of the multiple correlations related to the prediction of "goodness" of decision were significant beyond the .01 level. The least profitable predictions resulted from attempts to predict decision time. Predictions of confidence in decision were intermediate. The largest amount of criterion variance accounted for was 16 percent. Low multiple correlation coefficients were expected due to the restricted range of personality and cognitive scores in persons normal in personality and above average in intelligence. Similar research in which normal individuals would be subjected to stress to reveal underlying personality differences is indicated.			

14 KEY WORDS Decision making The decision process Personality and decision making Intelligence and decision making Multiple prediction of decision behavior	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT

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