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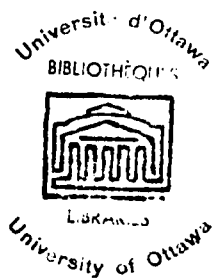
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SEX, MOTIVATION, EXTRAVERSION AND NEUROTICISM AS MULTIPLE
PREDICTORS AND MODERATORS WHEN PREDICTING TWO
GRADE NINE ATTAINMENT CRITERIA

by Yvonne L. Perrault

Thesis presented to the School of Graduate
Studies of the University of Ottawa in
partial fulfilment of the requirements for
the degree of Doctor of Philosophy.



Ottawa, Canada, 1976

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CURRICULUM STUDIORUM

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TABLE OF CONTENTS

Chapter	Page
ABSTRACT.....	xiii
INTRODUCTION.....	xv
I. - REVIEW OF THE LITERATURE.....	1
1. Research by Gough and Cattell - The Multiple Regression Model.....	7
2. Research on Univariate Moderator Models in Educational Settings.....	11
3. Research on Joint Moderator Models in Educational Settings.....	16
a. Joint Moderator Models-General	16
b. A Stepwise Multiple Moderated Regression System.....	18
4. Research on the Relationship of Motivation to Scholastic Achievement.....	22
5. Research on the Relationship of Extraversion and Neuroticism to Scholastic Achievement.....	25
6. Research on the Relationship of Motivation, Extraversion and Neuroticism to Scholastic Achievement.....	29
7. Summary of the Literature Review.....	32
8. Statement of the Problem(s).....	33
II. - EXPERIMENTAL DESIGN.....	39
1. The Subjects.....	39
2. The Measuring Instruments.....	41
a. The Mental Ability Predictor Measure.....	41
b. The Measures of Academic Motivation, Extraversion and Neuroticism.....	43
c. The Criterion Measures.....	47
3. Procedures - Testing, Scoring and Data Processing.....	50
a. Testing and Scoring.....	50
b. Data Processing.....	52
4. The Methods Used to Obtain Reliability Estimates.....	61
5. Statistical Analyses.....	62

TABLE OF CONTENTS

vi

Chapter	Page
III. - PRESENTATION OF RESULTS.....	73
1. Reliability.....	73
2. Linearity of Regression.....	78
3. Cross-Validation.....	86
4. Statistical Testing of the Null Hypotheses.....	95
5. Subsequent Analysis.....	135
IV. - DISCUSSION OF RESULTS.....	137
1. Interpretation of the Major Finding..	137
2. Implications of the Findings for Theory and Research.....	141
3. Recommendations for Further Research.	144
BIBLIOGRAPHY.....	146
Appendix	
I. - COPY OF QUESTIONNAIRE USED IN THIS RESEARCH TO ESTIMATE BIOGRAPHICAL CHARACTERISTICS OF THE SAMPLE.....	154
II. - RAW SCORE DATA FOR VARIABLES USED IN THIS RESEARCH.....	156

LIST OF TABLES

Table	Page
I. - Number of Ss by Total Group and by Sex According to Three Levels of Extraversion (Approximate Low, Middle and High Thirds) and Corresponding Moderator Scores.....	56
II. - Number of Ss by Total Group and by Sex According to Three Levels of Neuroticism (Approximate Low, Middle and High Thirds) and Corresponding Moderator Scores.....	57
III. - Number of Ss by Total Group and by Sex According to Three Levels of Achievement via Independence (Approximate Low, Middle and High Thirds) and Corresponding Modera- tor Scores.....	58
IV. - Number of Ss by Total Group and by Sex According to Three Levels of Achievement via Conformance (Approximate Low, Middle and High Thirds) and Corresponding Modera- tor Scores.....	59
V. - Number of Ss by Total Group and by Sex According to Three Levels of Intellectual Efficiency (Approximate Low, Middle and High Thirds) and Corresponding Moderator Scores.....	60
VI. - Means, SD's, Alternate Form Reliability Co- efficient (raf), SEM's for the Otis-Lennon Mental Ability Test (Time Between Testing - 4 weeks).....	75
VII. - Means, SD's, Test Re-Test Reliability Coeffi- cients (rtt), SEM's for the Junior Eysenck Personality Inventory (Time Between Testing - 4 weeks).....	76
VIII. - Means, SD's, Test Re-Test Reliability Coeffi- cients (rtt), SEM's for the Academic Motiva- tion Scales of the California Psychological Inventory (CPI) (Time Between Testing - 4 weeks).....	77

LIST OF TABLES

viii

Table		Page
IX.	- Means, SD's, Reliability Coefficients - Alternate Form (raf) and Test Re-Test (rtt) for Reading and Mathematics Tests of the Stanford Achievement Test: High School Battery (Time Between Testing - 1 week).....	79
X.	- Linearity of Regression of the Stanford Achievement Test and School Grades Criterion Measures on the JEPI Extraversion (E) and Neuroticism (N) Measures (N = 246).....	81
XI.	- Linearity of Regression of the Stanford Achievement Test and School Grades Criterion Measures on the CPI Achievement via Independence (Ai) Measure (N = 246).....	83
XII.	- Linearity of Regression of the Stanford Achievement Test and School Grades Criterion Measures on the CPI Achievement via Conformance (Ac) Measure (N = 246).....	84
XIII.	- Linearity of Regression of the Stanford Achievement Test and School Grades Criterion Measures on the CPI Intellectual Efficiency (Ie) Measure (N = 246).....	85
XIV.	- Intercorrelation Matrix, Means, SD's and Multiple R's for Predictor Variables and Two Achievement Criterion Measures for the Total Sample (Multiple Regression Model N = 246).....	87
XV.	- Intercorrelation Matrix, Means, SD's and Multiple R's for Predictor Variables and Two Achievement Criterion Measures for Validation Sample A (Multiple Regression Model N = 123).....	88
XVI.	- Intercorrelation Matrix, Means, SD's and Multiple R's for Predictor Variables and Two Achievement Criterion Measures for Validation Sample B (Multiple Regression Model N = 123).....	89

LIST OF TABLES

ix

Table	Page
XVII. - Multiple R's, Cross-Validation R's, z's, Diff _z , Diff/ σ d _z and Levels of Statistical Significance for Comparison of the R's for the Multiple Regression Model.....	91
XVIII. - Pearson r's, Cross-Validation r's, z's, Diff _z , Diff/ σ d _z and Levels of Statistical Significance for Comparison of the r's for Data Including One and Five Moderators for the Moderated Regression Model.....	94
XIX. - Pearson r's, Diff _r , σ r _s , t's, t _p 's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and Achievement Test Performance for Total Group and Subgroupings Having the Highest Validity on Each of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie).....	102
XX. - Pearson r's, Diff _r , σ r _s , t's, t _p 's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and School Grades for Total Group and Subgroupings Having the Highest Validity on Each of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie).....	103
XXI. - Pearson r's, Diff _r , σ r _s , t's, t _p 's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and Achievement Test Performance for Total Group and Subgroupings Having the Highest Validity on Combinations of Two of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie)	105
XXII. - Pearson r's, Diff _r , σ r _s , t's, t _p 's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and School Grades for Total Group and Subgroupings Having the Highest Validity on Combinations of Two of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie).....	107

LIST OF TABLES

x

Table		Page
XXIII.	- Pearson r's, Diff _r , σ_r s, t's, tp's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and Achievement Test Performance for Total Group and Subgroupings Having the Highest Validity on Combinations of Three of the Sex (S), Extraversion(E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie).....	109
XXIV.	- Pearson r's, Diff _r , σ_r s, t's, tp's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and School Grades for Total Group and Subgroupings Having the Highest Validity on Combinations of Three of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie)	110
XXV.	- Pearson r's, Diff _r , σ_r s, t's, tp's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and Achievement Test Performance for Total Group and Subgroupings Having the Highest Validity on Combinations of Four of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie).....	112
XXVI.	- Pearson r's, Diff _r , σ_r s, t's, tp's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and School Grades for Total Group and Subgroupings Having the Highest Validity on Combinations of Four of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie)...	113
XXVII.	- Pearson r's, Diff _r , σ_r s, t's, tp's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and Achievement Test Performance for Total Group and Subgroupings Having the Highest Validity on Combinations of Five of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie).....	114

LIST OF TABLES

xi

Table	Page
XXVIII. - Pearson r's, Diff _r , σ _s , t's, tp's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and School Grades for Total Group and Subgroupings Having the Highest Validity on Combinations of Five of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie)...	115
XXIX. - Pearson r's, Diff _r , σ _s , t's, tp's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and Achievement Test Performance for Total Group and Subgrouping Having the Highest Validity on all six of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie).....	117
XXX. - Pearson r's, Diff _r , σ _s , t's, tp's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and School Grades for Total Group and Subgrouping Having the Highest Validity on all six of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie).....	118
XXXI. - Multiple R's, Pearson r's, Diff _r , σ _s , t's tp's and Levels of Statistical Significance for Comparison of Variables as Multiple Predictors and Moderators in Testing of Null Hypothesis 7.....	120
XXXII. - Multiple R's, Pearson r's, Diff _r , σ _s , t's, tp's and Levels of Statistical Significance for Comparison of Variables as Multiple Predictors and Moderators in Testing of Null Hypothesis 8.....	124
XXXIII. - Multiple R's, Pearson r's, Diff _r , σ _s , t's, tp's and Levels of Statistical Significance for Comparison of Variables as Multiple Predictors and Moderators in Testing of Null Hypothesis 9.....	126
XXXIV. - Multiple R's, Pearson r's, Diff _r , σ _s , t's, tp's and Levels of Statistical Significance for Comparison of Variables as Multiple Predictors and Moderators in Testing of Null Hypothesis 10.....	127

LIST OF TABLES

xii

Table	Page
XXXV. - Multiple R's, Pearson r's, Diff_r , σ_{rs} , t's, t_p 's and Levels of Statistical Significance for Comparison of Variables as Multiple Predictors and Moderators in Testing of Null Hypothesis 11.....	129
XXXVI. - Multiple R's, Pearson r's, Diff_r , σ_{rs} , t's, t_p 's and Levels of Statistical Significance for Comparison of Variables as Multiple Predictors and Moderators in Testing of Null Hypothesis 12.....	131
XXXVII. - Pearson r's, t's and Levels of Statistical Significance Reported for Comparison of Pearson r's Between Mental Ability and Two Achievement Criteria for Total Group (r_t) and Subgroupings (r_s) on Sex, Personality and Motivation Variables in Testing Null Hypotheses 1 to 6.....	132
XXXVIII.- Pearson r's, Multiple R's, t's and Levels of Statistical Significance Reported for Comparison of Sex, Personality and Motivation Variables as Moderators and Multiple Predictors in Testing of Null Hypotheses 7 to 12.....	134

ABSTRACT OF

Sex, Motivation, Extraversion and Neuroticism as Multiple Predictors and Moderators When Predicting Two Grade Nine Attainment Criteria¹

Although the moderator variable concept has acquired popularity among researchers concerned for the low predictive validity of psychological tests, no conclusive evidence has been presented for the greater effectiveness of moderated prediction techniques over the traditional multiple regression model. It was the principal aim of this research to investigate whether use of sex and five measures of personality and motivation as moderators would increase the size of correlations of a mental ability predictor with criteria of academic success. As behaviour may be sensitive to the conditions in which it occurs, the research also sought to determine whether use of school grades and standardized achievement tests as criteria might obtain inconsistent results.

The Ss in this investigation were 246 males and females enrolled in grade nine at a public high school.

¹ Yvonne L. Perrault, Doctoral Thesis Presented to the Faculty of Psychology of the University of Ottawa, Ottawa, Canada, June 1976, xvi-167p.

They were initially administered a battery of tests designed to measure mental ability, extraversion, neuroticism, and three aspects of academic motivation. Six weeks later, standardized reading and mathematics achievement tests were administered to the same Ss. End-of-year grades in english and mathematics also were obtained. The sets of achievement test scores and grades were combined to yield two overall criterion measures.

A statistically significant improvement was demonstrated ($P < .05$, one-tailed) in support of using the extraversion variable as a moderator when predicting achievement test performance. The more accurate prediction was given for a subgroup with scores in the low one-third of the extraversion distribution. Joint use of the sex, personality and motivation variables did not enhance this moderator effect. In no case did the moderator analysis provide a significant improvement over the traditional multiple regression technique when predicting school grades. These research findings were interpreted and discussed in terms of their implications for psychological theory and research.

INTRODUCTION

Efforts to increase the predictive ceiling of psychological tests with classical validation models have had generally discouraging results. This problem has suggested to many researchers that the traditional statistical approach to prediction, i.e., multiple regression, requires improvement. Research to this end has produced a variety of sophisticated prediction models which can be subsumed under the title of moderator variable techniques, and with which the predictive validity of psychological tests may be enhanced.

Several procedures designed to identify moderator variables have been tested in educational settings. The variables examined frequently include measures of personality, insofar as such variables have demonstrated questionable utility as multiple predictors of scholastic attainment. Few investigators, however, have compared results of research using non-intellectual variables as moderators to results using the same variables as predictors in a multiple regression model. This empirical test might provide additional evidence of the usefulness of a moderator technique. Similarly, the effects of achievement criterion heterogeneity on results rarely have been examined,

yet if it can be assumed that behavior is affected by assessment conditions, variables shown to be effective as moderators for one type of achievement criterion may be less effective in the context of another criterion.

The principal goal of this research, then, is to investigate whether use of sex and measures of personality and motivation as moderators might increase the magnitude of correlations of a mental ability predictor with attainment criteria beyond those provided by use of the same variables as multiple predictors. A secondary aim is to determine whether use of school grades and standardized achievement test scores as criteria obtains dissimilar research results.

Chapter I will review the research literature on traditional and moderated prediction models, with emphasis on the utility of a multiple moderated regression system. The Chapter will also consider personality and motivation variables found relevant in prediction of scholastic attainment, and will conclude with the null hypotheses for the research. Chapter II will present the experimental design, while Chapter III will report and summarize the results of the data analyses. A discussion of the findings and recommendations for further research will be presented in Chapter IV.

CHAPTER I

REVIEW OF THE LITERATURE

Many investigators have concerned themselves with the problem of improving predictive validity beyond that usually provided by psychological tests. One research area in which attempts to enhance prediction have concentrated is that of academic achievement. Research efforts spanning half a century have demonstrated two facts. First, while mental ability - frequently referred to as scholastic aptitude, intelligence or IQ - is an efficient predictor of scholastic performance, it accounts only for thirty-five to forty-five percent of the overall variance of achievement.¹ Second, the combining of personality and motivational variables with mental ability measures in a multiple regression equation rarely improves prediction.²

1 D.E. Lavin, The Prediction of Academic Performance: A Theoretical Analysis and Review of Research, New York, Russell Sage, 1965, p. 59.

2 George Middleton, Jr., and George M. Guthrie, "Personality Syndromes and Academic Achievement", in Journal of Educational Psychology, Vol. 60, 1959, p. 66.

Gough³ and Cattell⁴ contend that the source of difficulty exists in the lack of valid measures of motivation and personality. On the other hand, Ghiselli⁵ challenges the usefulness of traditional regression techniques in accounting for the dynamic interrelationships of human traits. Decades earlier, Stagner⁶ presented evidence that personality measures influence the magnitude of ability-achievement correlations, while demonstrating no significant linear relation either to ability or achievement. He concluded that

...personality influences achievement in an indirect way, by affecting the degree to which use is made of the individual's potentialities.
...At some points along the distribution personality is an advantage in academic work

3 Harrison G. Gough, "Academic Achievement in High School as Predicted from the California Psychological Inventory", in Journal of Educational Psychology, Vol. 55, 1964, p. 174.

4 Raymond B. Cattell and H.J. Butcher, The Prediction of Achievement and Creativity, New York, Bobbs-Merrill, 1968, p. 196.

5 Edwin E. Ghiselli, "Comment on the Use of Moderator Variables", in Journal of Applied Psychology, Vol. 56, 1972, p. 270.

6 Ross Stagner, "The Relation of Personality to Academic Aptitude and Achievement", in Journal of Educational Research, Vol. 26, 1933, p. 648-660.

while different amounts of the same personality variable may be disadvantageous...⁷

New statistical models with which to examine the manner in which variables influence the predictive power of other variables materialized in the 1950's. In their usual form, these techniques strive to maximize prediction within homogeneous subgroups of individuals by considering the validity of a predictor at two or three levels of some other variable. Saunders⁸ referred to the third variable as a moderator, a term which persisted in the literature regardless of methodological differences. As interest in moderator variable research grew, the techniques expanded to include two or more moderators, in accordance with the assumption that variables may interact to influence within-group prediction.⁹

Although the moderator concept appears promising, few investigators have compared the results of a moderator technique with the results of a multiple regression

⁷ Idem, ibid, p. 655.

⁸ David R. Saunders, "Moderator Variables in Prediction", in Educational and Psychological Measurement, Vol. 16, 1956, p. 209-222.

⁹ Stephen P. Klein, Donald A. Rock and Franklin R. Evans, "The Use of Multiple Moderators in Academic Prediction", in Journal of Educational Measurement, Vol. 5, 1968, p. 151-152.

technique which includes the moderator variable as a predictor. Abrahams and Alf¹⁰ suggest that this procedure may demonstrate that the utility of many variables in the moderator context is overestimated. It is also pointed out by Zedeck¹¹ that the problems of subgrouping and sample size ordinarily associated with moderator strategies would be eliminated if applying the moderator as a multiple predictor can produce equally good results.

This research compares the predictive efficiency of traditional and moderated regression models in a school setting. A sample of grade nine subjects was administered a battery of mental ability, personality and academic motivation tests. Several weeks later, achievement test scores and end-of-year grades were obtained. The data were analyzed by multiple regression and with the stepwise multiple moderated regression system developed by Rock, Barone and Linn.¹² This system differs from the

10 Norman M. Abrahams and Edward Alf, Jr., "Pratfalls in Moderator Research", in Journal of Applied Psychology, Vol. 56, 1972, p. 250-251.

11 Sheldon Zedeck, "Problems With the Use of Moderator Variables", in Psychological Bulletin, Vol. 76, 1971, p. 304.

12 Donald A. Rock, John L. Barone and Robert L. Linn, "A Fortran Computer Program for a Moderated Stepwise Prediction System", in Educational and Psychological Measurement, Vol. 27, 1967, p. 709-713.

usual moderator model in that it can examine the effects of up to five moderators on within-group prediction. It first identifies subgroups with similar scores on each moderator variable. Following computation of validity coefficients between predictor(s) and criterion for these groupings of the cases, it combines the moderator yielding the highest predictive objective function with each of the remaining moderators. Validity coefficients are subsequently computed for groups with similar profiles on the subsets of two moderators. This procedure is repeated for combinations of three and four moderators, until all moderator variables are simultaneously included in the groupings. Identification of those variables which, singly or jointly, have a moderating effect on the predictor-criterion relationship is the goal of the system.

It is anticipated that use of sex, motivation and personality as moderators will increase the size of correlations with the criterion of success over and above outcomes using the same variables as multiple predictors. Evidence in this direction might support the view that scores on predictor tests should not be interpreted in the same manner for all individuals.¹³ It is further expected that results using achievement test scores and

13 Klein et al, Op. Cit., p. 151.

school grades as attainment criteria will be inconsistent. Results in this direction may uphold the conviction that behavior also is influenced by the condition or situation in which it occurs.¹⁴

Prior to stating the problem in detail, a review of the research literature which encouraged development of the above hypotheses will be presented. The review is organized as follows:

1. Research by Gough and Cattell - The Multiple Regression Model;
2. Research on Univariate Moderator Models in Educational Settings;
3. Research on Joint Moderator Models in Educational Settings:
 - a. Joint Moderator Models - General;
 - b. A Stepwise Multiple Moderated Regression System;
4. Research on the Relationship of Motivation to Scholastic Achievement;
5. Research on the Relationship of Extraversion and Neuroticism to Scholastic Achievement;
6. Research on the Relationship of Motivation, Extraversion and Neuroticism to Scholastic Achievement.

¹⁴ Walter Mischel, Introduction to Personality, Second Edition, New York, Holt Rinehart, 1976, p. 492-514.

1. Research by Gough and Cattell - The Multiple Regression Model

Neither Gough¹⁵ nor Cattell¹⁶ concede that new statistical models are required to achieve gains in academic prediction. Both investigators emphasize the need for valid meaningful measures of personality and motivation, while endorsing the use of traditional multiple regression techniques.

Gough¹⁷ calls attention to the value of the California Psychological Inventory (CPI), an empirically derived set of eighteen scales which were designed for use in educational settings. To demonstrate the predictive power of this test, the five CPI scales found to be most highly correlated with high school grade point average were combined with an ability measure in a multiple regression equation and the equation cross-validated on an independent sample. Although the predictive validity of the combined tests (.68) was shown to be significantly greater than that provided by the ability measure alone (.60),¹⁸ the increase is relatively trivial insofar as it

15 Gough, Op. Cit., p. 174-180.

16 R.B. Cattell, A.P. Sealy and A.B. Sweney, "What Can Personality and Motivation Source Traits Add to the Prediction of School Achievement?", in British Journal of Educational Psychology, Vol. 36, 1966, p. 280-295.

