

MANIFEST STRUCTURE ANALYSIS  
II. ACADEMIC PREDICTION

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## CURRICULUM STUDIOHUM

Raymond F. Vaillancourt was born November 17, 1926, at Laconia, New Hampshire. He attended the University of Ottawa where he graduated, in 1950, with the degree of Bachelor of Arts. This same institution also awarded him, in 1951, a Baccalaureate in Education, and, in 1953, the Bachelor of Science degree. He received the Master of Arts degree in Psychology from the University of Ottawa in 1955. The title of his thesis was: Local College Prediction with the Otis and the Otis-Ottawa.

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## INTRODUCTION

The vast amount of research in educational prognosis is an indication of the generally poor predictability of scholastic achievement. Despite the continual progress made in devising better measuring instruments, the forecasting of academic success has not improved appreciably. Since the psychological measurements that are currently being used tend to be reasonably good, it seems proper to question whether the statistical means employed are equal to the task. Is it not conceivable that some other technique might be better suited to this situation? Could some less restrictive procedure lead to more satisfactory results?

The present study is an attempt to evaluate a new, relatively untried approach, called Manifest Structure Analysis, by comparing it with the usual regression method applied to the same data. The data on which the comparison is based are concerned with the prediction of scholastic success in the first and second years of the Faculty of Science at the University of Ottawa. The attempted prediction utilizes measures of scholastic aptitude, study habits and attitudes, and personality traits.

The main value of this survey is to test the validity of Manifest Structure Analysis as a predictive technique. Because this technique is being used in an attempt

to forecast college success, this study also should determine the over-all applicability of Manifest Structure Analysis to college prediction. Moreover, the utilization of these particular psychological instruments should shed some light on the contribution of scholastic aptitude, study habits and attitudes, and personality traits to academic achievement in collegiate science faculties.