17 Gough, Op. Cit., p. 174-180.

18 Idem, ibid., p. 178.

accounts only for six percent of the variance.

Of particular interest to the present research is the finding that the three CPI scales described as especially relevant to academic achievement¹⁹ were significantly correlated with grade point average. These are the Achievement via Independence (Ai), Achievement via Conformance (Ac) and Intellectual Efficiency (Ie) scales, which may be subsumed under the more general heading of academic motivation.

Cattell et al²⁰ reported results of five studies investigating the relationship of ability, motivation and personality to junior high school achievement. Subjects were tested with the High School Personality Questionnaire (HSPQ), which measures fourteen primary source traits, and the School Motivation Analysis Test (SMAT), which measures fifteen second order traits related to interest and self-assertiveness. Substantial gains in prediction were observed for the combination of ability, personality and motivation measures in the case both of standardized achievement criteria and school grades.

Sources of difficulty in the above research include absence of cross-validation data which would give

19. Idem, ibid., p. 175.

20 Cattell et al, Op. Cit., p. 280-285.

evidence of the stability of the regression weights, the low reliability of the SMAT, and a prediction equation based on correlations corrected for the effects of unreliability of the measures. According to McNemar,²¹ correlation coefficients must be computed on the basis of obtained, not true, scores if they are to be utilized in prediction equations. Nevertheless, Cattell and Butcher²² maintain in a more recent study that personality factors account for approximately twenty-five percent of the overall achievement variance. As with the earlier investigations, cross-validation data were not provided.

In a review of Cattell's work, Entwisle²³ concludes on methodological grounds that faith in such a prediction equation is premature. Entwisle et al²⁴ failed to improve prediction of grades at higher educational levels from a combination of ability, secondary

21 Quinn McNemar, Psychological Statistics, New York, John Wiley, 1962, p. 153.

22 Cattell and Butcher, Op. Cit., p. 192-196.

23 N.J. Entwisle, "Personality and Academic Attainment", in British Journal of Educational Psychology, Vol. 42, 1972, p. 140.

24 N.J. Entwisle, J.B. Nisbet, D.M. Entwisle and M.D. Cowell, "The Academic Performance of Students, I - Prediction from Scales of Motivation and Study Habits", in British Journal of Educational Psychology, Vol. 41, 1971, p. 262-263.

school grades, personality, study habits and motivation measures. The multiple correlation coefficients were not significantly higher than those provided by ability and grades alone. Entwisle further concludes from a review of research linking extraversion and neuroticism to achievement that

...it is dangerous to assume wide generality in statements about the relationships between personality and academic attainment. Age, ability, sex, geographical area, classroom organization, class size, teaching methods and teacher personality may all affect these relationships to some extent.²⁵

The above statements suggest that many factors ought to be considered when interpreting results of research in this area. That is, the relationship between personality and achievement behavior may depend on other characteristics of the person and on the environments and conditions in which the behavior is assessed. Gough's²⁶ finding that use of personality variables raises predictive validity to .68 still leaves fifty-four percent of the variance unexplained.

Similarly, the relationship between ability and attainment may be influenced by any number of variables, including individual differences in personality. Correlational

25. Entwisle, Op. Cit., p. 147.

26. Gough, Op. Cit., p. 178.

techniques applied to an intact sample may obscure the relationships being investigated. It is the present author's belief that a moderated approach to prediction is preferable to the customary multiple regression technique because it might identify variables which separate the population into differentially predictable subgroups.

Results of efforts to maximize prediction with moderated regression models will be presented in the next two sections of this chapter. The first of these sections will include univariate moderator approaches, so named by the present investigator because they attempt to identify one variable which determines the degree of relationship between other variables. The discussion will be confined to procedures which have been given use in educational settings.

2. Research on Univariate Moderator Models in Educational Settings

A survey of moderator variable research reported between 1956 and 1972 suggests that a moderator may be most simply defined as a variable which influences the magnitude of predictor-criterion relationships and so identifies homogeneous groups of individuals for which a given predictor is more or less valid.

The effect of a moderator is frequently examined by subgroup analysis. A sample is divided in half or thirds on the basis of scores on a third variable, and

predictor-criterion correlations computed for each subgroup. In an often cited study, Grooms and Endler²⁷ examined the relationship between scholastic aptitude and college grades at three levels of test anxiety. The grades of the high anxiety subgroup were more predictable than those of the overall sample. The results of another study²⁸ also demonstrated that test anxiety moderated the prediction of college achievement, but in favour of a low anxiety group. Similarly, the grades of individuals classified as normal were more predictable than those of maladjusted individuals.²⁹

Sex was shown to influence the relationship between aptitude and achievement, and to do so differently for test and non-test criteria.³⁰ The grades of females were significantly more predictable than those of males,

27 R.R. Grooms and N.S. Endler, "The Effect of Anxiety on Academic Achievement", in Journal of Educational Psychology, Vol. 51, 1960, p. 299-304.

28 L.A. Pervin, "Aptitude, Anxiety and Academic Performance: A Moderator Variable Analysis", in Psychological Reports, Vol. 20, 1967, p. 215-221.

29 D.P. Hoyt and W.T. Norman, "Adjustment and Academic Predictability," in Journal of Counselling Psychology, Vol. 1, 1954, p. 96-99.

30 Norman S. Endler and Larry S. Snyder, "Anxiety, Aptitude and Academic Achievement", in Ontario Journal of Educational Research, Vol. 6, 1964, p. 85-91.

but performance on a reading test was more highly related to the aptitude scores of males. Sex differences in prediction of grade point average from personality test scores were reported elsewhere.³¹

An alternative to subgrouping is Ghiselli's³² D-score technique, designed to demonstrate which of two tests gives the better prediction for any given individual. The better predictor is the one which yields the smallest difference (D) between standardized predictor and criterion scores. The moderator variable - referred to in this context as a differential predictability variable - is one which correlates positively with the difference between the D scores. The greater the correlation, the greater the likelihood that for individuals with high scores on the differential predictability variable the first test gives the better prediction, and for individuals with low scores the second test gives the better prediction.

31 L.D. Goodstein and A.B. Heilbrun, Jr., "Prediction of College Achievement from the Edwards Personal Preference Schedule at Three Levels of Intellectual Ability", in Journal of Applied Psychology, Vol. 46, 1962, p. 317-320.

32 Edwin E. Ghiselli, "Differentiation of Tests in Terms of the Accuracy with Which they Predict for a Given Individual", in Educational and Psychological Measurement, Vol. 20, 1960, p. 675-684.

Richardson³³ was unable to show that California Psychological Inventory (CPI) items function as differential predictability variables in prediction of grade point average from an aptitude test and the Intellectual Efficiency (Ie) scale of the CPI. The increase in the correlation obtained from scores on the better predictor for each subject in the sample was not maintained with a cross-validation group. A subsequent item analysis of the differential predictability scale showed that it failed to discriminate between the two groups in the cross-validation sample.

Another approach to the identification of moderator variables is Saunders' ³⁴ moderated regression model. One nonlinear regression equation including a cross-product term is constructed to demonstrate how the validity of a predictor varies in accordance with scores on the moderator. Saunders ³⁵ used data from an investigation by Frederiksen and Melville ³⁶ to compare

³³ H. Richardson, "Utility of a New Method for Predicting College Grades", in Journal of General Psychology, Vol. 72, 1965, p. 159-164.

³⁴ Saunders, Op. Cit., p. 209-222.

³⁵ Idem, ibid.

³⁶ N. Frederiksen and S.D. Melville, "Differential Predictability in the Use of Test Scores", in Educational and Psychological Measurement, Vol. 14, 1954, p. 647-656.

the results of moderated regression and the subgrouping method used by the other investigators. Subgroup analysis produced higher test validities and supported the results of the earlier study in that the engineering grades of non-compulsive students were more predictable with the Engineer scale of the Strong Vocational Interest Blank (SVIB) than those of compulsive students. Comparison of moderated and linear regression with data from additional interest scales showed Saunders' technique to be more effective in only half the cases.

In an evaluation of moderator variable research up to 1971, Zedeck³⁷ concludes that none of the three methods discussed thus far has fully demonstrated its utility. Zedeck³⁸ suggests elsewhere that the univariate approach does not allow for the possibility that moderators may exert an influence in combination with one another. The first part of the following section will review research attempting to identify joint moderator variables with the models enumerated above. The second part will describe the multiple moderated regression system to be implemented in the present research.

37 Zedeck, Op. Cit., p. 295-310.

38 Sheldon Zedeck, C.J. Cranny, Carol A. Vale and Patricia Cain Smith, "Comparison of 'Joint Moderators' in Three Prediction Techniques", in Journal of Applied Psychology, Vol. 55, 1971, p. 235.

3. Research on Joint Moderator Models in Educational Settings

a. Joint Moderator Models - General

Zedeck proposes the following definition of joint moderator variables. They refer to

...two or more variables, quantitative or qualitative, that interact to influence a validity coefficient.³⁹

It was noted in the preceding section of this chapter that subgroup analysis produced compulsivity as a moderator in prediction of college grades from the Engineer scale of the Strong Vocational Interest Blank (SVIB). The compulsivity variable was defined in terms of scores on the Accountant scale of the SVIB and the ratio of reading speed to vocabulary on a reading comprehension test. To examine the joint moderator effect of the two compulsivity variables, Stricker⁴⁰ dichotomized the distributions at their medians and formed four subgroups each of Engineering and Liberal Arts students. The joint use of the two measures did not enhance the moderator effect beyond that provided by separate use of the measures. It was further observed that neither compulsivity variable moderated prediction for Liberal Arts or female subjects.

³⁹ Idem, ibid.

⁴⁰ Lawrence J. Stricker, "Compulsivity as a Moderator Variable: A Replication and Extension", in Journal of Applied Psychology, Vol. 50, 1966, p. 331-335.

Zedeck⁴¹ attempted to identify anxiety and study habits as joint moderators in prediction of grade point average from a scholastic aptitude test. Data were analyzed by subgrouping on the moderator variables, the D-score technique and moderated regression, so as to permit comparison of the three models. In addition, the results of linear and moderated regression techniques were compared.

The joint use of the two variables failed to enhance prediction. When the two measures were independently examined, anxiety was identified as a moderator by all but the moderated regression technique, while the study habits variable was useful as a predictor. None of the moderator methods improved test validity beyond that provided by use of anxiety and study habits as multiple predictors, a finding that supports Abrahams and Alf's⁴² view that the utility of many moderator variables may be overrated.

An alternative approach to the identification of joint moderators has been developed at the Educational Testing Service by Donald A. Rock and his associates.⁴³

41 Zedeck et al, Op. Cit., p. 234-240.

42 Abrahams and Alf, Op. Cit., p. 250-251.

43 Rock et al., Op. Cit., p. 709-713.

The second part of this section will describe this prediction model and enumerate the results of research based on its use.

b. A Stepwise Multiple Moderated Regression System

According to its originators, this model is

...a computer based statistical system which is general in nature yet could yield some tentative answers to questions concerning interactions between groups of individuals and their attributes when predicting some criterion of success. Thus, given a sample of individuals with multiple measures on each individual including a criterion of success, one can utilize the present system to isolate groups which consist of individuals characterized by common profiles on background or personality variables, and which also yield optimal within group prediction systems.⁴⁴

When data on criterion, predictor(s) and a maximum of five hypothesized moderator variables are given, the technique identifies groupings of the cases with common score patterns on the moderators and computes within-group correlations between predictor(s) and criterion. It starts by examining the moderating effects of each individual variable, then uses Cronbach and Gleser's⁴⁵ squared distance (D^2) measure of similarity to cluster

44 Idem, ibid., p. 709.

45 Lee J. Cronbach and Goldine C. Gleser, "Assessing Similarity Between Profiles", in The Psychological Bulletin, Vol. 50, 1953, p. 456-473.

subjects with similar profiles on combinations of two and up to the maximum of five moderators. For this grouping objective function, a modification of Ward's⁴⁶ hierarchical grouping technique is applied to each D^2 matrix of scores on the moderators, thus reducing at every stage the number of subgroups from a maximum of five to fewer and fewer units, until only one group remains. For each of the defined groups, a predictive objective function is computed, so as to determine the extent to which these groupings have had an influence on the relationship between predictor(s) and criterion. The variable or combination of variables which yields the highest predictive objective function is retained for the next stepwise level. For example, the one moderator which yields the highest predictive objective function at the first stepwise level will be retained and carried into level two. Validity coefficients are thus computed at all stepwise levels for the unique groupings of subjects and moderators, in a search for subgroupings of the cases that will improve on the multiple correlation obtained for the overall sample.

The multiple moderator system can be used to deal with two related problems of prediction. The first, that

⁴⁶ Joe H. Ward, Jr., "Hierarchical Grouping to Optimize an Objective Function", in Journal of the American Statistical Association, Vol. 58, 1963, p. 236-244.

of identifying groups which are most different in predictability, was investigated by Klein et al.⁴⁷ The study treated five biodata items as moderators in prediction of law school grades from undergraduate grade point average and two standardized tests. Use of all moderators defined four groups in the cross-validation sample, one of which was characterized by a significantly higher validity coefficient than two others. It was also found that the highest validity coefficient obtained in the moderator context exceeded that using the five moderators as multiple predictors.

The other problem handled by the system concerns the identification of over- and underachievers; that is, groups with under- and overpredicted criterion scores. In a study by Flaughner and Rock⁴⁸, the effects of five biodata items on prediction of grade point average from high school rank and an aptitude test were examined. Groupings which showed the largest positive and negative differences in mean residual scores obtained by subtraction of mean

47 Klein et al, Op. Cit., p. 151-160.

48 Ronald L. Flaughner and Donald A. Rock, "A Multiple Moderator Approach to the Identification of Over- and Underachievers", in Journal of Educational Measurement, Vol. 6, 1969, p. 223-228.

predicted from mean obtained grade point average were accepted as examples of over - and underachievement if similar results were obtained for the same moderators in the cross-validation sample. This analysis resulted in the identification of two groups with dissimilar moderator characteristics, one of which was underachieving, the other overachieving.

It may be concluded that research using this prediction model has successfully identified biodata items as moderators, but application of the system to other types of moderator variable is needed. Although Velicer⁴⁹ contends that biodata items may function more efficiently as moderators than items derived from continuous variables because there is no problem of misclassification, the utility of a moderator technique would seem to be limited if it must confine itself to this type of variable.

Commensurate with the goal of selecting personal trait variables with which to demonstrate the generalizability of the multiple moderated regression system, the next three stages of the literature review will encompass research utilizing measures of motivation, extraversion, neuroticism and combined measures of these traits in the context of academic prediction.

⁴⁹ Wayne F. Velicer, "The Moderator Variable Viewed as Heterogeneous Regression", in Journal of Applied Psychology, Vol. 56, 1972, p. 269.

4. Research on the Relationship of Motivation to Scholastic Achievement

Conventional wisdom dictates that academic motivation is linked to academic achievement. Early studies based on McClelland's⁵⁰ view that the achievement need is unconscious, used projective techniques to measure it. The results of such research were inconclusive, leading many investigators to rely on objective, more reliable measures of this trait.

Research using objective tests of motivation has not been much more fruitful, as the predictive validity of such measures is generally low. In four studies^{51,52,53,54} of high school and college populations, the majority of

50 David C. McClelland, John W. Atkinson, Russell A. Clark and Edgar L. Lowell, The Achievement Motive, New York, Appleton-Century-Crofts, 1953, p. 1-106.

51 John L. Holland, "The Prediction of College Grades from the California Psychological Inventory and the Scholastic Aptitude Test", in Journal of Educational Psychology, Vol. 50, 1959, p. 135-141.

52 Mary Louise Griffin and Sister M. Rita Flaherty, "Correlations of CPI Traits with Academic Achievement", in Educational and Psychological Measurement, Vol. 24, 1964, p. 369-371.

53 Gough, Op. Cit., p. 174-180.

54 Atlee L. Stroup and John H. Eft, "The CPI as a Predictor of College Academic Success", in The Alberta Journal of Educational Research, Vol. 15, 1969, 191-194.

correlations between grades and the three scales of the California Psychological Inventory (CPI) that purport to measure the achievement motive did not exceed .3.

Evidence that motivation measures may serve better as joint moderators than as predictors comes from two sources. First, it appears that other factors may operate simultaneously with this trait either to suppress or exaggerate its relationship to scholastic achievement. Oakland⁵⁵ found the grade point average of males classified as over- and underachievers to be significantly more predictable than that of females with the motivation scale of the Edwards Personality Inventory (EPI). The best prediction from this scale was given for low aptitude males. Goodstein and Heilbrun⁵⁶ also demonstrated that sex differences in prediction of college grades from the Achievement and Endurance scales of the Edwards Personal Preference Schedule (EPPS) were heightened when the sample was

⁵⁵ James A Oakland, "Measurement of Personality Correlates of Academic Achievement in High School Students," in Journal of Counselling Psychology, Vol. 16, 1969, p. 452-457.

⁵⁶ Goodstein and Heilbrun, Op. Cit., p. 317-320.

subgrouped by ability level. This study showed the grade point average of middle ability males to be more predictable than that of high and low ability males or females at any ability level.

A second source of evidence pointing to the potential value of motivation measures as joint moderators is provided by a group of British investigators.^{57,58,59} Their findings suggest that sex, motivation and personality variables may interact to affect the relationship between ability and scholastic achievement. Prior to describing these research efforts, the research relating the personality dimensions of extraversion and neuroticism to achievement will be reviewed.

57 J.D. Wilson, "Predicting Levels of First Year University Performance", in British Journal of Educational Psychology, Vol. 41, 1971, p. 163-170.

58 Entwisle et al, Op. Cit., p. 258-267.

59 N.J. Entwisle and T. Brennan, "The Academic Performance of Students, II - Types of Successful Students", in British Journal of Educational Psychology, Vol. 41, 1971, p. 268-276.

5. Research on the Relationship of Extraversion and Neuroticism to Scholastic Achievement

In support of Eysenck's⁶⁰ claim that two broad dimensions underlie human personality, factor analysis produced two second order factors which were labelled extraversion=introversion and neuroticism. The extent to which individuals differ on these personality types can be measured with the Eysenck Personality Inventory (EPI) or its childrens' form, the Junior Eysenck Personality Inventory (JEPI).

Studies of the relationship of these variables to academic achievement proliferated. Small scale research at the elementary school level^{61,62,63} showed extraverts to be the superior students, while neuroticism was not significantly related to achievement. In a fairly recent and quite extensive study of school age

60 H.J. Eysenck, Dimensions of Personality, London, Kegan Paul, 1947, p. 1-32.

61 R.D. Savage, "Personality Factors and Academic Attainment in Junior School Children", in British Journal of Educational Psychology, Vol. 36, 1966, p. 91-92.

62 J.R. Rushton, "The Relationship Between Personality Characteristics and Scholastic Success in 11-Year-Old Children", in British Journal of Educational Psychology, Vol. 36, 1966, p. 178-184.

63 L.W. Ridding, "An Investigation of the Personality Measures Associated with Over- and Under-achievement in English and Arithmetic", in British Journal of Educational Psychology, Vol. 37, 1967, p. 397-398.

children, Eysenck and Cookson⁶⁴ found positive correlations between extraversion and achievement for both sexes, although the validity coefficients were, as in the earlier studies, low. These investigators also presented evidence of interaction between extraversion and neuroticism which was related to sex, insofar as unstable extraverted females obtained high scores on verbal reasoning and achievement tests, while males possessing the same characteristics obtained poor test scores.

Sex differences were also observed in a junior high school population. Entwisle and Cunningham⁶⁵ found a significant nonlinear relationship between extraversion and achievement in that extraverted females and introverted males were the better students. There was a slight negative correlation between neuroticism and achievement, with no apparent sex differences. The superiority of the introvert

64 H.J. Eysenck and D. Cookson, "Personality in Primary School Children: 1.- Ability and Achievement", in British Journal of Educational Psychology, Vol 39, 1969, p. 109-122.

65 N.J. Entwisle and Shirley Cunningham, "Neuroticism and School Attainment - A Linear Relationship?" in British Journal of Educational Psychology, Vol. 38, 1968, p. 123-132.

and the absence of extraversion-neuroticism interaction at this educational level were explained by Eysenck and Cookson⁶⁶ in terms of the differential influence of age on the relationship between personality and achievement.

Entwisle and Welsh⁶⁷ used data from the same junior high school population to examine the manner in which ability level modifies the relationship between the personality variables and achievement for each sex. Similar sex differences were demonstrated, with extraverted females and introverted males forming superior groups, but when the data were analyzed by ability level, high ability introverts and low ability extraverts of both sexes were the better students. Although the moderator concept has not acquired popularity in Britain, it can be seen that subgrouping techniques were increasingly used, and that sex and ability level may be referred to in this study as moderators in prediction of achievement from personality measures.

66 Eysenck and Cookson, Op. Cit., p. 121.

67 N.J. Entwisle and Jennifer Welsh, "Correlates of School Attainment at Different Ability Levels", in British Journal of Educational Psychology, Vol. 39, 1969, p. 57-63.

Research at the university level provides evidence that the introvert is at an advantage, but the relationship of neuroticism to achievement is less clear⁶⁸. The inconclusive nature of these results and the fact that an overwhelming majority of correlations between personality and achievement measures are too low for prediction purposes led Entwisle to conclude:

It is possible to dismiss a non-linear relationship in reporting an insignificant product-moment coefficient and also to ignore the possibility of important interactions between variables. Correlations average out the relationships over the whole sample, ignoring possible differences between sub-groups.⁶⁹

The next stage in the literature review will focus on the more recent research efforts of British investigators. These highlight the need for improved statistical techniques with which interactions between variables may be observed and more substantial predictions of scholastic achievement made.

68 Entwisle, Op. Cit., p. 141.

69 Idem, ibid., p. 144.

6. Research on the Relationship of Motivation,
Extraversion and Neuroticism to
Scholastic Achievement

Two studies of college populations examined the relationship of sex, ability, motivation and the personality variables to achievement. The findings suggest that these relationships may be too complex to be adequately described by a single regression equation.

Wilson⁷⁰ differentiated between successful and unsuccessful college groups on the basis of ability, motivation, personality, study habits and background variables. The discriminating variables were shown to vary with sex and faculty. For Arts subjects, extraversion and poor study methods were symptomatic of academic failure for both sexes, but low motivation also contributed to the failure of males, limited intelligence to female failure. High intelligence was an indicator of success for both sexes, while neuroticism was also related to the success of males. Wilson⁷¹

70 Wilson, Op. Cit., p. 163-170.

71 Idem, ibid., p. 169=170.

notes, however, that more sophisticated statistical models may be required to identify which clusters of traits are related to high and low achievement.

The results of a two-part investigation by Entwisle^{72,73} and his associates furnish evidence that an updated statistical approach to the problem might be needed. In the first part of the study, multiple correlations adding six non-intellectual variables to prior grades and aptitude measures did not improve predictive validity beyond that provided by the intellectual variables alone. As an alternative to traditional regression procedures, Entwisle and Brennan⁷⁴ applied the Cronbach and Gleser⁷⁵ method of cluster analysis to data from the same population in an effort to identify patterns of traits which contribute to academic success and failure.

72 Entwisle et al, Op. Cit., p. 258-267.

73 Entwisle and Brennan, Op. Cit., p. 268-276.

74 Idem, ibid.

75 Cronbach and Gleser, Op. Cit., p. 456-473.

The findings suggest that relevant variables interact to affect the relationship between aptitude for academic work and the capacity to make use of this aptitude in achievement. That is, although the grades of many individuals were consistent with their ability scores, this was not always the case. One low ability group showed better-than-expected attainment, but members of this group were highly motivated, extraverted and stable, with excellent study habits. Conversely, the cluster of subjects obtaining the poorest grades demonstrated average ability combined with extraversion, low motivation and poor study methods. It is observed that whether extraversion contributes to or detracts from scholastic performance depends on the presence of other characteristics.

Rock et al⁷⁶ have extended the clustering concept to include means by which the predictive validity of a test is provided for each cluster. The results of Entwisle and Brennan's⁷⁷ research suggest that motivation, extraversion and neuroticism may have meaning as joint moderator variables in the context of the multiple moderated regression system.

76 Rock et al, Op.Cit., p. 709-713.

77 Entwisle and Brennan, Op.Cit., p. 268-276.

This concludes the review of the literature which influenced the development of the research and the selection of moderator variables. The following section presents a brief summary of the major points outlined in the review.

7. Summary of the Literature Review

The preceding sections presented a review of the research literature on traditional and moderated prediction models. Emphasis was placed on the utility of a stepwise multiple moderated regression system. As this and the traditional regression technique are to be empirically tested in a school setting, a review of research on variables found to be relevant to scholastic achievement was also presented. These traits and the instruments selected to measure them will be more fully described in the chapter on Experimental Design. That chapter will also provide a description of the mental ability and achievement measures.

It is anticipated that sex, motivation and personality will function as moderators in prediction of academic achievement from a mental ability measure, and that they will serve better in that role than as predictors in an ordinary multiple regression equation.

Evidence in this direction might support the view that test scores cannot be similarly interpreted for all individuals. It is further expected that results using standardized achievement tests and school grades as criteria will be inconsistent. Such a finding would suggest that behavior also is influenced by situational factors.

8. Statement of the Problem(s)

This section of the chapter will state the problems to be investigated by the research, and will subsequently re-state them as null hypotheses. The first six problems will test the utility of selected variables as independent and joint moderators in prediction of achievement test performance or school grades. For these problems the term "validity coefficient" will be used to describe the relationship between a mental ability predictor and an achievement criterion. Variables shown to moderate prediction of achievement test scores or grades will be then compared as moderators and multiple predictors by problems seven to twelve. The problems are as follows:

- Problem 1. To test whether the validity coefficients computed for subgroups with similar scores on any one of the sex, extraversion, neuroticism, or three motivation variables exceed that computed for the total group when predicting achievement test performance or school grades.

- Problem 2. To test whether the validity coefficients computed for subgroups with similar profiles on any two of the sex, extraversion, neuroticism, or three motivation variables exceed that computed for the total group when predicting achievement test performance or school grades.
- Problem 3. To test whether the validity coefficients computed for subgroups with similar profiles on any three of the sex, extraversion, neuroticism, or three motivation variables exceed that computed for the total group when predicting achievement test performance or school grades.
- Problem 4. To test whether the validity coefficients computed for subgroups with similar profiles on any four of the sex, extraversion, neuroticism, or three motivation variables exceed that computed for the total group when predicting achievement test performance or school grades.
- Problem 5. To test whether the validity coefficients computed for subgroups with similar profiles on any five of the sex, extraversion, neuroticism, or three motivation variables exceed that computed for the total group when predicting achievement test performance or school grades.
- Problem 6. To test whether the validity coefficients computed for subgroups with similar profiles on all six of the sex, extraversion, neuroticism, and three motivation variables exceed that computed

for the total group when predicting achievement test performance or school grades.

- Problem 7. To test whether using any one of the sex, extraversion, neu-roticism, or three motivation variables as a moderator in prediction of achievement test performance or school grades has any advantage over using that variable as a predictor in a multiple regression equation.
- Problem 8. To test whether using any two of the sex, extraversion, neu-roticism, or three motivation variables as moderators in prediction of achievement test performance or school grades has any advantage over using these variables as predictors in a multiple regression equation.
- Problem 9. To test whether using any three of the sex, extraversion, neu-roticism, or three motivation variables as moderators in prediction of achievement test performance or school grades has any advantage over using these variables as predictors in a multiple regression equation.
- Problem 10. To test whether using any four of the sex, extraversion, neu-roticism, or three motivation variables as moderators in prediction of achievement test performance or school grades has any advantage over using these variables as predictors in a multiple regression equation.

- Problem 11. To test whether using any five of the sex, extraversion, neu-roticism, or three motivation variables as moderators in prediction of achievement test performance or school grades has any advantage over using these variables as predictors in a multiple regression equation.
- Problem 12. To test whether using all six of the sex, extraversion, neu-roticism, and three motivation variables as moderators in prediction of achievement test performance or school grades has any advantage over using these variables as predictors in a multiple regression equation.

The twelve problems are re-stated as null hypotheses as follows:

Null Hypothesis:

1. There is no significant increase in the validity coefficients computed for subgroups with similar scores on any one of the sex, extraversion, neuroticism, or three motivation variables beyond that computed for the total group when predicting achievement test performance or school grades.
2. There is no significant increase in the validity coefficients computed for subgroups with similar profiles on any two of the sex, extraversion, neuroticism, or three motivation variables beyond that computed for the total group when predicting achievement test performance, or school grades.

3. There is no significant increase in the validity coefficients computed for subgroups with similar profiles on any three of the sex, extraversion, neuroticism, or three motivation variables beyond that computed for the total group when predicting achievement test performance or school grades.
4. There is no significant increase in the validity coefficients computed for subgroups with similar profiles on any four of the sex, extraversion, neuroticism, or three motivation variables beyond that computed for the total group when predicting achievement test performance or school grades.
5. There is no significant increase in the validity coefficients computed for subgroups with similar profiles on any five of the sex, extraversion, neuroticism, or three motivation variables beyond that computed for the total group when predicting achievement test performance or school grades.
6. There is no significant increase in the validity coefficients computed for subgroups with similar profiles on all six of the sex, extraversion, neuroticism, and three motivation variables beyond that computed for the total group when predicting achievement test performance or school grades.
7. There is no significant improvement in prediction of achievement test performance or school grades using any one of the sex, extraversion, neuroticism, or three motivation variables as a moderator over and above its use as a predictor in a multiple regression equation.

8. There is no significant improvement in prediction of achievement test performance or school grades using any two of the sex, extraversion, neuroticism, or three motivation variables as moderators over and above their use as predictors in a multiple regression equation.
9. There is no significant improvement in prediction of achievement test performance or school grades using any three of the sex, extraversion, neuroticism, or three motivation variables as moderators over and above their use as predictors in a multiple regression equation.
10. There is no significant improvement in prediction of achievement test performance or school grades using any four of the sex, extraversion, neuroticism, or three motivation variables as moderators over and above their use as predictors in a multiple regression equation.
11. There is no significant improvement in prediction of achievement test performance or school grades using any five of the sex, extraversion, neuroticism, or three motivation variables as moderators over and above their use as predictors in a multiple regression equation.
12. There is no significant improvement in prediction of achievement test performance or school grades using all six of the sex, extraversion, neuroticism, and three motivation variables as moderators over and above their use as predictors in a multiple regression equation.

CHAPTER II

EXPERIMENTAL DESIGN

This chapter presents the research design. It describes the subjects, the measuring instruments, and the means by which the data were collected, scored and processed. The procedures used to obtain reliability estimates for the test measures are also described. The last section of the chapter presents the statistical procedures used to test the null hypotheses which were outlined at the close of Chapter I.

1. The Subjects

The Ss were 118 males and 128 females enrolled in grade nine at a Protestant high school in Hull, Québec. They comprised only 75% of the grade nine population, as participation in the research was on a voluntary basis. The age of the Ss ranged from 13 years 6 months to 18 years 9 months, but only 34 Ss were older than sixteen years of age. The mean age of the sample was 14 years 8 months, which is appropriate for the grade nine level.

Five biographical characteristics of the sample were obtained with a short questionnaire which was prepared by the investigator and administered at the end

of the testing program: A copy of this document is shown in Appendix I.

In terms of schooling, 82% of Ss were enrolled in the academic program, while the remaining Ss were in the vocational (male) or commercial (female) programs. Nearly 80% obtained their schooling to date in the Province of Québec.

Although all Ss claimed sufficient proficiency in English to take the tests, 17% spoke some other language in the home. The majority of this group claimed French or Cree as a maternal language.

Of those Ss with fathers present in the home, 85% appeared to have a "middle" or "upper-middle" class background. Socio-economic level was inferred on the basis of descriptions of fathers' occupations. Although the job descriptions were diverse, this large group included many children of government employees. The remaining Ss included all those of Cree descent, who consistently described their fathers as hunters or farmers.

With regard to birth order, 96% of Ss came from homes with two or more children in the family. Of this group, 26% were first-born and 23% last-born.

In summary, it would appear that the grade nine sample was fairly heterogeneous with respect to age, school program, linguistic background, socioeconomic level of the home, and birth order. The "typical" S, however, appeared to be academically oriented and from an affluent, English-speaking home.

2. The Measuring Instruments

a. The Mental Ability Predictor Measure

The Otis-Lennon Mental Ability Test (MAT)¹, Intermediate Level, Form J was selected to measure the Ss' general mental ability. The authors provide the following description of this instrument:

...the Otis-Lennon tests are measures of learned or developed abilities in the broadest sense. Performance on the samples of tasks included in the tests reflects a complex interaction of genetic and environmental factors influencing the ability to deal with the abstract manipulation of the verbal, numerical, and figural symbol systems of our culture.²

The Otis-Lennon series represent the most recent efforts by the authors of the Otis Quick-Scoring Tests to develop a broadly based measure of general

1 Arthur S. Otis and Roger T. Lennon, Technical Handbook - Otis-Lennon Mental Ability Test, New York, Harcourt, Brace and World, 1969, p. 4-52.

2. Idem, ibid., p. 7.

mental ability. The Intermediate Level of the Otis-Lennon was designed for use in grades seven to nine, and, like the other tests in the series, is available in two parallel forms, emphasizes power over speed, and has been found useful in predicting scholastic achievement. It has a working time of forty minutes, and provides eighty multiple choice items which are classified by four major types as follows:

- (i) Verbal Comprehension: 25 percent of items are of this type, which measures ability to understand verbal concepts. The items include synonym and antonym definition, sentence completion, and scrambled sentences.
- (ii) Verbal Reasoning: 40 percent of items are of this type, which measures ability to reason with verbal concepts. The items include word-letter matrices, verbal analogies and classification, inference, and logical selection.
- (iii) Figural Reasoning: 19 percent of items are of this type, which measures ability to reason with figural concepts. The items include figure analogies, series completion, and pattern matrices.
- (iv) Quantitative Reasoning: 16 percent of items are of this type, which measures ability to reason with numerical concepts. The items include arithmetic reasoning and number series.

The authors note that performance on this type of test is frequently said to depend on word knowledge and reading skill³. The results of a reading level analysis⁴ of verbal comprehension and analogies items indicated that the Otis-Lennon is not biased in favour of proficient readers.

b. The Measures of Academic Motivation, Extraversion and Neuroticism

Of the standardized tests designed to measure the achievement motive, the three scales of the California Psychological Inventory (CPI)⁵ which are grouped under the heading of Measures of Achievement Potential and Intellectual Efficiency were considered the most useful for purposes of this research. The CPI was developed for use in educational settings, and it was noted in the literature review that the three motivation scales were found to predict scholastic performance⁶.

3 Idem, ibid, p. 11.

4 Idem, ibid, p. 11-13.

5 Harrison G. Gough, Manual for the California Psychological Inventory, Palo Alto, California, Consulting Psychologists Press, 1957.

6 Harrison G. Gough, "Academic Achievement in High School as Predicted from the California Psychological Inventory", in Journal of Educational Psychology, Vol. 55, 1964, p. 174-180.

The three CPI scales are described as follows:

- (i) Achievement via Independence (Ai):
Subjects are required to agree or disagree with 31 personal opinion items which were designed "to identify those factors of interest and motivation which facilitate achievement in any setting where autonomy and independence are positive behaviours." For example, agreement with the statement "I seem to be as capable and smart as most others around me" would contribute to a high score. High scorers are "mature, forceful, dominant, demanding, and foresighted; independent and self-reliant, having superior intellectual ability and judgment." Low scorers are "inhibited, anxious, cautious, dissatisfied, dull; submissive and compliant before authority; lacking in self-insight and self-understanding."
- (ii) Achievement via Conformance (Ac):
Subjects are required to agree or disagree with 37 personal opinion items which were designed "to identify those factors of interest and motivation which facilitate achievement in any setting where conformance is a positive behaviour". For example, agreement with the statement "I have a strong desire to be a success in the world" would contribute to a high score. High scorers are "capable, co-operative, organized, responsible, stable, and sincere; persistent and industrious; valuing intellectual activity and achievement". Low scorers are "coarse, stubborn, awkward, insecure and opinionated; easily disorganized under stress or pressures to conform; pessimistic about their occupational futures."
- (iii) Intellectual Efficiency (Ie): Subjects are required to agree or disagree with 48 personal opinion items which were

designed to "indicate the degree of personal and intellectual efficiency which the individual has attained". For example, disagreement with the statement "I must admit, I have no great desire to learn about new things" would contribute to a high score. High scorers are "efficient, clear-thinking, intelligent, progressive, thorough, and resourceful; alert and well-informed; placing a high value on intellectual matters". Low scorers are "confused, cautious, easy-going, defensive, shallow, and unambitious; conventional and stereotyped in thinking; lacking in self-direction and self-discipline."

The Junior Eysenck Personality Inventory

(JEPI)⁷ is the childrens' form of the instrument designed to measure the personality dimensions of extraversion-introversion and neuroticism. These variables were selected as predictors because their relation to performance on standardized achievement tests has not, to this investigator's knowledge, been examined. As noted in the preceding chapter, use of achievement test scores as criteria may not yield results similar to those based on grades. The two dimensions of personality also are independent of ability and each other⁸. It is common knowledge that if two variables are highly

7 Sybil B.G. Eysenck, Manual of the Junior Eysenck Personality Inventory, San Diego, California, Educational and Industrial Testing Service, 1963, p. 3-10.

8 Idem, ibid, p. 7-9.

intercorrelated, the inclusion of both will contribute little to the prediction achieved.

The junior form of the Eysenck inventory requires approximately ten minutes to administer and yields three sets of scores. In addition to the forty-eight items which make up the personality scales, a Lie Scale consisting of twelve items is included. As this scale is intended to identify individuals who "fake good", it was decided to follow Eysenck and Cookson's⁹ procedure and exclude from the sample all Ss with Lie Scale scores of nine and above.

The JEPI was developed for use with persons aged seven to sixteen. While it may be argued that it is not appropriate for use with the older Ss in the sample, exclusion of these Ss would have restricted the range of age and intellectual talent. Administration of the adult form of the inventory was not justifiable in view of evidence that the two forms do not measure identical traits.¹⁰

9 H.J. Eysenck and D. Cookson, "Personality in Primary School Children:1- Ability and Achievement", in British Journal of Educational Psychology, Vol. 39,

10 N.J. Entwisle, "Personality and Academic Attainment", in British Journal of Educational Psychology, Vol. 42, 1972, p. 146.

The personality scales of the JEPI are described as follows:

- (i) Extraversion-Introversion (E): Subjects are required to answer "yes" or "no" to 24 items about themselves. Affirmative answers to the questions "Are you rather lively?" or "Do you like practical jokes?" would contribute to a high score and be indicative of extraversion. "Extraversion is characterized by sociability, activity, optimism, out-going and impulsive behaviour, while introversion is characterized by unsociable, passive, quiet, thoughtful and reserved behaviour."
- (ii) Neuroticism (N): Subjects are required to answer "yes" or "no" to 24 items about themselves. Affirmative answers to the questions "Are you moody?" or "Do you often feel fed-up?" would contribute to a high score and be indicative of neuroticism. "The unstable person is moody, touchy, usually restless and rigid, while the stable person is calm, care-free, easy-going and reliable."

c. The Criterion Measures

It was decided to use both standardized achievement test scores and end-of year grades as measures of scholastic attainment. Achievement test measures may be optimally reliable, but their prediction is of limited practical value to an educational system in which school performance is subjectively assessed. Conversely, the prediction of teacher grades is more relevant to the practical needs of the community, but the reliability of grades is questionable. As noted

in the preceding chapter, it is also possible that scholastic performance is sensitive to the conditions in which it occurs.¹¹ Use of criteria which reflect different achievement conditions may, therefore, obtain dissimilar research results.

The Reading Test and Part A of the Mathematics Test of the Stanford Achievement Test: High School Battery¹² were selected to measure scholastic attainment in these two subject areas. Choice of the tests was based on the investigator's opinion that achievement in reading and mathematics is the best index of general school progress.

The High School Battery is an advanced set of tests designed for use in grades nine to twelve. It is an extension of the Stanford Achievement Test, which has been used in the lower grades since 1922. Although considerable effort was made to ensure content validity by an investigation of American high school curricula and consultation with subject matter specialists, the appropriateness of the battery for Canadian high schools is unknown.

¹¹ Walter Mischel, Introduction to Personality, Second Edition, New York, Holt Rinehart, 1976, p. 492-514.

¹² Eric F. Gardner, Jack C. Merwin, Robert Callis and Richard Madden, Stanford Achievement Test: High School Battery Manual, New York, Harcourt, Brace and World, 1965, p. 7-50.

The ten tests in the battery are available in three parallel forms, stress power over speed, and are recommended for testing of grade nine students during the last half of the year¹³. The Reading and Mathematics Tests are described as follows:

- (i) Reading Test: Consists of paragraphs of varying length, the contents of which are related to history, science, social studies, behavioural science, and arts and humanities. 65 multiple choice items "test the ability to comprehend what is explicit in the material, to judge what is implied, and to draw inferences with reference to other situations". Working time: 40 minutes.
- (ii) Mathematics Test: The 40 multiple choice items included in Part A "measure specifically the content of high school mathematics courses, emphasizing elementary algebra and geometry as usually taught in grades nine and ten". (Part A must be used independently of Part B, as the latter is appropriate only for use with grades eleven and twelve) Working time: 40 minutes.

End-of-year grades in English and Mathematics constitute the second set of achievement criteria. As a reading course is not offered at the grade nine level, English was considered an acceptable substitute because of its dependence on reading skill, its importance in the school curriculum, and the fact that grades in this subject were available for all Ss in the sample.

13 Idem, ibid, p. 7.

3. Procedures - Testing, Scoring and Data Processing

a. Testing and Scoring

The tests to be used as predictors and moderators were administered in April 1973, six weeks prior to administration of the standardized achievement tests. The Intermediate Form J of the Otis-Lennon Mental Ability Test (MAT) consisted of a test booklet and hand-scorable IBM answer sheet. The Achievement via Independence (Ai), Achievement via Conformance (Ac) and Intellectual Efficiency (Ie) scales of the California Psychological Inventory (CPI) were reproduced¹⁴ in test booklets which were accompanied by answer sheets. The Junior Eysenck Personality Inventory (JEPI) consisted of one booklet in which subjects recorded their responses. Two hours were required for administration of the tests, so as to ensure appropriate seating arrangements, sufficient working time, full understanding of instructions, and a brief rest period between tests.

Eight university students assisted the investigator with test administration. In keeping with the

14 By permission of Consulting Psychologists Press, Inc.

school principal's request that testing be conducted in the cafeteria rather than in the classrooms, subjects were assigned to three groups with approximately eighty individuals to a group. While it is acknowledged that the groups were somewhat too large for purposes of group testing, it was believed that the presence of a team of three monitors served the subjects' needs quite well.

The subjects were seated either at long cafeteria-style benches with four subjects to a bench, or at tables with three subjects to a table. Three monitors with group testing experience were designated as leaders of the teams, and were responsible for oral presentation of instructions and the setting of time limits where necessary. The instructions were prepared by the investigator, and corresponded to the written instructions for each test. Each set of instructions provided for a question period, so as to ensure that the subjects fully understood what was expected of them.

Form W of the Reading and Mathematics Tests of the Stanford Achievement Test: High School Battery were administered at the end of May 1973. These tests consisted of test booklets and hand-scorable IBM answer sheets. The procedures described above were

followed for administration of these tests, which also required a two hour period.

The tests were all scored by hand with the appropriate scoring keys, half by the investigator and half by a research assistant. The results were then double-checked by having each scorer verify the results obtained by the other scorer. To ensure confidentiality, only the two scorers were permitted access to the original data.

b. Data Processing

As a first step to organizing the data for card-punching and computer analysis, the Lie Scale scores of the Junior Eysenck Personality Inventory (JEPI) were examined. As no score exceeded seven, all subjects were retained in the sample. Identification numbers and scores denoting the sex of each subject (1-male; 2-female) were subsequently assigned. As the moderated regression system to be used in the research accommodates only one criterion, the next step involved summing the Reading and Mathematics achievement test scores and treating them as one variable. Their combination seemed justified in view of a correlation of .72 between the

two measures. The same procedure was followed for the two sets of grades. These data and the predictor scores were punched on a set of IBM cards for the multiple regression analysis.

At this point decisions had to be made as to how data obtained from the Junior Eysenck Personality Inventory (JEPI) and California Psychological Inventory (CPI) would be processed for the moderator analysis. It was noted in the literature review that the moderated regression system utilizes a squared distance (D^2) measure to cluster subjects with similar profiles on the moderators. This distance measure is defined by the system¹⁵ as follows:

$$D_{ii'}^2 = \sum_{m=1}^M (V_{im} - V_{i'm})^2$$

where

V_{im} is score on the Mth moderator variable for the ith individual.

Cronbach and Gleser¹⁶ point out, however, that use of the squared distance measure greatly exaggerates

¹⁵ Donald A. Rock, John L. Barone and Robert L. Linn, "A Fortran Computer Program for a Moderated Stepwise Prediction System", in Educational and Psychological Measurement, Vol. 27, 1967, p. 710.

¹⁶ Lee J. Cronbach and Goldine C. Gleser, "Assessing Similarity Between Profiles", in The Psychological Bulletin, Vol. 50, 1953, p. 459.

the larger differences between persons' scores. This problem is negligible when the moderator scales contain few items and are of approximately equal length, as in the case of the biodata variables used by Klein et al.¹⁷ As the JEPI and CPI scales are represented by many more items and are of very different length, the computation of D^2 with raw scores would magnify large differences between scores and assign too much weight to the moderator with the larger number of items. For the moderator variables, the distributions of scores were divided into approximate low, middle and high thirds, in such a manner that a maximum number of cases would be included at each level, for the total group and for both sexes. This method of classifying subjects is similar to the classification procedures used by Eysenck and Cookson¹⁸ for the JEPI and by McInnis¹⁹ for the combined CPI scales. Raw scores

17 Stephen P. Klein, Donald A. Rock and Franklin R. Evans, "The Use of Multiple Moderators in Academic Prediction", in Journal of Educational Measurement, Vol. 5, 1968, p. 151-160.

18 Eysenck and Cookson, Op.Cit., p. 113.

19 Charles E. McInnis, Does Either the Moderator Model or the Multiplicative Model Improve Prediction Over the Usual Multiple Regression Model? Unpublished Doctoral Dissertation, University of Ottawa, 1972, p. 30.

falling at each of the three levels were subsequently converted to a 1 (low third), 2 (middle third) or 3 (high third). This treatment corrects for the problem of large distance measures being exaggerated insofar as D^2 for any two persons on any moderator will not exceed 4; i.e., $(3 - 1)^2$. It also ensures that equal weight is assigned to the moderators when assessing profile similarity.

The classification data for the extraversion, neuroticism, and three motivation variables are shown in Tables I to V, and include the range of raw scores, moderator scores, and number of cases in each group. It should be noted that the sex variable will be treated as a moderator by traditional subgroup analysis. The multiple moderated regression program accommodates only five moderator variables, which for this research are the personality and motivation measures. Therefore, data from the male and female groups will be independently processed by the program.

Following the classification process, the data were punched on a set of IBM cards for subsequent computer analysis. In keeping with the requirements of the moderated regression program, the scores were ordered on the cards in the following manner: moderator scores (converted), criterion scores (raw), predictor scores (raw).

Table I

Number of Ss by Total Group and by Sex According
to Three Levels of Extraversion (Approximate
Low, Middle and High Thirds) and
Corresponding Moderator Scores

Moderator Score	Extraversion			Total
	Low Third (0-16)	Middle Third (17-20)	High Third (21-24)	
	1	2	3	
Males	39	40	39	118
Females	48	48	32	128
Total	87	88	71	246

Table II

Number of Ss by Total Group and by Sex According
to Three Levels of Neuroticism (Approximate
Low, Middle and High Thirds) and
Corresponding Moderator Scores

Moderator Score	Neuroticism			Total
	Low Third (0-10)	Middle Third (11-18)	High Third (19-24)	
	1	2	3	
Males	51	43	24	118
Females	32	41	55	128
Total	83	84	79	246

Table III

Number of Ss by Total Group and by Sex According
to Three Levels of Achievement via Independence
(Approximate Low, Middle and High Thirds)
and Corresponding Moderator Scores

Moderator Score	Achievement via Independence			Total
	Low Third (0-12)	Middle Third (13-16)	High Third (17-31)	
	1	2	3	
Males	37	48	33	118
Females	38	44	46	128
Total	75	92	79	246

Table IV

Number of Ss by Total Group and by Sex According
to Three Levels of Achievement via Conformance
(Approximate Low, Middle and High Thirds)
and Corresponding Moderator Scores

Moderator Score	Achievement via Conformance			Total
	Low Third (0-19)	Middle Third (20-23)	High Third (24-37)	
	1	2	3	
Males	38	37	43	118
Females	44	40	44	128
Total	82	77	87	246

Table V

Number of Ss by Total Group and by Sex According
to Three Levels of Intellectual Efficiency
(Approximate Low, Middle and High Thirds)
and Corresponding Moderator Scores

Moderator Score	Intellectual Efficiency			Total
	Low Third	Middle Third	High Third	
	(0-26)	(27-31)	(32- 48)	
1	2	3		
Males	40	44	34	118
Females	46	34	48	128
Total	86	78	82	246

4. The Methods Used to Obtain Reliability Estimates

As reliability is specific, it was estimated from samples of the population used in this research. Reliability estimates for the predictor measures were obtained four weeks after initial administration of these tests. The reliability of the Otis-Lennon Mental Ability Test (MAT) was estimated by computing an alternate form reliability coefficient between Forms J and K of the test for a sample of 59 Ss. As alternate forms were not available for the Junior Eysenck Personality Inventory (JEPI) or the three scales of the California Psychological Inventory (CPI), test-retest reliability estimates were computed. The 51 Ss retested on the JEPI included 44 Ss to whom the CPI scales were re-administered plus 7 Ss who volunteered to take the test following completion of the Otis-Lennon MAT. It is acknowledged that the N's used to estimate the reliability of the personality and motivation measures were smaller than desired, but additional Ss were not available at the time of re-testing.

With regard to the criterion measures, alternate forms were available from the Guidance Centre (Toronto) for the Stanford Mathematics Test only. Form X of this

test was administered to a sample of 80 Ss one week following administration of Form W to the total population. An alternate form reliability coefficient was subsequently computed. In the case of the Reading Test, a test-retest estimate was obtained from the 80 Ss during the same period.

For all reliability estimates, means, standard deviations and standard errors of measurement were computed. The SEM's are of particular importance, as they provide indices of reliability which are unaffected by the homogeneity of the sample. Helmstadter²⁰ notes that a restriction in the range of a trait reduces the reliability coefficient but does not influence the interpretation of the SEM.

5. Statistical Analyses

Two limitations of the multiple regression model were explored prior to testing the null hypotheses enumerated at the end of Chapter 1. These involve the assumption of linear regression and the problem of shrinkage.

²⁰ G.C. Helmstadter, Principles of Psychological Measurement, New York, Appleton-Century-Crofts, 1964, p. 76-78.

With regard to the assumption of linear regression, Guilford²¹ reports that many regressions are nonlinear, particularly when the entire range of a trait is considered. For this research it was assumed that regressions of the achievement criteria on the mental ability measure were linear, but for each of the regressions of achievement on the extraversion, neuroticism, and three academic motivation measures, an F test of linearity of regression was applied. For this test the following formula from Guilford²² was used.

$$F = \frac{(\eta^2 - r^2)(N - k)}{(1 - \eta^2)(k - 2)}$$

where

k = number of columns (or rows)

In interpreting this F, the numbers of degrees of freedom are (k - 2) and (N - k).

On the problem of shrinkage, it was emphasized in the literature review that cross-validation of data on a replication sample is mandatory. Guilford²³ points

21 J.P. Guilford, Psychometric Methods, Second Edition, Toronto, McGraw-Hill, 1954, p. 404.

22 J.P. Guilford, Fundamental Statistics in Psychology and Education, Fifth Edition, Toronto, McGraw-Hill, 1973, p. 290.

23 Guilford, Op.Cit., 1954, p. 405.

out that multiple regression procedures capitalize on chance and so may yield a spuriously high predictive validity. Application of the regression weights obtained from one sample to scores obtained by a second sample is a means by which the degree of shrinkage of the multiple R may be known. McCornack²⁴ notes that some shrinkage is inevitable in the use of any regression technique, but if this is slight, confidence is greater concerning the applicability of the regression weights to new samples.

For this research a double cross-validation design was implemented. The total N of 246 was randomly divided by means of a table of random numbers²⁵ into two Samples A and B, each consisting of 123 Ss. In the case of the multiple regression model, the predictors were optimally weighted and a multiple R computed for each of the two samples and for each achievement criterion. The regression weights obtained from Sample A were applied to the scores for Sample B and vice versa,

²⁴ Robert L. McCornack, "A Comparison of Three Predictor Selection Techniques in Multiple Regression", in Psychometrika, Vol. 35, 1970, p. 257.

²⁵ N.M Downie and R.W. Heath, Basic Statistical Methods, Second Edition, New York, Harper and Row, 1965, p. 316-317.

and cross-validated multiple R's computed. As the purpose of cross-validation is to determine the extent of the "drop" in the cross-validated multiple R, differences between validation and cross-validation R's were tested with the formula for correlation coefficients for independent groups.²⁶ This requires the conversion of the R's to Fisher's z coefficients, which is justifiable in view of McNemar's²⁷ statement that the multiple R has the same predictive meaning as the ordinary bivariate correlation coefficient. The difference between the z coefficients was divided by the standard error of their difference, the formula²⁸ which is as follows:

$$\sigma_{dz} = \sqrt{\frac{1}{N_1 - 3} + \frac{1}{N_2 - 3}}$$

For cross-validation of the multiple moderated regression model, the same Samples A and B were used and a double cross-validation design also adopted for two

26 Guilford, Op. Cit., 1973, p. 166-167.

27 Quinn McNemar, Psychological Statistics, Third Edition, New York, John Wiley, 1962, p. 175.

28 Guilford, Op. Cit., 1973, p. 166-167.

types of data. First, homogeneous subgroups were formed in each sample on the basis of the similarity of the subjects' profiles on all five moderators, and Pearson r 's computed between mental ability and the achievement measures for each group. Then the centroids (vectors of means) were used from Sample A to cluster subjects in Sample B and vice versa, in the manner recommended by Rock.²⁹ That is, a subject in the cross-validation sample was assigned to the subgroup with the highest validity coefficient in the validation sample if his scores on the five moderators were similar to the profile of means on the measures for that group. When the clustering was accomplished, the regression weight obtained from the validation subgroup in Sample A was applied to the corresponding subgroup in Sample B and vice versa, and cross-validated Pearson r 's computed. A similar procedure was followed for cross-validation of the second set of data, but moderators were only included in the analysis if it could be shown that their addition resulted in a statistically significant improvement in the

29 Donald A. Rock, Senior Research Psychologist, Educational Testing Service, Personal Correspondence with the Author, letter dated October 31, 1973.

subgroup validity coefficient. Differences between validation and cross-validation r 's were tested with the formula for correlation coefficients for independent groups.³⁰

Null Hypothesis 1 states that there is no significant increase in the validity coefficients computed for subgroups with similar scores on any one of the sex, extraversion, neuroticism, or three motivation variables beyond that computed for the total group when predicting achievement test performance or school grades. Accordingly, Pearson r 's were computed between the mental ability and two achievement measures for the total group, the samples of males and females, and for subgroups within the overall group which were defined by each of the five remaining moderators. The next step required comparison of the within-group validity coefficients to the validity coefficient obtained for the total sample. Zedeck³¹ states that he does not know of a statistic with which subgroup-total group differences can be tested. As a tentative solution to this problem, Dayhaw

30 Guilford, Op.Cit., 1973, p. 166-167.

31 Sheldon Zedeck, "Problems With the Use of Moderator Variables", in Psychological Bulletin, Vol. 76, 1971, p. 303.

devised the following formula which is taken as the standard error of the difference between a validity coefficient of a subgroup and the validity coefficient of the total group which contains the subgroup.³²

$$\sigma R_S = \sqrt{\frac{1 - R_t^2}{N_S - 1}} \sqrt{\frac{N_t - N_S}{N_t - 1}}$$

where

R_t = multiple R for total group

N_t = number in total group

N_S = number in subgroup

For this research, the above formula was adopted for use with bivariate correlation coefficients. First, differences between the total group and highest within-sex Pearson r 's were computed. The differences were then divided by their standard errors to determine the extent to which they deviate from 0.0. The same procedure was followed for comparison of the total group validity coefficients to the highest validity coefficients for subgroups formed by each of the extraversion,

³² This formula has been incorporated in a more general discussion by Nan Hughes in Memorandum NS - 271, A Note on Testing Correlation Coefficients, Department of Statistics, Harvard University, Cambridge, Mass., 1974, p. 4.

neuroticism, and three motivation measures.

Following computation of the Diff/σ_{rs} (i.e., t) values, the percentile point (t_p) corresponding to each t was found using a table of percentile points for t - distributions.³³ As the research is concerned only with results in one direction; that is, with testing the hypothesis that subgroup validity coefficients might be significantly greater than validity coefficients computed for the total group, one-tailed tests of significance were applied.

Null Hypothesis 2 states that there is no significant increase in the validity coefficients computed for subgroups with similar profiles on any two of the sex, extraversion, neuroticism, or three motivation variables beyond that computed for the total group when predicting achievement test performance or school grades. To evaluate this hypothesis, Pearson r 's were first computed between mental ability and the two achievement measures for subgroups within the male and female samples with similar scores on each of

³³ G.V. Glass and J.C. Stanley, Statistical Methods in Education and Psychology, Englewood Cliffs, N.J., Prentice-Hall, 1970, p.521.

the personality and motivation measures. This was expected to yield information concerning the joint moderator effect of sex and each of the other variables. Pearson r 's were also computed for subgroups within the overall sample which were defined by a combination of the moderator variable yielding the highest predictive objective function with each of the four remaining moderators. The formula³⁴ for the standard error of the difference between the subgroup and total group validity coefficients was subsequently applied.

Null Hypotheses 3 to 5 were tested in the same manner as Null Hypotheses 1 and 2, but required comparison of the total group validity coefficient to the validity coefficients of subgroups with similar profiles on a combination of three, four and five moderators respectively. For Null Hypothesis 6, all six hypothesized moderators were included in the formation of groups, so that Pearson r 's were computed between the ability and achievement measures for subgroups within the samples of males and females which were defined by all personality and motivation measures. Differences

34 Hughes-Harvard, Op.Cit., p. 4.

between subgroup and total group validity coefficients were tested in the usual way.

Null Hypothesis 7 states that there is no significant improvement in prediction of achievement test performance or school grades using any one of the sex, extraversion, neuroticism, or three motivation variables as a moderator over and above its use as a predictor in a multiple regression equation. Accordingly, multiple R's were computed for the total group from a combination of mental ability and each variable identified as a moderator in the testing of Null Hypothesis 1. Differences between the predictor and moderator use of the same variables were tested by comparing the subgroup Pearson r's to the corresponding multiple R's with the formula³⁵ for the standard error of the difference between subgroup and total group validity coefficients.

Null Hypothesis 8 states that there is no significant improvement in prediction of achievement test performance or school grades using any two of the sex, extraversion, neuroticism, or three motivation variables as moderators over and above their use as predictors in a multiple regression equation. To evaluate this

35 Idem, ibid.

null hypothesis, multiple R's were first computed for the total group from combinations of the mental ability measure and each set of two variables identified as joint moderators in the testing of Null Hypothesis 2. Subgroup and total group validity coefficients were subsequently compared. Null Hypotheses 9 to 12 were tested in the same manner, except that they included a greater number of predictor and moderator variables.

The results of the statistical procedures are presented and discussed in the following chapter. For this research it was decided to reject the null hypothesis at the .05 level (one-tailed), to accept it at the .10 level, and to suspend judgment when P is between .10 and .05. This procedure conforms to McNemar³⁶ and Guilford's³⁷ suggestion that researchers may elect not to confine themselves to a definite and arbitrary reject-accept decision in terms of whether a given level of significance is or is not reached, and was influenced by actual and expected characteristics of the data.

36 McNemar, Op. Cit., p. 69.

37 Guilford, Op. Cit., 1973, p. 179.

CHAPTER III

PRESENTATION OF RESULTS

The results of the analyses of the data are presented and discussed in this chapter. First, reliability estimates for all test variables used in the research are reported. Test of linearity of regression of both achievement criterion variables on the personality and academic motivation measures are then presented. Following these preliminary analyses, data from the multiple regression and multiple moderated regression models are cross-validated, using a double cross-validation design. Subsequently, the multiple moderated regression model is used to test six null hypotheses designed to determine whether sex, personality and motivation variables function as moderators in the prediction of both standardized achievement test performance and school grades. Those variables identified as moderators are then compared as moderators and multiple predictors in the testing of six additional null hypotheses.

1. Reliability

The alternate form reliability coefficient (r_{af}), means, SD's and SEM's for the Otis-Lennon Mental

Ability Test (MAT) are presented in Table VI. The test is seen to have an acceptable degree of reliability. The coefficient of .92 approaches the high end of the range of reliabilities reported by Helmstadter¹ for scholastic ability tests.

Test re-test reliability coefficients (r_{tt}), means, SD's and SEM's for the extraversion and neuroticism scales of the Junior Eysenck Personality Inventory (JEPI) are shown in Table VII. Both reliabilities exceed .70 and approximate the values reported by the test authors for samples of fourteen year old subjects.²

The reliability estimates for the motivation scales of the California Psychological Inventory (CPI) are presented in Table VIII. These data are similar to the range of values reported by McInnis³ for the three

1 G.C. Helmstadter, Principles of Psychological Measurement, New York, Appleton-Century-Crofts, 1964, p. 85.

2 Sybil B.C. Eysenck, Manual of the Junior Eysenck Personality Inventory, San Diego, California, Educational and Industrial Testing Service, 1963, p. 6.

3 Charles E. McInnis, Does Either the Moderator Model or the Multiplicative Model Improve Prediction Over the Usual Multiple Regression Model? Unpublished Doctoral Dissertation, University of Ottawa, 1972, p. 68.

PRESENTATION OF RESULTS

75

Table VI

Means, SD's, Alternate Form Reliability Coefficient
(raf), SEM's for the Otis-Lennon Mental Ability
Test (Time Between Testing - 4 weeks)

Statistics	Otis-Lennon MAT	
	N	59
Means		
Form J		55.37
Form K		61.22
SD's		
Form J		14.71
Form K		11.73
raf		.92
SEM's		
Form J		4.10
Form K		3.27

PRESENTATION OF RESULTS

76

Table VII

Means, SD's, Test Re-Test Reliability Coefficients
(r_{tt}), SEM's for the Junior Eysenck Personality
Inventory (Time Between Testing - 4 weeks)

Statistics	JEPI	
	Extraversion	Neuroticism
N	51	51
Means		
Test	17.88	12.98
Re-Test	17.96	12.11
SD's		
Test	3.88	5.83
Re-test	3.66	5.91
r_{tt}	.71	.72
SEM's		
Test	2.08	3.08
Re-Test	1.96	3.12

PRESENTATION OF RESULTS

77

Table VIII

Means, SD's, Test Re-Test Reliability Coefficients
(r_{tt}), SEM's for the Academic Motivation Scales
of the California Psychological Inventory (CPI)
(Time Between Testing - 4 weeks)

Statistics	CPI*		
	Ai	Ac	Ic
N	44	44	44
Means			
Test	16.00	22.77	31.72
Re-Test	16.75	21.95	31.18
SD's			
Test	3.76	3.99	5.71
Re-Test	3.73	5.08	5.66
r_{tt}	.66	.60	.73
SEM's			
Test	2.18	2.52	2.93
Re-Test	2.16	3.20	2.91

*CPI: Ai - Achievement via Independence
Ac - Achievement via Conformance
Ic - Intellectual Efficiency

measures. It is observed that the Intellectual Efficiency (Ie) scale is more reliable than the Achievement via Independence (Ai) or Achievement via Conformance (Ac) scales.

Table IX presents the reliability data for the standardized test criterion measure. An alternate form reliability estimate (r_{af}) is shown for the Mathematics test, while test re-test estimates (r_{tt}) are reported for the Reading and combined tests of the High School Battery. The three measures possess an acceptable degree of reliability.

In general, then, the reliability estimates for all test measures are adequate for purposes of this research, although the intellectual measures are more reliable than the personality and motivation scales.

2. Linearity of Regression

As stated in the previous chapter, it is assumed that the regressions of the two achievement criteria on the mental ability measure are linear. To test the linearity of regression of the achievement criteria on the extraversion, neuroticism and three academic motivation measures, the steps outlined in Guilford⁴ were followed. These call for

⁴ J.P. Guilford, Fundamental Statistics in Psychology and Education, Fifth Edition, Toronto, McGraw-Hill, 1973, p.287-290.

PRESENTATION OF RESULTS

79

Table IX

Means, SD's, Reliability Coefficients - Alternate Form (raf) and Test Re-Test (rtt), SEM's for Reading and Mathematics Tests of the Stanford Achievement Test: High School Battery (Time Between Testing - 1 week)

Stanford Achievement Test: HSB				
Statistics	Mathematics	Reading	Total	Statistics
N	80	80	80	N
Means				Means
Form W	23.50	31.48	54.98	Test
Form X	23.23	34.08	57.32	Re-Test
SD's				SD's
Form W	7.25	11.42	17.47	Test
Form X	7.45	11.57	18.05	Re-Test
raf	.85	.92	.93	rtt
SEM's				SEM's
Form W	2.73	3.15	4.39	Test
From X	2.81	3.19	4.53	Re-Test

the Pearson correlation coefficient (r) and correlation ratio (η), so that the following F test can be applied.

$$F = \frac{(\eta^2 - r^2) (N - k)}{(1 - \eta^2) (k - 2)}$$

where

k = number of columns (or rows)

In interpreting this F, the numbers of degrees of freedom are $(k - 2)$ and $(N - k)$.

For this research, $k = 6$. Reference was made to Guilford⁵ and Ferguson⁶ respectively for testing the statistical significance of the Pearson r and η .

Table X presents the results of the linearity of regression analyses for the extraversion and neuroticism variables. Although it may be argued that a discussion of linearity of regression is not warranted in the absence of any relationship, Entwistle and Cunningham⁷ found that extraversion and school achievement were

5 Idem, ibid., p. 145.

6 George A. Ferguson, Statistical Analysis in Psychology and Education, Toronto, McGraw-Hill, 1959, p. 209.

7 N.J. Entwistle and Shirley Cunningham, "Neuroticism and School Attainment - A Linear Relationship?" in British Journal of Educational Psychology, Vol. 38, 1968, p. 126-127.

Table X

Linearity of Regression of the Stanford Achievement
Test and School Grades Criterion Measures on the
JEPI Extraversion (E) and Neuroticism (N)
Measures (N = 246)

JEPI	r	t _r	η_{yx}	F _{η_{yx}}	F(Lin) _{yx}
Test on E	.03	.46	.17	1.42	1.72
Grades on E	-.09	1.41	.14	.97	.70
Test on N	-.05	.78	.15	1.12	1.22
Grades on N	.01	.15	.11	.58	.72

nonlinearly related, while demonstrating no linear relationship between those variables. There is, however, no evidence of nonlinearity in the present research. A related argument may hold that the obtained r 's are too low to justify consideration of the extraversion and neuroticism variables as predictors in a multiple regression equation. It might be noted, however, that low correlations with intellectual variables are anticipated⁸ but have not slowed down attempts by other investigators⁹ to assess the effectiveness of E and N as multiple predictors. Inclusion of these variables as predictors might also provide useful information should they function as suppression variables.

For the CPI scales, the data in Tables XI to XIII indicate that only the regressions of school grades on the Achievement via Conformance (Ac) measure (Table XII)

8 Eysenck, Op.Cit., p. 9.

9 N.J. Entwisle, J.B. Nisbet, D.M. Entwisle and M.D. Cowell, "The Academic Performance of Students, I - Prediction from Scales of Motivation and Study Habits", in British Journal of Educational Psychology, Vol. 41, 1971, p. 262-263.

Table XI

Linearity of Regression of the Stanford Achievement
Test and School Grades Criterion Measures on the
CPI Achievement via Independence (Ai)
Measure (N = 246)

CPI	r	t _r	η_{yx}	F _{η_{yx}}	F(Lin) _{yx}
Test on Ai	.40	6.79 ^{(1)**}	.39	8.68 ^{(2)**}	-
Grades on Ai	.29	4.73 ^{(3)**}	.29	4.42 ^{(4)**}	.00

** (1) Significance at $p < .01$ requires a t value of 2.59

** (2) Significance at $p < .01$ requires an F value of 3.10

** (3) Significance at $p < .01$ requires a t value of 2.59

** (4) Significance at $p < .01$ requires an F value of 3.10

Table XII

Linearity of Regression of the Stanford Achievement
Test and School Grades Criterion Measures on the
CPI Achievement via Conformance (Ac)
Measure (N = 246)

CPI	r	t _r	η_{yx}	F _{η_{yx}}	F(Lin) _{yx}
Test on Ac	.28	4.55 ^{(1)**}	.27	3.81 ^{(2)**}	-
Grades on Ac	.24	3.86 ^{(3)**}	.48	14.37 ^{(4)**}	13.47 ^{(5)**}

** (1) Significance at $p < .01$ requires a t value of 2.59

** (2) Significance at $p < .01$ requires an F value of 3.10

** (3) Significance at $p < .01$ requires a t value of 2.59

** (4) Significance at $p < .01$ requires an F value of 3.10

** (5) Significance at $p < .01$ requires an F value of 3.40

Table XIII

Linearity of Regression of the Stanford Achievement
Test and School Grades Criterion Measures on the
CPI Intellectual Efficiency (Ie)
Measure (N = 246)

CPI	r	t _r	η_{yx}	F _{η_{yx}}	F(Lin) _{yx}
Test on Ie	.49	8.78 ^{(1)**}	.50	16.12 ^{(2)**}	.79
Grades on Ie	.39	6.61 ^{(3)**}	.43	11.18 ^{(4)**}	2.41 ^{(5)*}

** (1) Significance at $p < .01$ requires a t value of 2.59

** (2) Significance at $p < .01$ requires an F value of 3.10

** (3) Significance at $p < .01$ requires a t value of 2.59

** (4) Significance at $p < .01$ requires an F value of 3.10

* (5) Significance at $p < .05$ requires an F value of 2.40

and Intellectual Efficiency (Ie) measure (Table XIII) were found to be significantly non-linear, ($p < .01$ and $.05$ respectively). The remaining regressions were linear.

In summary, the results of the linearity of regression analyses show that only the regressions of school grades on two CPI scales (Ac, Ie) are non-linear. The JEPI variables and grades were not found to be non-linearly related, nor is there evidence of non-linearity when using an achievement test as a criterion of academic success.

3. Cross-Validation

Prior to reporting the results of the cross-validation analyses, the intercorrelations, means, SD's and multiple R's are presented for the total sample and two validation samples for the multiple regression model. The data in Tables XIV to XVI suggest that the validation samples are approximately equivalent to each other and to the overall sample.

As a first step in conducting the double cross-validation for the multiple regression model, multiple R's were computed between the variables used as predictors and each achievement criterion for the validation samples A and B. As previously reported in Tables XV and XVI, these are $.828$ and $.736$ for Sample A, and $.802$ and $.650$ for Sample B. The regression weights obtained from Sample A were subsequently applied to the scores for Sample B, and weights from Sample B to Sample A scores. Cross-validated multiple R's,

PRESENTATION OF RESULTS

87

Table XIV

Intercorrelation Matrix, Means, SD's and Multiple R's for
 Predictor Variables and Two Achievement Criterion
 Measures for the Total Sample (Multiple
 Regression Model N = 246)

Vari- ables*	1	2	3	4	5	6	7	8	9
1	1.00	-0.13	-0.12	0.12	0.17	0.03	-0.09	0.08	-0.09
2	-0.13	1.00	-0.35	-0.54	-0.48	-0.05	0.01	0.01	0.28
3	-0.12	-0.35	1.00	0.44	0.59	0.40	0.29	0.28	0.06
4	0.12	-0.54	0.44	1.00	0.65	0.28	0.24	0.22	-0.22
5	0.17	-0.48	0.59	0.65	1.00	0.49	0.39	0.42	0.01
6	0.03	-0.05	0.40	0.28	0.49	1.00	0.68	0.77	0.13
7	-0.09	0.01	0.29	0.24	0.39	0.68	1.00	0.63	0.19
8	0.08	0.01	0.28	0.22	0.42	0.77	0.63	1.00	0.09
9	-0.09	0.28	0.06	-0.02	0.01	0.13	0.19	0.09	1.00

Means 17.72 12.80 14.97 21.44 28.82 55.06 126.89 56.84 1.52

SD's 4.05 5.57 3.99 4.75 5.65 17.22 25.63 14.63 0.50

Multi-
ple R's .809 (Achievement Test); .686 (School Grades)

*Variables 1 and 2: JEPI Extraversion and Neuroticism
 Variables 3 to 5 : CPI Academic Motivation (Ai, Ac, Ic)
 Variable 6 : Stanford Achievement Test: HSB } Criteria
 Variable 7 : School Grades
 Variable 8 : Otis-Lennon MAT
 Variable 9 : Sex

PRESENTATION OF RESULTS

88

Table XV

Intercorrelation Matrix, Means, SD's and Multiple R's for
 Predictor Variables and Two Achievement Criterion
 Measures for Validation Sample A (Multiple
 Regression Model N = 123)

Variables*	1	2	3	4	5	6	7	8	9
1	1.00	-0.08	-0.19	0.10	0.13	0.00	-0.19	0.05	-0.10
2	-0.08	1.00	-0.29	-0.55	-0.45	-0.01	0.00	0.05	0.13
3	-0.19	-0.29	1.00	0.37	0.50	0.43	0.33	0.25	0.17
4	0.10	-0.55	0.37	1.00	0.62	0.25	0.24	0.13	0.06
5	0.13	-0.45	0.50	0.62	1.00	0.52	0.39	0.39	0.13
6	0.00	-0.01	0.43	0.25	0.52	1.00	0.69	0.76	0.19
7	-0.19	0.00	0.33	0.24	0.39	0.69	1.00	0.66	0.18
8	0.05	0.05	0.25	0.13	0.39	0.76	0.66	1.00	0.10
9	-0.10	0.13	0.17	0.06	0.13	0.19	0.18	0.10	1.00
Means	18.44	12.59	15.08	21.86	29.39	54.16	126.99	56.43	1.53
SD's	3.79	5.30	3.82	4.63	5.33	17.72	27.38	15.07	0.50
Multi- ple R'S	.828 (Achievement Test); .736 (School Grades)								

*Variables 1 and 2: JEPI Extraversion and Neuroticism
 Variables 3 to 5 : CPI Academic Motivation (Ai, Ac, Ic)
 Variable 6 : Stanford Achievement Test: HSB
 Variable 7 : School Grades
 Variable 8 : Otis-Lennon MAT
 Variable 9 : Sex

89

Intercorrelation Matrix, Means, SD's and Multiple R'S for
Predictor Variables and Two Achievement Criterion
Measures for Validation Sample B (Multiple
Regression Model N = 123)

Variables*	1	2	3	4	5	6	7	8	9
1	1.00	-0.17	-0.07	0.12	0.18	0.08	0.00	0.13	-0.09
2	-0.17	1.00	-0.39	-0.53	-0.50	-0.09	0.04	-0.02	0.42
3	-0.07	-0.39	1.00	0.50	0.68	0.39	0.25	0.32	-0.03
4	0.12	-0.53	0.50	1.00	0.68	0.33	0.24	0.32	-0.11
5	0.18	-0.50	0.68	0.68	1.00	0.48	0.39	0.47	-0.08
6	0.08	-0.09	0.39	0.33	0.48	1.00	0.67	0.78	0.07
7	0.00	0.04	0.25	0.24	0.39	0.67	1.00	0.59	0.20
8	0.13	-0.02	0.32	0.32	0.47	0.78	0.59	1.00	0.07
9	-0.09	0.42	-0.03	-0.11	-0.08	0.07	0.20	0.07	1.00
Means	17.00	13.00	14.86	21.01	28.26	55.95	126.79	57.26	1.50
SD's	4.19	5.85	4.17	4.85	5.93	16.72	23.87	14.23	0.50
Multi- ple R's	.802 (Achievement Test); .650 (School Grades)								
*Variables 1 and 2:	JEPI Extraversion and Neuroticism								
Variables 3 to 5 :	CPI Academic Motivation (Ai, Ac, Ie)								
Variable 6 :	Stanford Achievement Test: HSB								
Variable 7 :	School Grades								
Variable 8 :	Otis-Lennon MAT								
Variable 9 :	Sex								

which are the correlations between obtained criterion scores and criterion scores predicted on the basis of regression weights derived from the other sample, were computed for each sample.

As the purpose of cross-validation is to estimate the extent of shrinkage in the multiple R when the regression weights are applied to new samples, the differences between pairs of validation and cross-validated multiple R's were tested with the formula for correlation coefficients for independent groups.¹⁰ Each pair of validation and cross-validated R's were converted to Fisher's z coefficients. The difference between the z's was divided by its standard error, the formula for which is:

$$\sigma_{d_z} = \sqrt{\frac{1}{N_1 - 3} + \frac{1}{N_2 - 3}}$$

Applying the above formula to the data yielded a standard error of difference value of .129. The results shown in Table XVII indicate that none of the differences between validation and cross-validated

10 Guilford, Op.Cit., p. 166-167.

PRESENTATION OF RESULTS

91

Table XVII

Multiple R's, Cross-Validation R's, z's, Diff_z , $\text{Diff}/\sigma dz$
and Levels of Statistical Significance for Comparison
of the R's for the Multiple Regression Model

Criterion	R (N=123)	z	Cross-Val R (N=123)	z	Diff_z	$\frac{\text{Diff}}{\sigma dz}$	P
Test Scores							
A	.828	1.181	A to B	.778	1.039	.142	1.100 NS
B	.802	1.105	B to A	.704	.875	.230	1.782 NS
Grades							
A	.736	.942	A to B	.694	.856	.086	.666 NS
B	.650	.775	B to A	.502	.551	.224	1.736 NS

multiple R's is statistically significant, although in terms of the observed "drop" in the R there would appear to be more shrinkage when cross-validation is conducted from Sample B to A than from Sample A to B.

The same samples A and B were used and a double cross-validation design also adopted for cross-validation of the moderator model. As the moderated regression technique includes one to five moderators in a stepwise manner, it was decided to cross-validate two types of data. First, data obtained by simultaneous inclusion of the five moderator variables were cross-validated. Cross-validation procedures were then implemented for data based on the selection of the "best" moderator or subset of moderators; that is, for data beyond which no statistically significant increases in the subgroup validity coefficients were found.

For the first cross-validation analysis, subgroups were formed in the samples on the basis of the similarity of the subjects' profiles on the five moderators, and Pearson r's computed between mental ability and each achievement measure for these groups. Then the centroids (vectors of means) were taken from Sample A, and euclidian distance measures (d^2) used to

assign subjects from Sample B to the group in Sample A whose centroid was closest to each subject's profile. That is, a subject in Sample B was assigned to the subgroup with the highest validity coefficient in Sample A if his scores on the five moderators were more similar (i.e. $d^2 = \text{minimum}$) to the profile of means on the measures for that group than for any other group. The same procedure was used to cluster the subjects in Sample A. When the clustering was accomplished, the regression weight obtained from the validation subgroup in Sample A was applied to the scores for the corresponding subgroup in Sample B and vice versa, and cross-validated Pearson r 's computed.

The same procedures were followed for the second cross-validation analysis, except that only one moderator was included. That is, no statistically significant differences in the subgroup validity coefficients were apparent with the inclusion of more than one moderator. Validation and cross-validated Pearson r 's for data using one and five moderator variables were subsequently converted to Fisher's z 's and tested for differences with the formula for correlated coefficients for independent groups.¹¹ The results of these analyses are presented in Table XVIII. None of the differences is

11 Idem, ibid.

Table XVIII

Pearson r's, Cross-Validation r's, z's, Diff_z, Diff/σdz
and Levels of Statistical Significance for Comparison
of the r's for Data Including One and Five
Moderators for the Moderated Regression Model

Criterion	Moderators*	r	z	Cross-Val r	z	Diff _z	Diff	p
Test Scores								
A	E	.892 (N = 35)	1.432	A to B .816 (N = 52)	1.145	.287	1.264	NS
A	E,N,Ai,Ac,Ie	.817 (N = 32)	1.148	A to B .789 (N = 43)	1.068	.080	.327	NS
B	Ac	.892 (N = 40)	1.432	B to A .783 (N = 47)	1.049	.383	1.717	NS
B	E,N,Ai,Ac,Ie	.795 (N = 38)	1.085	B to A .700 (N = 41)	.867	.218	.931	NS
Grades								
A	E	.757 (N = 44)	.988	A to B .612 (N = 44)	.712	.276	1.254	NS
A	E,N,Ai,Ac,Ie	.683 (N = 32)	.835	A to B .763 (N = 48)	1.002	-.167	-.701	NS
B	Ac	.731 (N = 39)	.931	B to A .625 (N = 40)	.733	.198	.846	NS
B	E,N,Ai,Ac,Ie	.612 (N = 38)	.712	B to A .645 (N = 41)	.767	-.055	-.235	NS

* E - Extraversion N - Neuroticism Ai - Achievement via Independence
Ac - Achievement via Conformance Ie - Intellectual Efficiency

statistically significant, although it is observed that there is less shrinkage of the r when all moderators are simultaneously included.

For both prediction models, therefore, the differential prediction weights obtained for the validation groups are sufficiently stable to suggest that the obtained regression equations could be generalized beyond the sample used in this research.

4. Statistical Testing of the Null Hypotheses

To test the first six null hypotheses, data from the overall, male, and female samples were processed independently by the moderated regression program. As noted in the chapter on Experimental Design, the capacity of the program to accommodate only five moderator variables necessitated treating sex as a moderator by traditional subgrouping procedures. Pearson r 's between mental ability and the two achievement criteria were thus computed for total, male, and female groups, and for subgroupings of the cases within each group as defined by the five personality and motivation measures.

As the subjects' raw scores on the five measures were converted a priori to three classes (i.e. approximate

low middle and high third of the distributions - see Tables 1 to V), three grouping procedures were carried out at each stepwise level. That is, it was stipulated that the technique first place the cases into three subgroups with maximally similar scores on each moderator or combination of moderators. These were then reduced to two subgroups, and, subsequently, to the one larger group which included all the cases. The method of reducing the initial number of groups to one group is based on a modification of Ward's¹² hierarchical grouping technique as applied to the D^2 matrix of scores on the moderators. The squared distance (D^2) measure was designed by Cronbach and Gleser¹³ to indicate the extent to which two profiles of test scores are similar, and is defined by the moderated regression program¹⁴ as

12 Joe H. Ward, Jr., "Hierarchical Grouping to Optimize an Objective Function", in Journal of the American Statistical Association, Vol. 58, 1963, p. 236-244.

13 Lee J. Cronbach and Goldine C. Gleser, "Assessing Similarity Between Profiles", in The Psychological Bulletin, Vol. 50, 1953, p. 456-473.

14 Donald A. Rock, John L. Barone and Robert L. Linn, "A Fortran Computer Program for a Moderated Stepwise Prediction System", in Educational and Psychological Measurement, Vol. 27, 1967, p. 710.

follows:

$$D_{ii'}^2 = \sum_{m=1}^M (V_{im} - V_{i'm})^2$$

where

V_{im} is score on the M th moderator variable for the i th individual.

The grouping of moderators at each stepwise level was accomplished in the following manner. First Pearson r 's were computed for subgroups characterized by similar scores on the individual moderator variables. The variable yielding the highest predictive objective function was then retained and combined with each of the remaining moderators at the second stepwise level. Similarly, Pearson r 's between mental ability and the achievement criteria were computed for subgroups with common profiles on each subset of two moderator variables. The combination of two variables yielding the highest predictive objective function was then carried into level three and so on, until all moderators were simultaneously included in the analysis. The predictive objective function provides an index for the predictive accuracy of the computer system for each set of groupings on the moderator variables, and is defined¹⁵ at stage S as:

¹⁵ Idem, ibid., p. 712.

PRESENTATION OF RESULTS

98

$$\bar{T}_s = \sum_{g=1}^G \left[R_{gs}^2 \sum_{i=1}^{N_g} Y_{ig}^2 \right]$$

where

- $\bar{T}_s$ = predicted objective function at stage S
- R_{gs}^2 = squared multiple correlation between the predictor and a criterion within the gth group at stage s
- Y_{ig} = observation on the criterion for individual i in the gth group
- G = number of groups which were formed at stage S
- N_g = number of observations in group g at stage s

Null Hypothesis 1 states that there is no significant increase in the validity coefficients computed for subgroups with similar scores on any one of the sex, extraversion, neuroticism, or three motivation variables beyond that computed for the total group when predicting achievement test performance or school grades. This and the null hypotheses to follow require comparison of validity coefficients computed in subgroups to validity coefficients computed for the total group. It was noted in the chapter on Experimental Design, however, that

Zedeck¹⁶ is unaware of a statistic that tests for such differences. To tentatively provide for such a test, Dayhaw developed the following formula which is taken as the standard error of the difference between a validity coefficient of a subgroup and the validity coefficient of the total group which contains the subgroup.¹⁷

$$\sigma R_s = \frac{1 - R_t^2}{\sqrt{N_s - 1}} \sqrt{\frac{N_t - N_s}{N_t - 1}}$$

where

R_t - multiple R for total group

N_t - number in total group

N_s - number in subgroup

For this research, the above error term was adopted for use with bivariate correlation coefficients. As a first step in the testing of Null Hypothesis 1, six subgroup validity coefficients were noted. These included the highest within-sex Pearson r 's and the highest Pearson r 's obtained for subgroups which were defined by each of the five remaining moderators.

16 Sheldon Zedeck, "Problem with the Use of Moderator Variables", in Psychological Bulletin, Vol. 76, 1971, p. 303.

17 This formula has been incorporated in a more general discussion by Nan Hughes in Memorandum NS - 271, A Note on Testing Correlation Coefficients, Department of Statistics, Harvard University, Cambridge, Mass., 1974, p.4.

The differences between the subgroup and total group Pearson r 's were first computed. These differences were subsequently divided by their standard errors to determine the extent to which they deviate from 0.0. Following computation of the Diff/σ_{rs} (i.e., t) values, the percentile point (t_p) corresponding to each t was found using a table of percentile points for t - distributions.¹⁸ One-tailed tests of significance were applied, as this research is concerned only with results in one direction; that is, with testing the hypothesis that subgroup validity coefficients would be significantly greater than validity coefficients computed for the total group.

It was decided, for this research, to reject H_0 at the .05 level, to accept H_0 at the .10 level, and to reserve judgment when P is between .10 and .05. Since $P = .10$ or more (one-tailed) for a t of 1.3, only t 's equal to or greater than 1.3 are considered in the reporting of P levels.

¹⁸ G.V. Glass and J.C. Stanley, Statistical Methods in Education and Psychology, Englewood Cliffs, N.J., Prentice-Hall, 1970, p.521.

The data relevant to testing of Null Hypothesis 1 with the achievement test criterion are presented in Table XIX. For two comparisons, P is less than .05, so that Null Hypothesis 1 is rejected. First, the validity coefficient of .842 computed for a subgroup on the Extraversion (E) variable represents a statistically significant improvement over and above the total group r of .777 ($P = .032$). The subgroup for which improved prediction of test performance is shown consists of subjects classified by the research in the approximate low third of the E distribution (see Table I).

The Achievement via Conformance (Ac) variable is also shown to contribute to improved prediction of achievement test performance in the testing of Null Hypothesis 1. The r of .836 computed for the subgroup classified as being in the approximate high third of the (Ac) distribution (see Table IV) is significantly greater than the r of .777 computed for the overall sample ($P = .045$).

Table XX reports the results of testing Null Hypothesis 1 with the school grades criterion. It is observed that none of the improvements in the subgroup validity coefficients over the total group value is statistically significant at the .05 level, although there is a meaningful trend towards significance in use of the sex variable as a moderator ($P = .057$). The

Table XIX

Pearson r 's, Diff_r , σr_s , t 's, t_p 's and Levels of Statistical Significance for Comparison of Pearson r 's Between Mental Ability and Achievement Test Performance for Total Group and Subgroupings Having the Highest Validity on Each of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai, Ac, Ic)

Groups	N	r	Diff_r	σr_s	t	t_p	P
Total Group:	246	.777					
Subgroups on:							
S	128	.791	.014	.024	.583	-	-
E	87	.842	.065	.034	1.911	.968	.032
N	83	.792	.015	.035	.428	-	-
Ai	79	.799	.022	.037	.594	-	-
Ac	87	.836	.059	.034	1.735	.955	.045
Ic	160	.765	-.012	.018	-.666	-	-

Table XX

Pearson r 's, Diff_r , σr_s , t 's, t_p 's and Levels of Statistical Significance for Comparison of Pearson r 's Between Mental Ability and School Grades for Total Group and Subgroupings Having the Highest Validity on Each of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ic)

Groups	N	r	Diff_r	σr_s	t	t_p	P
Total Group:	246	.636					
Subgroups on:							
S	128	.694	.058	.036	1.611	.943	.057
E	88	.690	.054	.051	1.058	-	-
N	79	.671	.035	.055	.636	-	-
Ai	92	.663	.027	.049	.551	-	-
Ac	87	.678	.042	.051	.823	-	-
Ie	82	.649	.013	.054	.240	-	-

grades of females tend to be more predictable than those of the sample taken as a whole.

To test Null Hypothesis 2, the same procedures were followed as for Null Hypothesis 1, except that the total group validity coefficients were compared to validity coefficients computed in subgroups with similar profiles on combinations of two of the sex, personality and motivation variables. As shown in Table XXI, the subgroup validity coefficients range from .781 to .863 for the achievement test criterion. None of these values represents a statistically significant improvement over and above the total group Pearson r , although one comparison approaches significance. That is, the r of .863 computed for a subgroup of females on the Achievement via Conformance (Ac) measure is shown to be greater than the total group value of .777 at the .062 level of confidence. However, it was found using the same method of subgroup-total group comparison that there is no advantage ($P > .10$) to grouping on the sex and Ac variables (.863) beyond that provided on the basis of Ac alone (.836 - see Table XIX). Subgrouping by sex on the Achievement via Conformance (Ac)

Table XXI

Pearson r 's, Diff_r , σ_{rs} , t 's, t_p 's and Levels of Statistical Significance for Comparison of Pearson r 's Between Mental Ability and Achievement Test Performance for Total Group and Subgroupings Having the Highest Validity on Combinations of Two of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai, Ac, Ic)

Groups	N	r	Diff_r	σ_{rs}	t	t_p	P
Total Group:	246	.777					
Subgroups on:							
S,E	39	.845	.068	.059	1.152	-	-
S,N	32	.814	.037	.066	.560	-	-
S,Ai	33	.836	.059	.065	.907	-	-
S,Ac	44	.863	.086	.054	1.592	.938	.062
S,Ie	48	.792	.015	.051	.294	-	-
N,E	117	.796	.019	.026	.730	-	-
N,Ai	69	.809	.032	.040	.800	-	-
N,Ac	127	.806	.029	.024	1.208	-	-
N,Ie	192	.781	.004	.013	.307	-	-

measure, therefore, makes no additional contribution to prediction of achievement test performance.

For school grades, the data reported in Table XXII show subgroup validity coefficients ranging from .655 to .757. Although none of the subgroup values was found to be significantly greater, at the .05 level, than the total group validity coefficient, there is a trend towards significance in use of the combined sex and Extraversion (E) variables ($P = .068$). However, comparison of the subgroup value of .757 with that of .694 computed on the basis of sex alone (see Table XX) demonstrated that the joint use of the two variables produced no additional gain in prediction of grades ($P > .10$). Null hypothesis 2 is not rejected.

Null Hypothesis 3 states that there is no significant increase in the validity coefficients computed for subgroups with similar profiles on any three of the sex, extraversion, neuroticism or three motivation variables beyond that computed for the total group when predicting test scores or grades. As in the testing of Null Hypotheses 1 and 2, differences between

Table XXII

Pearson r's, Diff_r, σ_r s, t's, t_p's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and School Grades for Total Group and Subgroupings Having the Highest Validity on Combinations of Two of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie)

Groups	N	r	Diff _r	σ_r s	t	t _p	P
Total Group:	246	.636					
Subgroups on:							
S,E	48	.757	.121	.078	1.551	.932	.068
S,N	55	.712	.076	.071	1.070	-	-
S,Ai	38	.714	.078	.090	.866	-	-
S,Ac	44	.750	.114	.082	1.390	.911	.089
S,Ie	34	.711	.075	.096	.781	-	-
E,N	46	.708	.072	.080	.900	-	-
E,Ai	125	.689	.053	.037	1.432	.919	.081
E,Ac	113	.688	.052	.041	1.268	-	-
E,Ie	204	.655	.019	.017	1.117	-	-

subgroup and total group validity coefficients were first computed. The differences were subsequently divided by their standard errors to obtain the t values.

Table XXIII presents the results of testing Null Hypothesis 3 with the achievement test criterion. One improvement is statistically significant at the .05 level, so that Null Hypothesis 3 is rejected. The validity coefficient for a subgrouping on the Neuroticism (N), Achievement via Conformance (Ac) and Intellectual Efficiency (Ie) variables (.835) is significantly greater than the validity coefficient computed for the overall sample (.777; $P = .047$). In addition, one other comparison approaches the probability level adopted for rejection of the null hypothesis ($P = .064$), suggesting that the difference between .827 and .777 may constitute a real improvement in prediction of test performance.

The data relevant to testing Null Hypothesis 3 with the school grades criterion are shown in Table XXIV. It is seen that none of the subgroup-total group comparisons reaches the .05 level of statistical significance,

Table XXIII

Pearson r 's, Diff_r , σr_s , t 's, t_p 's and Levels of Statistical Significance for Comparison of Pearson r 's Between Mental Ability and Achievement Test Performance for Total Group and Subgroupings Having the Highest Validity on Combinations of Three of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ic)

Groups	N	r	Diff_r	σr_s	t	t_p	P
Total Group:	246	.777					
Subgroups on:							
S,E,Ac	39	.845	.068	.059	1.152	-	-
S,N,Ac	72	.790	.013	.039	.333	-	-
S,Ai,Ac	71	.820	.043	.039	1.102	-	-
S,Ac,Ic	71	.804	.027	.039	.692	-	-
E,N,Ac	95	.827	.050	.032	1.562	.936	.064
N,Ac,Ic	86	.835	.058	.034	1.705	.953	.047
N,Ai,Ac	82	.827	.050	.035	1.428	.918	.082

Table XXIV

Pearson r 's, Diff_r , σ_r s, t 's, t_p 's and Levels of Statistical Significance for Comparison of Pearson r 's Between Mental Ability and School Grades for Total Group and Subgroupings Having the Highest Validity on Combinations of Three of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie)

Groups	N	r	Diff_r	σ_r	t	t_p	P
Total Group:	246	.636					
Subgroups on:							
S,E,N	33	.762	.126	.098	1.285	-	-
S,E,Ai	54	.742	.106	.072	1.472	.923	.077
S,E,Ac	51	.715	.079	.075	1.053	-	-
S,E,Ie	42	.761	.125	.084	1.488	.924	.076
E,N,Ac	175	.659	.023	.024	.958	-	-
E,N,Ai	130	.659	.023	.036	.638	-	-
E,N,Ie	61	.710	.074	.066	1.121	-	-

although two results show a trend towards improvement, ($P = .077$; $P = .076$).

Null Hypothesis 4 required comparison of total group Pearson r 's to r 's of subgroups with similar profiles on combinations of four of the sex, personality and motivation variables. The same procedures were followed as in the testing of Null Hypotheses 1 to 3, the results of which are reported in Tables XXV and XXVI. It can be readily observed that none of the obtained increases in the subgroup r 's is statistically significant at the .05 level for the achievement test criterion (Table XXV), and that t values are not equal to or greater than 1.3 in the context of school grades (Table XXVI). Null Hypothesis 4, therefore, cannot be rejected.

Null Hypothesis 5 compares the total group Pearson r 's to Pearson r 's of subgroups formed by combinations of five of the hypothesized moderator variables. The results of these analyses are presented in Tables XXVII and XXVIII. For the achievement test criterion (Table XXVII), two subgroup validity coefficients are significantly greater, at the .05 level or better, than the validity coefficient computed for the overall sample ($P = .05$; $P = .048$), so that Null Hypothesis 5 is rejected.

Table XXV

Pearson r 's, Diff_r , σ_r 's, t 's, t_p 's and Levels of Statistical Significance for Comparison of Pearson r 's Between Mental Ability and Achievement Test Performance for Total Group and Subgroupings Having the Highest Validity on Combinations of Four of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie)

Groups	N	r	Diff_r	σ_r	t	t_p	P
Total Group:	246	.777					
Subgroups on:							
S,E,N,Ai	33	.836	.059	.065	.907	-	-
S,E,N,Ac	52	.819	.042	.049	.857	-	-
S,E,N,Ie	39	.845	.068	.059	1.152	-	-
S,E,Ai,Ac	61	.845	.068	.044	1.545	.933	.067
S,E,Ac,Ie	60	.812	.035	.044	.795	-	-
E,N,Ac,Ie	79	.785	.008	.037	.216	-	-
N,Ai,Ac,Ie	108	.812	.035	.028	1.250	-	-

Table XXVI

Pearson r's, Diff_r, σ _rs, t's, t_p's and Levels of Statistical Significance for Comparison of Pearson r's Between Mental Ability and School Grades for Total Group and Subgroupings Having the Highest Validity on Combinations of Four of the Sex(S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie)

Groups	N	r	Diff _r	σ _r s	t	t _p	P
Total Group:	246	.636					
Subgroups on:							
S,E,N,Ai	44	.731	.095	.082	1.158	-	-
S,E,N,Ac	32	.723	.087	.099	.878	-	-
S,E,N,Ie	32	.728	.092	.099	.929	-	-
S,E,Ai,Ac	47	.618	-.018	.079	-.227	-	-
S,E,Ac,Ie	84	.641	.005	.053	.094	-	-
E,N,Ai,Ac	85	.645	.009	.052	.173	-	-
E,N,Ac,Ie	67	.690	.054	.062	.870	-	-

Table XXVII

Pearson r 's, Diff_r , σ_{rs} , t 's, t_p 's and Levels of Statistical Significance for Comparison of Pearson r 's Between Mental Ability and Achievement Test Performance for Total Group and Subgroupings Having the Highest Validity on Combinations of Five of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ie)

Groups	N	r	Diff_r	σ_{rs}	t	t_p	P
Total Group:	246	.777					
Subgroups on:							
S,E,Ai,Ac,Ie	39	.877	.100	.059	1.694	.950	.050
S,E,N,Ai,Ac	44	.822	.045	.054	.833	-	-
E,N,Ai,Ac,Ie	119	.821	.044	.026	1.692	.952	.048

Table XXVIII

Pearson r 's, Diff_r , σ_{rs} , t 's, t_p 's and Levels of Statistical Significance for Comparison of Pearson r 's Between Mental Ability and School Grades for Total Group and Subgroupings Having the Highest Validity on Combinations of Five of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai, Ac, Ie)

Groups	N	r	Diff_r	σ_{rs}	t	t_p	P
Total Group:	246	.636					
Subgroups on:							
S,E,N,Ai,Ac	44	.731	.095	.082	1.158	-	-
S,E,Ai,Ac,Ie	35	.684	.048	.094	.510	-	-
E,N,Ai,Ac,Ie	119	.658	.022	.039	.564	-	-

One subgroup is defined by the sex, Extraversion (E) and three motivation variables, the other by the personality and motivation measures. The reader will note that the difference between the r computed for the first grouping of subjects and moderators (.877) and the total group r (.777) numerically represents optimal improvement of prediction of test performance. For the grades criterion, the data in Table XXVIII indicate that none of the subgroup validity coefficients exceeds the total group value at the .05 level of statistical significance.

Null Hypothesis 6 was tested in the same manner as Null Hypotheses 1 to 5, except that the total group validity coefficients were compared to validity coefficients computed in subgroups with similar score profiles on all six of the sex, personality and motivation variables. As shown in Tables XXIX and XXX, neither subgroup-total group comparison approaches the probability level adopted for rejection of the null hypothesis. Subgrouping on all six variables makes no contribution to prediction of achievement test performance or school grades. Null Hypothesis 6, therefore, is accepted.

Null Hypothesis 7 states that there is no significant improvement in prediction of achievement test performance or school grades using any one of the sex,

Table XXIX

Pearson r 's, Diff_r , σr_s , t 's, t_p 's and Levels of Statistical Significance for Comparison of Pearson r 's Between Mental Ability and Achievement Test Performance for Total Group and Subgrouping Having the Highest Validity on all Six of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ic)

Groups	N	r	Diff_r	σr_s	t	t_p	P
Total Group:	246	.777					
Subgroup on:							
S,E,N,Ai,Ac,Ic	52	.824	.047	.049	.959	-	-

Table XXX

Pearson r 's, Diff_r , σ_r s, t 's, t_p 's and Levels of Statistical Significance for Comparison of Pearson r 's Between Mental Ability and School Grades for Total Group and Subgrouping Having the Highest Validity on all Six of the Sex (S), Extraversion (E), Neuroticism (N) and Three Motivation Variables (Ai,Ac,Ic)

Groups	N	r	Diff_r	σ_r s	t	t_p	P
Total Group:	246	.636					
Subgroup on:							
S,E,N,Ai,Ac,Ic	52	.729	.093	.076	1.223	-	-

extraversion, neuroticism or three motivation variables as a moderator over and above its use as a predictor in a multiple regression equation. As a first step in the testing of Null Hypothesis 7, multiple R's were computed for the overall sample from combinations of the mental ability measure and each variable shown in the testing of Null Hypothesis 1 to moderate prediction of test scores or grades ($P < .05$) or to have potential utility as a moderator ($P < .10$), (see Tables XIX and XX). The subgroup Pearson r's and corresponding multiple R's were compared for significant improvements in the usual manner. The difference between each pair of correlation coefficients was divided by the standard error of the difference between a subgroup validity coefficient and the validity coefficient for the total group which contains the subgroup.¹⁹ For t's equal to or greater than 1.3, percentile values (t_p) and P levels are reported, using one-tailed tests of significance.

The data presented in the top section of Table XXXI are relevant to testing Null Hypothesis 7 with the

19 Hughes-Harvard, Op.Cit., p. 4.

Table XXXI

Multiple R's, Pearson r's, Diff_r, σ_r s, t's, t_p's and Levels
of Statistical Significance for Comparison of Variables
as Multiple Predictors and Moderators in Testing
of Null Hypothesis 7

		Variables	Groups	N	R	r	Diff _r	σ_r s	t	t _p	P
Test	E		Total	246	.777						
			Subgroup			.842	.065	.034	1.911	.968	.032
	Ac		Total	246	.785						
			Subgroup	87		.836	.051	.033	1.545	.934	.066
Grades	S		Total	246	.650						
			Subgroup	128		.694	.044	.035	1.257	-	-

achievement test criterion. Extraversion (E) and Achievement via Conformance (Ac) were compared as moderators and multiple predictors, insofar as they were found to independently moderate prediction of test performance (see Table XIX). It is seen, first, that E functions more efficiently as a moderator than as a predictor in a multiple regression equation, so that Null Hypothesis 7 is rejected. That is, the subgroup r of .842 is significantly greater than the total group multiple R of .777 ($P = .032$). Predictive validity of the mental ability test is improved for a subgroup classified by this research as being in the approximate low third of the E distribution.

Further support for the greater usefulness of E as a moderator is given by comparing the multiple R (.777) to the Pearson r computed for the lowest validity subgroup on the Extraversion measure (.724) ($N = 71$, $\sigma_{rs} = .039$, $t = 1.358$). As $P = .091$ that the improvement is not due to chance, it may be concluded that this research shows no advantage to using Extraversion as a multiple predictor of achievement test performance.

For the Achievement via Conformance (Ac) variable, the subgroup r of .836 represents an improvement

over and above the multiple R of .785 at $P = .066$. Although it appears that Ac has some utility as a moderator in prediction of achievement test performance, the results of a subsequent test suggest that it is not more effective in this role than as a multiple predictor. Employing the usual method of subgroup-total group comparison, the multiple R of .785 was found to be greater, at the .057 level of statistical significance than the Pearson r of .730 computed for the lowest validity subgroup on the Ac measure ($N = 82$, $\sigma r_s = .034$, $t = 1.617$).

To evaluate the results of testing Null Hypothesis 7 for the school grades criterion, the Pearson r of .694 computed for the female subsample was compared to the total group multiple R of .650 using sex as a multiple predictor. The results of this analysis are reported in the bottom section of Table XXXI. As the value of t is not equal to or greater than 1.3, it is concluded that there is no significant improvement in prediction of grades when using sex as a moderator variable. In fact, the results of comparing the R of .650 to the Pearson r of .574 computed for the subsample of males suggest that the sex variable is more

useful as a predictor in a traditional multiple regression equation ($N = 118$, $\sigma_r = .038$, $t = 2.00$, $P = .024$).

To test Null Hypothesis 8, multiple R 's were computed for the total group from combinations of the mental ability measure and each set of two variables shown in the testing of Null Hypothesis 2 to have potential utility as joint moderator variables ($P < .10$ - see Tables XXI and XXII). A summary of the data involved in testing Null Hypothesis 8 is presented in Table XXXII. For the achievement test criterion, the one relevant comparison (i.e. sex and A_c as multiple moderators and predictors) does not attain statistical significance at $P < .05$ (one-tailed), although there is a trend towards significance ($P = .082$). None of the three comparisons reported in the bottom section of Table XXXII for the school grades criterion obtains a t value equal to or greater than 1.3, indicating that there is no advantage to using the moderator technique in this context. Null Hypothesis 8 is not rejected.

Null Hypothesis 9 was tested in the same manner as Null Hypotheses 7 and 8, except that multiple R 's were computed from combinations of the mental ability measure and each set of three variables shown in the

PRESENTATION OF RESULTS

124

Table XXXII

Multiple R's, Pearson r's, Diff_r, σ_r s, t's, t_p 's and Levels
of Statistical Significance for Comparison of Variables
as Multiple Predictors and Moderators in Testing
of Null Hypothesis 8

Variables	Groups	N	R	r	Diff _r	σ_r s	t	t_p	P
Test	S,Ac	Total	246	.788					
		Subgroup	44		.863	.075	.052	1.442	.918 .082
Grades	S,E	Total	246	.665					
		Subgroup	48		.757	.092	.073	1.260	- -
	S,Ac	Total	246	.659					
		Subgroup	44		.750	.091	.078	1.166	- -
	E,Ai	Total	246	.660					
		Subgroup	125		.689	.029	.035	.828	- -

testing of Null Hypothesis 3 to moderate prediction of achievement ($P < .05$) or to be potentially useful as joint moderators ($P < .10$ - see Tables XXIII and XXIV). The subgroup Pearson r 's (variables as moderators) and corresponding multiple R 's (variables as predictors) were compared for significant improvements in the usual manner, as shown in Table XXXIII. For one-tailed tests at $P < .05$, the increases obtained by grouping on three variables are statistically non-significant, so that Null Hypothesis 9 is not rejected.

For testing of Null Hypothesis 10, a multiple R was computed from the combination of mental ability and the subset of four variables shown in testing of Null Hypothesis 4 to have potential utility as joint moderators in prediction of achievement test performance ($P = .067$ - see Table XXV). As grouping on four variables failed to produce moderator effects in the school grades context (see Table XXVI), the largest subgroup Pearson r (.731) was accepted for comparison with the appropriate multiple R .

The data involved in testing Null Hypothesis 10 are presented in Table XXXIV. As the t values computed for subgroup-total group comparisons using both

PRESENTATION OF RESULTS

126

Table XXXIII

Multiple R's, Pearson r's, Diff_r, σ_r s, t's t_p 's and Levels
of Statistical Significance for Comparison of Variables
as Multiple Predictors and Moderators in Testing
of Null Hypothesis 9

Variables	Group	N	R	r	Diff _r	σ_r s	t	t_p	P
Test	E,N,Ac	Total	246	.786					
		Subgroup	95		.827	.041	.030	1.366	.910
	N,Ac,Ie	Total	246	.801					
		Subgroup	86		.835	.034	.031	1.096	-
	N,Ai,Ac	Total	246	.802					
		Subgroup	82		.827	.025	.032	.781	-
Grades	S,E,Ai	Total	246	.671					
		Subgroup	54		.742	.071	.066	1.075	-
	S,E,Ie	Total	246	.683					
		Subgroup	42		.761	.078	.076	1.026	-

Table XXXIV

Multiple R's, Pearson r's, Diff_r, σ_s , t's, t_p 's and Levels
of Statistical Significance for Comparison of Variables
as Multiple Predictors and Moderators in Testing
of Null Hypothesis 10

		Variables	Groups	N	R	r	Diff _r	σ_s	t	t_p	P
Test	S,E,Ai,Ac	Total		246	.804						
		Subgroup		61		.845	.041	.039	1.051	-	-
Grades	S,E,N,Ai	Total		246	.671						
		Subgroup		44		.731	.060	.076	.789	-	-

attainment criteria are not equal to or greater than 1.3, Null Hypothesis 10 must be accepted. Subgrouping on four variables does not result in predictive gain beyond that provided by use of the variables as multiple predictors of achievement test scores or school grades.

The same procedures were followed for testing of Null Hypothesis 11. First, multiple R's computed from combinations of the mental ability measure and each set of five variables shown in the testing of Null Hypothesis 5 to influence prediction of achievement test performance (see Table XXVII) were compared to the relevant subgroup validity coefficients. Second, the largest subgroup r obtained for the school grades criterion (see Table XXVIII) was compared to the corresponding multiple R . As shown in Table XXXV, none of the comparisons reaches significance at the .05 level, so that Null Hypothesis 11 is not rejected. Although the Pearson r of .877 represents the optimal subgroup validity coefficient obtained by this research for the achievement test criterion, the improvement of this value over the multiple R of .809 suggests that there was no advantage to be gained by using the moderator model.

PRESENTATION OF RESULTS

129

Table XXXV

Multiple R's, Pearson r's, Diff_r, σ_s , t's, t_p 's and Levels
of Statistical Significance for Comparison of Variables
as Multiple Predictors and Moderators in Testing
of Null Hypothesis 11

Variables	Groups	N	R	r	Diff _r	σ_s	t	t_p	P
Test	Total	246	.809						
	S,E,Ai,Ac,Ie								
	Subgroup	39		.877	.068	.051	1.333	.904	.096
	Total	246	.807						
E,N,Ai,Ac,Ie	Subgroup	119		.821	.014	.023	.608	-	-
	Total	246	.684						
Grades	S,E,N,Ai,Ac	44		.731	.047	.073	.643	-	-
	Subgroup								

As a first step in the testing of Null Hypothesis 12, multiple R's including all predictor variables in the regression equations were computed for both achievement criteria. These values were compared to validity coefficients obtained by subgrouping on all six of the hypothesized moderator variables in testing of Null Hypothesis 6 (see Tables XXIX and XXX). The data reported in Table XXXVI offer no assurance, for either achievement criterion, that the sex, personality and motivation variables might be more useful as joint moderators than as predictors in a traditional multiple regression model. As the t values are not equal to or greater than 1.3, Null Hypothesis 12 is accepted.

The results of testing Null Hypotheses 1 to 6 are provisionally summarized in Table XXXVII. It is seen that the Extraversion (E) and Achievement via Conformance (Ac) measures enhanced prediction of test scores, while sex (S) was the only variable shown to influence the relationship between mental ability and grades. Differences using the two achievement criteria were also evident in the character and number of moderator groupings for which subgroup validity coefficients were optimal in the testing of Null Hypotheses 2 to 5.

PRESENTATION OF RESULTS

131

Table XXXVI

Multiple R's, Pearson r's, Diff_r, σ_r s, t's, t_p 's and Levels
of Statistical Significance for Comparison of Variables
as Multiple Predictors and Moderators in Testing
of Null Hypothesis 12

Variables	Groups	N	R	r	Diff _r	σ_r s	t	t_p	P
Test	Total	246	.809						
	S,E,N,Ai,Ac,Ic								
	Subgroup	52		.824	.015	.042	.357	-	-
Grades	Total	246	.686						
	S,E,N,Ai,Ac,Ic								
	Subgroup	50		.729	.043	.067	.641	-	-

Table XXXVII

Pearson r's, t's and Levels of Statistical Significance Reported for Comparison of Pearson r's Between Mental Ability and Two Achievement Criteria for Total Group (rt) and Subgroupings (rs) on Sex, Personality and Motivation Variables in Testing Null Hypotheses 1 to 6

Achievement Test						School Grades					
N.H.	Variables*	rs	rt	t	P	Variables	rs	rt	t	P	
1	E Ac	.842 .836	.777 .777	1.911 1.735	.032 .045	S	.694	.636	1.611	.057	
2	S,Ac	.863	.777	1.592	.062	S,E S,Ac E,Ai	.757 .750 .689	.636 .636 .636	1.551 1.390 1.432	.068 .089 .081	
3	E,N,Ac N,Ac,Ie	.827 .835	.777 .777	1.562 1.705	.064 .047	S,E,Ai S,E,Ie	.742 .761	.636 .636	1.472 1.488	.077 .076	
4	S,E,Ai,Ac	.845	.777	1.545	.067	S,E,N,Ai	.731	.636	1.158	-	
5	S,E,Ai,Ac,Ie E,N,Ai,Ac,Ie	.877 .821	.777 .777	1.694 1.692	.050 .048	S,E,N,Ai,Ac	.731	.636	1.158	-	
6	S,E,N,Ai,Ac,Ie	.824	.777	.959	-	S,E,N,Ai,Ac,Ie	.729	.636	1.223	-	

* E - Extraversion
N - Neuroticism
S - Sex

Ai - Achievement via Independence
Ac - Achievement via Conformance
Ie - Intellectual Efficiency

PRESENTATION OF RESULTS

Joint moderators were not shown by this study to be particularly effective. Although subgrouping on combinations of three and five variables led to improvements over and above the total group Pearson r when using the test criterion, these subgroup values were not significantly greater than those computed on the basis of Extraversion (E) and Achievement via Conformance (Ac) alone.

Table XXXVIII summarizes the results of testing Null Hypotheses 7 to 12. None of the sex, personality and motivation variables functioned more efficiently as independent or joint moderators than as multiple predictors when using school grades as a criterion of success. However, a statistically significant improvement in prediction of achievement test performance was demonstrated using Extraversion (E) as a moderator over its use as a multiple predictor ($P < .05$). While a few moderator effects were shown for the test criterion in testing Null Hypotheses 3 and 5 (see Table XXXVII), comparison of the same variables as moderators and multiple predictors provided no evidence for the superiority of the moderated regression model.

Table XXXVIII

Pearson r's, Multiple R's, t's and Levels of Statistical Significance
Reported for Comparison of Sex, Personality and Motivation Variables
as Moderators and Multiple Predictors of Two Achievement
Criteria in Testing of Null Hypotheses 7 to 12

N.H.	Variables*	Achievement Test				School Grades			
		r	R	t	P	Variables	r	R	t
7	E	.842	.777	1.911	.032	S	.694	.650	1.257
	Ac	.836	.785	1.545	.066				
8	S,Ac	.863	.788	1.442	.082	S,E	.757	.665	1.260
						S,Ac	.750	.659	1.166
						E,Ai	.689	.660	.828
9	E,N,Ac	.827	.786	1.366	.089	S,E,Ai	.742	.671	1.075
	N,Ac,Ie	.835	.801	1.096	-	S,E,Ie	.761	.683	1.026
	N,Ai,Ac	.827	.802	.781	-				
10	S,E,Ai,Ac	.845	.804	1.051	-	S,E,N,Ai	.731	.671	.789
11	S,E,Ai,Ac,Ie	.877	.809	1.333	.096	S,E,N,Ai,Ac	.731	.684	.643
	E,N,Ai,Ac,Ie	.821	.807	.608	-				
12	S,E,N,Ai,Ac,Ie	.824	.809	.357	-	S,E,N,Ai,Ac,Ie	.729	.686	.641

* E - Extraversion
N - Neuroticism
S - Sex

Ai - Achievement via Independence
Ac - Achievement via Conformance
Ie - Intellectual Efficiency

5. Subsequent Analysis

It was reported that Extraversion (E), when used as a moderator, increases the predictability of achievement test performance but not that of school grades. This is the major finding of the research. It was decided at this point in presentation of the results to explore the apparent behavioural inconsistency of subjects classified as introverted by the research, i.e., those individuals with scores in the low one-third of the E distribution. A choice was made to examine the phenomenon in terms of over- and underachievement because these concepts continue to receive attention in the research literature²⁰ and are of particular interest to this investigator. Overachievement is defined here in terms of achievement test scores or grades which exceed those predicted on the basis of mental ability scores; conversely, underachievement is defined in terms of lower-than-expected test scores or grades.

Introverted subjects (N = 87) were classified as overachievers if their grades or test scores placed

²⁰ Merville C. Shaw, "Underachievement: Useful Construct or Misleading Illusion", in Psychology in the Schools, Vol. 5, 1968, p. 41-46.

above plus one-half standard error of estimate of the regression equation for the overall sample. Under-achievers were those subjects whose grades or achievement test scores placed below minus one-half error of estimate. As a number of the same individuals were shown to over- or underachieve on both test scores and grades, the procedure for testing the difference between correlated proportions ²¹ was adopted.

The proportion of introverted subjects characterized by overachievement on grades (.30, N = 26) was found to be significantly different ($\bar{z} = 3.54$, $P < .01$) from the proportion which overachieved on the standardized achievement tests (.07, N = 6). There was no significant difference ($\bar{z} = .63$, $P > .05$) in the proportions of introverted subjects who underachieved on grades (.15, N = 13) and the tests (.11, N = 10).

A psychological interpretation of the above findings and their implications for theory and research will be offered in the first two sections of the following chapter. The chapter will conclude with recommendations for further investigation of the relationship between personality, situational variables and academic achievement.

21 Guilford, Op. Cit., p. 164-165.

CHAPTER IV

DISCUSSION OF RESULTS

This chapter presents a discussion of the results of the data analyses. First, the major finding is discussed and interpreted from the vantage point of traditional trait theory and in terms of the more recent view that personality and situational factors both contribute to behaviour. Second, the implications of the overall findings for psychological theory and research are presented. The chapter concludes with suggestions and recommendations for further research.

1. Interpretation of the Major Finding

The major finding that emerged from the analyses of the data was that the extraversion variable, when used as a moderator, enhances the predictability of standardized achievement test scores but not that of grades. As noted in the preceding chapter, the test scores of subjects classified in the low one-third of the extraversion distribution are optimally predictable. The question remains as to why introverted individuals should appear to behave inconsistently across the two achievement conditions. That this behavioural inconsistency seems to manifest itself in a greater degree

of overachievement in the school than in the research setting presents an interesting problem.

Mischel¹ notes that this type of "behavioural specificity" is frequently attributed to methodological and measurement problems by traditional trait theorists. That is, it is assumed that were it not for the inadequacies of currently employed tests and methods, behaviour would be consistent across situations and ought to be explained in terms of personal traits. For example, Cattell² proposes that personality and motivation variables, if measured by tests with demonstrable validity, may be found to account for up to seventy-five percent of the variance of scholastic achievement.

Thus, the psychologist committed to trait theory might argue that the behavioural inconsistency of introverted subjects in this research is due to defects such as the presumably low reliability of the school grades criterion measure. It is common knowledge that errors of measurement tend to reduce the correlations between

1 Walter Mischel, Introduction to Personality, Second Edition, New York, Holt Rinehart, 1976, p. 493.

2 R.B. Cattell, A.P. Sealy and A.B. Sweney, "What Can Personality and Motivation Source Traits Add to the Prediction of School Achievement?" in British Journal of Educational Psychology, Vol. 36, 1966, p. 294.

traits. While methodological problems clearly cannot be ignored, this view overlooks the fact that the situation in which performance is assessed is an important determinant of behaviour. Gray³ concludes from studies of the effects of barbiturates on behaviour that the relationship between extraversion-introversion and performance in learning situations is dependent on the type of reinforcement used in the situation. Introverts appear to be more sensitive than extraverts to punishment, threats of punishment, and nonreward, which in turn seems to be related to the greater arousability of the introvert.⁴ It follows that introverted individuals might tend to avoid punishment and strive for reward in situations where such consequences are imminent.

As Mischel⁵ points out, the majority of behaviours are not uniformly reinforced across different situations. It is the present author's opinion that

3 J.A. Gray, "The Psychophysiological Nature of Introversion-Extraversion: A Modification of Eysenck's Theory," in V.D. Nebylitsyn and J.A. Gray (Ed.), Biological Bases of Individual Behaviour, New York, Academic Press, 1970, p. 182-205.

4 Idem, ibid, p. 194.

5 Mischel, Op. Cit., p. 85.

there is more threat or perceived threat of punishment in the real-life classroom situation than in the artificial and relatively neutral research setting. Therefore, introverted individuals may show greater strivings in class to minimize the probability of punishment and maximize the probability of reward. These strivings might result in a greater degree of overachievement; that is, in grades which are higher than predicted on the basis of mental ability scores. It was noted in the chapter on Presentation of Results that the introverts in the sample do tend more towards overachievement in the classroom than in the standardized achievement test situation, and that no difference was apparent in the proportions of introverted subjects who underachieved on grades and the tests. This behavioural inconsistency is understandable in terms of Gray's⁶ view that the behaviour of introverts is dependent on reinforcement contingencies, and if it can be further assumed that the nature of reinforcement differs across the two achievement conditions. It is acknowledged, however, that these conclusions are tentative, insofar as no direct evidence of situational differences was provided by the study.

6 Gray, Op. Cit., p. 194.

2. Implications of the Findings for Theory and Research

As noted in the preceding section of this chapter, personality theorists tend to assume that there are cross-situational consistencies to behaviour which are explainable in terms of intrapsychic variables. Similarly, individual differences in behaviour are said to reflect personality differences. The role of situational influences on behaviour is correspondingly ignored or minimized.

The results of this research appear to support an alternate hypothesis, namely, that behaviour also can be accounted for in terms of the situation in which it occurs⁷. The achievement behaviour of introverted subjects does seem to be influenced by the conditions in which this behaviour is assessed. However, it is not the present author's intention to overemphasize the importance of situational factors at the expense of personality. While persons do not live in a social vacuum, it is unlikely that social or environmental influences are independent of the qualities of the person. The introvert's susceptibility to punishment is part of his nature. Conditions involving punishment and nonreward

7 Mischel, Op. Cit., p. 492-514.

would affect his behaviour because he is more sensitive to these conditions in the first place.

Behaviour might be most profitably conceived of in terms of complex interactions between person and situation variables. This model of man is becoming increasingly popular among psychologists^{8,9,10} In a review of the results of eleven studies which evaluate the extent of person and situation influences on behaviour, Bowers¹¹ found the interaction of persons and settings to account for a larger percentage of the variance than either main effect in the majority of comparisons. It is theoretically possible, as Gray¹² suggests, that differences along the extraversion variable used in the present study would interact with the type of reinforcement used in a particular learning situation.

8 Norman S. Endler, "The Person Versus the Situation - A Pseudo Issue? A Response to Alker", in Journal of Personality, Vol. 44, 1973, p. 287-303.

9 Mischel, Op. Cit., p.492-514.

10 Lee J. Cronbach, "Beyond the Two Disciplines of Scientific Psychology", in American Psychologist, Vol. 38, Feb. 1975, p. 116-127.

11 Kenneth S. Bowers, "Situationalism in Psychology; An Analysis and a Critique", in Psychological Review, Vol. 80, 1973, p. 307-336.

12 Gray, Op. Cit., p. 194.

The overall results of this research suggest that the stepwise moderated regression system is not more useful for prediction purposes than the traditional multiple regression model. There are, of course, a number of methodological problems inherent in this and much of the research attempting to identify moderators with subgrouping techniques. These have been discussed by Zedeck¹³, and include problems of subgroup sample size and intercorrelations of variables which may contribute to their ineffectiveness as joint moderators. These difficulties notwithstanding, it is also possible that correlational research designs per se have outlived their usefulness. Endler¹⁴ points out that correlational designs have not produced conclusive evidence that personality is an important source of behavioural variance, nor can they yield direct evidence of the impact of situational variables on behaviour.

There is controversy surrounding the relative merits of correlational and manipulative research strategies¹⁵ which will not be dealt with here. It is this

13 Sheldon Zedeck, "Problems With the Use of Moderator Variables", in Psychological Bulletin, Vol. 76, 1971, p. 295-310.

14 Endler, Op. Cit., p. 287-303.

15 Cronbach, Op. Cit., p. 116-127.

author's opinion that an experimental approach which permits the investigator to vary conditions might be productive, while the choice of statistic with which data are analyzed ought to depend on the problem under study. The following section of this chapter includes recommendations for the type of research which might contribute to the ongoing investigation of the nature of relationships between personality, situational factors and scholastic achievement behaviour.

3. Recommendations for Further Research

Efforts to extend this investigation might involve direct examination of the effects of personality and situational factors on grade nine attainment, using teacher differences, classroom differences or stimulus conditions which are varied by the researcher as situational variables. As differences on the extraversion-introversion dimension are expected to interact with reinforcement contingencies¹⁶, perhaps it would be useful to examine the relationship of success on a learning task to this personality variable under varying conditions of threat.

¹⁶ Gray, Op. Cit., p. 194.

Additional extensions to this research could involve use of other personal trait measures, situational factors, criteria and samples. Insofar as the response mode used as assess behaviour also is postulated as a source of behavioural variance¹⁷, person-situation interactions might also be examined in relation to, for example, subject response to oral and written achievement tasks.

Cronbach¹⁸ proposes that evidence of interactions between personal and situational dimensions may be obtained by comparing the regressions of a measure of outcome onto a measure hypothesized to affect responses to particular treatments. Aptitude x Treatment interaction (ATI) is evident if the regression lines in two treatments differ in slope. Aptitude is conceptualized as any personal characteristic which influences a person's response to a treatment condition. An ATI study might prove fruitful, using degree of threat as a treatment, an achievement task as a measure of outcome, and extraversion-introversion as the dimension hypothesized to affect responses to the treatment.

17 Endler, Op. Cit., p. 288.

18 Cronbach, Op. Cit., p. 116-127.

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Cronbach, Lee J., "Beyond the Two Disciplines of Scientific Psychology", in American Psychologist, Vol. 38, Feb. 1975, p. 116-127.

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Endler, Norman S., "The Person Versus the Situation - A Pseudo Issue? A Response to Alker", in Journal of Personality, Vol. 44, 1973, p. 287-303.

This theoretical article discusses the issue of behavioral stability and change with respect to personality traits. Emphasis is placed on how personality and situation variables interact in influencing behavior.

Endler, Norman S., and Synder, Larry S., "Anxiety, Aptitude and Academic Achievement", in Ontario Journal of Educational Research, Vol. 6, 1964, p. 85-91.

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This report provides evidence that sex influences the relationship between extraversion and scholastic achievement.

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Eysenck, H.J., and Cookson, D., "Personality in Primary School Children: 1. - Ability and Achievement", in British Journal of Educational Psychology, Vol. 39, 1969, p. 109-122.

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Klein, Stephen P., Rock, Donald A., and Evans, Franklin R., "The Use of Multiple Moderators in Academic Prediction", in Journal of Educational Measurement, Vol. 5, 1968, p. 151-160.

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McInnis, Charles E., Does Either the Moderator Model or the Multiplication Model Improve Prediction over the Usual Multiple Regression Model? Unpublished Doctoral Dissertation, University of Ottawa, 1972.

This dissertation influenced several aspects of the research, including the implementation of double cross-validation procedures and use of the motivation scales of the California Psychological Inventory as moderator variables.

Middleton, George, Jr., and Guthrie, George M., "Personality Syndromes and Academic Achievement", in Journal of Educational Psychology, Vol. 60, 1959, p. 66-69.

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Pervin, L.A., "Aptitude, Anxiety and Academic Performance: A Moderator Variable Analysis", in Psychological Reports, Vol. 20, 1967, p. 215-221.

The results of this study showed that test anxiety moderates the prediction of college achievement.

Richardson, H., "Utility of a New Method for Predicting College Grades", in Journal of General Psychology, Vol. 72, 1965, p. 159-164.

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This publication provides a description of the Multiple Moderated Regression model adopted for this research. The technique permits inclusion of a maximum of five moderator variables, so that their interactive effects on prediction may be observed.

Rushton, J.R., "The Relationship Between Personality Characteristics and Scholastic Success in 11-year Old Children", in British Journal of Educational Psychology, Vol. 36, 1966, p. 178-184.

These findings suggest that extraversion is an asset at the elementary school level.

Saunders, David R., "Moderator Variables in Prediction", in Educational and Psychological Measurement, Vol. 16, 1956, p. 209-222.

This report describes research and the rationale involved in a non-linear approach to the identification of moderators. It was Saunders who first proposed the concept of a moderator variable.

Savage, R.D., "Personality Factors and Academic Attainment in Junior School Children", in British Journal of Educational Psychology, Vol. 36, 1966, p. 91-92.

These research findings suggest that high extraversion is related to higher intellectual level and academic attainment among elementary school age children.

Shaw, Merville, C., "Underachievement: Useful Construct or Misleading Illusion", in Psychology in the Schools, Vol. 5, 1968, p. 41-46.

This report offers a critique and analysis of prevailing concepts of underachievement.

Stagner, Ross, "The Relation of Personality to Academic Aptitude and Achievement", in Journal of Educational Research, Vol. 26, 1933, p. 648-660.

The results of this early research suggest that personality factors affect the magnitude of the correlation between ability and academic achievement.

Stricker, Lawrence J., "Compulsivity as a Moderator Variable: A Replication and Extension", in Journal of Applied Psychology, Vol. 50, 1966, p. 331-335.

This research failed to show that the joint use of two moderators enhanced prediction beyond that provided by separate use of the variables.

Stroup, Atlee L., and Eft, John H., "The CPI as a Predictor of College Academic Success", in The Alberta Journal of Educational Research, Vol. 15, 1969, p. 191-194.

Results of this research provide further evidence that the CPI scales are useful as predictors of academic success.

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This author suggests that the best moderators would be discrete variables such as biodata items.

Ward, Joe H. Jr., "Hierarchical Grouping to Optimize an Objective Function", in Journal of the American Statistical Association, Vol. 58, 1963, p. 236-244.

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Wilson, J.D., "Predicting Levels of First Year University Performance", in British Journal of Educational Psychology, Vol. 41, 1971, p. 163-170.

These research results highlight the need for updated statistical techniques with which patterns of traits which contribute to or detract from academic performance may be observed.

Zedeck, Sheldon, "Problems with the Use of Moderator Variables", in Psychological Bulletin, Vol. 76, 1971, p. 295-310.

In this theoretical article some of the difficulties encountered in the use of moderator variables are discussed. Different methods of identifying moderators are presented and appraised.

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This study failed to produce joint moderator variables with subgroup analysis, the D-score method and moderated regression.

APPENDIX I

COPY OF QUESTIONNAIRE USED IN THIS RESEARCH TO
ESTIMATE BIOGRAPHICAL CHARACTERISTICS
OF THE SAMPLE

APPENDIX I

Copy of Questionnaire Used in this Research to
Estimate Biographical Characteristics
of the Sample

Name:

1. What school program are you in?
(Academic, Vocational, Commercial)
2. Do you speak English at home?
If not, what language do you speak?
3. Have you received all your schooling in Québec?
4. What is your father's occupation?
5. How many children are there in your family?
Are you the youngest? Eldest? In the middle?

APPENDIX II

RAW SCORE DATA FOR VARIABLES USED IN THIS RESEARCH

Raw Score Data for Variables Used in this Research

SUBJECT	OTIS- LENNON	JEPI		CPI			SEX	SAT- HSB	GRADES
		E	N	At	Ac	Ic			
101	55	14	6	12	25	34	2	51	101
102	76	19	5	16	28	36	2	77	170
103	54	22	15	10	19	27	1	32	110
104	66	17	17	16	21	30	2	57	129
105	64	23	3	21	28	36	2	61	147
106	67	9	15	17	24	27	1	63	146
107	63	19	4	20	30	40	1	54	133
108	52	17	8	10	15	23	1	46	116
109	56	21	14	12	19	19	1	41	112
110	71	22	8	17	21	29	1	73	139
111	32	16	7	12	18	21	2	54	96
112	47	24	11	13	22	28	1	51	101
113	71	18	6	21	25	38	2	86	180
114	75	18	9	18	23	34	2	72	153
115	60	16	20	11	21	22	2	56	134
116	31	11	6	14	28	29	2	33	120
117	60	19	13	13	30	32	1	37	117
118	49	21	19	12	21	24	1	34	127
119	56	23	19	17	19	28	2	61	128
120	72	20	24	9	12	22	2	56	144
121	23	19	6	21	16	27	1	34	87
122	72	18	11	13	22	33	1	59	125
123	73	21	6	22	32	40	1	89	163
124	68	21	5	13	25	37	1	78	165
125	75	21	13	16	26	33	1	83	170

Raw Score Data for Variables Used in this Research (cont'd)

SUBJECT	OTIS- LENNON	JEPI		AI	CPI		SEX	SAT- HSB	GRADES
		E	N		Ac	Ic			
126	68	21	16	8	16	23	2	70	140
127	63	13	9	12	21	32	1	52	128
128	18	16	15	11	20	26	1	34	129
129	39	15	8	12	24	25	2	40	85
130	41	20	10	13	26	33	2	40	85
131	72	16	20	24	25	29	2	86	168
132	70	19	14	15	24	34	2	69	150
133	31	12	19	14	11	28	1	33	97
134	25	20	9	13	22	24	1	38	103
135	71	14	10	16	21	34	1	63	145
136	45	20	17	13	22	26	2	50	110
137	39	13	9	15	24	28	2	31	121
138	75	11	18	16	25	30	2	71	128
139	28	22	6	14	19	33	1	35	90
140	69	19	16	10	18	26	2	61	158
141	62	21	8	12	26	31	2	53	145
142	75	20	11	13	18	34	1	86	150
143	51	14	23	9	16	16	2	42	94
144	71	22	12	14	32	34	2	68	163
145	32	23	3	19	24	28	1	29	140
146	53	22	13	10	22	28	1	37	110
147	53	12	23	10	19	19	2	64	128
148	58	18	14	11	18	21	1	53	128
149	32	11	16	16	15	26	1	40	79
150	52	23	13	15	24	38	2	79	72

Raw Score Data for Variables Used in This Research (cont'd)

SUBJECT	OTIS- LENNON	JEPI		CPI			SEX	SAT- HSB	GRADES
		E	N	Ai	Ac	Ic			
151	56	19	13	15	18	28	2	64	132
152	71	17	20	13	18	33	2	59	136
153	61	19	16	12	13	20	1	36	132
154	46	17	11	9	20	27	1	31	105
155	57	12	16	12	14	18	1	54	128
156	76	17	16	21	22	40	2	93	174
157	65	24	8	15	24	39	1	57	112
158	54	13	9	16	25	30	1	53	125
159	75	17	21	13	14	23	2	66	155
160	56	18	23	11	8	12	2	46	116
161	64	24	14	12	25	37	1	60	126
162	66	7	12	13	17	31	2	63	153
163	61	21	16	8	19	22	1	36	82
164	76	20	6	21	27	36	1	74	137
165	76	23	9	16	25	37	1	83	174
166	67	20	12	19	24	37	1	85	146
167	39	14	5	14	24	33	1	51	111
168	70	21	6	20	28	37	2	72	166
169	65	18	12	13	18	26	2	60	130
170	73	14	9	14	17	23	1	68	151
171	59	21	15	17	19	29	2	52	133
172	50	20	17	13	19	27	1	34	105
173	46	18	17	12	16	24	2	34	95
174	50	16	8	12	20	29	1	52	111
175	38	15	10	17	24	29	1	42	143

Raw Score Data for Variables Used in this Research (cont'd)

SUBJECT	OTIS- LENNON	JEPI		CPI			SLX	SAT- HSB	GRADES
		E	N	AI	Ac	Ic			
176	72	20	12	21	26	40	2	80	168
177	57	19	11	15	20	24	1	48	125
178	45	17	2	25	28	31	2	56	87
179	77	19	7	16	26	34	1	84	160
180	71	13	8	18	27	37	2	82	181
181	41	23	6	16	26	36	1	39	123
182	40	17	24	6	15	18	2	54	118
183	69	15	13	16	26	34	1	60	125
184	41	21	11	16	21	31	2	42	150
185	74	21	11	16	30	41	2	82	153
186	54	8	24	18	12	20	2	52	149
187	74	17	19	18	18	27	2	52	105
188	75	19	20	18	17	32	2	91	167
189	61	16	18	12	19	22	2	52	150
190	53	13	20	18	15	25	1	51	126
191	48	19	21	13	17	22	2	47	110
192	46	13	2	25	26	33	2	46	100
193	54	16	14	13	20	24	2	43	121
194	59	23	11	15	25	31	1	59	116
195	62	24	10	12	22	26	1	59	104
196	56	23	14	12	22	25	1	50	124
197	71	22	14	27	25	35	1	85	144
198	49	22	17	13	12	25	2	48	121
199	62	19	8	19	22	31	1	60	100
200	69	18	12	21	28	38	2	79	123

Raw Score Data for Variables Used in this Research (cont'd)

SUBJECT	OTIS- LENNON	JEPI		CPI			SEX	SAT- HSB	GRADES
		E	N	Ai	Ac	Ic			
201	71	23	20	12	20	22	2	51	128
202	39	20	4	16	22	27	1	59	64
203	67	12	16	16	25	29	1	53	110
204	29	15	20	13	18	25	2	35	75
205	67	19	15	14	23	33	2	63	133
206	46	21	11	12	20	31	2	34	108
207	29	15	15	7	16	23	1	17	96
208	64	24	13	12	25	29	1	70	115
209	57	20	7	16	26	29	2	41	124
210	72	23	10	20	16	32	2	67	106
211	35	18	12	16	25	26	1	31	97
212	71	17	7	21	19	34	2	83	155
213	27	21	19	11	17	23	2	39	75
214	60	10	10	23	26	31	1	55	143
215	74	16	15	17	24	31	2	73	170
216	61	20	9	13	32	29	1	46	138
217	61	14	11	16	18	31	1	54	120
218	64	18	11	18	26	32	2	72	164
219	52	17	24	11	10	20	2	62	119
220	57	10	15	11	25	25	1	60	120
221	72	20	8	16	25	33	2	76	157
222	35	24	12	15	23	21	2	50	102
223	16	15	17	19	17	24	1	27	120
224	43	20	4	16	26	26	2	48	122
225	32	19	6	10	22	26	1	31	83

Raw Score Data for Variables Used in this Research (cont'd)

SUBJECT	OTIS- LENNON	JEPI		CPI			SEX	SAT- HSB	GRADES
		E	N	Ai	Ac	Ic			
226	39	19	9	17	26	27	2	38	82
227	66	19	12	18	16	28	1	74	125
228	58	15	20	9	16	27	1	41	103
229	55	15	2	19	33	34	1	60	142
230	54	22	19	14	23	28	2	45	132
231	71	19	13	20	21	25	1	56	105
232	61	19	13	18	24	32	2	56	125
233	54	19	20	19	21	31	2	39	84
234	68	22	19	12	17	24	1	55	133
235	59	19	16	14	24	29	1	53	122
236	66	23	19	12	21	28	2	74	148
237	34	17	22	12	6	19	2	41	101
238	65	19	20	7	18	19	1	62	134
239	61	21	15	16	23	31	2	57	135
240	66	23	10	13	22	23	2	56	110
241	64	16	13	15	17	27	1	42	100
242	73	14	12	19	22	35	1	59	149
243	50	16	14	17	26	28	2	44	116
244	69	21	4	17	22	33	1	62	158
245	76	20	12	17	21	27	1	76	151
246	48	19	13	15	24	30	2	42	111
247	57	22	12	13	15	23	1	27	91
248	32	15	20	12	17	26	1	33	83
249	71	15	6	17	22	28	1	89	168
250	24	12	12	20	22	28	1	31	90

Raw Score Data for Variables Used in this Research (cont'd)

SUBJECT	OTIS- LENNON	JEPI		CPI			SEX	SAT- HSB	GRADES
		E	N	Al	Ac	Ic			
251	76	24	23	11	17	20	2	68	144
252	64	23	13	14	20	28	1	58	127
253	61	14	16	25	21	31	2	50	122
254	23	17	12	14	12	23	1	28	129
255	65	21	12	8	21	23	1	71	135
256	61	15	24	14	14	22	2	44	152
257	48	16	13	12	18	28	2	37	123
258	63	17	18	17	26	32	2	58	142
259	40	22	10	14	20	26	2	35	134
260	54	13	14	16	21	30	2	51	132
261	69	24	7	13	21	33	1	42	103
262	61	14	16	9	27	29	2	60	165
263	75	19	6	21	25	37	1	75	154
264	79	17	22	14	21	25	2	86	170
265	71	10	11	17	20	29	2	75	136
266	62	10	16	24	21	38	2	69	150
267	52	20	9	17	20	33	1	71	125
268	46	15	16	8	17	25	2	45	117
269	53	20	19	12	20	32	2	46	139
270	59	22	14	14	20	26	1	58	96
271	79	11	16	24	18	33	2	84	159
272	76	20	19	12	21	37	1	81	144
273	23	14	12	15	19	26	2	28	110
274	43	14	19	11	17	16	2	33	136
275	47	16	16	19	25	22	1	45	98

Raw Score Data for Variables Used in this Research (cont'd)

SUBJECT	OTIS- LENNON	JEPI		CPI			SEX	SAT- HSB	GRADES
		E	N	Ai	Ac	Ic			
276	22	18	16	12	26	29	1	28	121
277	51	15	23	13	19	21	2	51	140
278	65	16	11	15	21	35	1	53	129
279	51	22	16	9	23	22	2	41	102
280	63	16	19	13	23	26	2	54	105
281	46	21	13	14	20	29	2	54	122
282	45	13	12	16	14	29	1	31	79
283	47	17	18	7	15	21	1	44	117
284	61	14	18	11	21	26	2	78	167
285	55	20	17	11	20	32	2	61	155
286	73	10	17	21	26	34	2	72	170
287	65	18	6	12	17	20	1	48	82
288	61	16	11	9	20	25	1	63	158
289	44	12	2	9	23	25	1	45	131
290	38	22	12	11	18	24	1	37	83
291	66	22	21	15	19	31	1	61	152
292	75	16	16	13	20	34	2	81	150
293	75	17	19	19	21	30	2	80	156
294	65	20	6	16	32	36	2	62	154
295	27	9	2	16	17	23	1	31	124
296	57	23	2	18	28	35	1	70	120
297	62	21	6	9	18	25	1	46	86
298	31	22	15	10	18	24	2	35	89
299	62	19	6	16	23	29	1	85	150
300	65	21	19	10	15	29	2	50	153

Raw Score Data for Variables Used in this Research (cont'd)

SUBJECT	OTIS- LENNON	JEPI		CPI			SEX	SAT- HSB	GRADES
		E	N	Ai	Ac	Ie			
301	48	17	19	17	16	21	1	34	90
302	62	15	9	20	25	31	1	69	134
303	54	16	10	18	22	32	2	40	131
304	56	20	12	17	18	30	2	81	132
305	57	21	17	14	18	33	1	47	127
306	69	21	16	12	22	31	1	71	143
307	62	11	11	18	25	30	2	68	138
308	47	18	4	12	23	24	1	26	92
309	36	12	23	9	17	14	2	40	119
310	22	13	17	9	18	21	2	26	110
311	48	19	16	11	14	24	2	31	115
312	51	19	3	19	32	40	2	38	85
313	62	21	14	21	29	37	2	79	160
314	57	12	23	14	9	23	2	57	135
315	67	23	4	13	29	42	2	56	146
316	65	23	17	16	22	33	2	72	155
317	69	17	4	24	28	43	2	77	170
318	27	17	3	11	17	24	1	38	100
319	73	17	19	22	23	33	2	85	140
320	56	11	18	19	20	27	2	51	153
321	68	9	11	19	22	29	2	60	181
322	52	21	16	14	26	33	1	61	121
323	57	20	5	15	18	29	1	47	111
324	71	20	12	18	23	38	2	60	140
325	54	15	18	14	29	27	1	56	120

SUBJECT	OTIS- LENNON	JEPI		CPI			SEX	SAT- HSB	GRADES
		E	N	Al	Ac	Ic			
326	77	10	3	25	29	38	1	91	175
327	66	14	21	13	20	29	2	44	145
328	59	23	10	19	24	34	1	60	114
329	71	22	7	16	26	39	1	62	131
330	45	19	15	16	29	28	1	60	95
331	57	4	15	16	23	22	2	45	115
332	62	10	19	10	16	26	2	67	110
333	73	13	6	24	26	38	2	73	122
334	42	23	13	12	21	30	2	29	93
335	77	5	16	16	24	28	1	87	165
336	54	18	20	10	12	21	1	30	83
337	45	20	9	13	20	25	1	40	102
338	52	23	6	17	26	28	1	32	128
339	68	24	8	17	24	36	2	78	126
340	72	14	10	17	23	29	2	54	159
341	63	18	4	18	27	32	2	49	92
342	34	14	4	18	25	31	1	24	108
343	20	15	15	13	27	26	2	24	90
344	72	13	9	15	21	29	1	77	145
345	76	22	11	21	26	40	2	79	176
346	69	21	1	21	32	39	1	56	130

N = 246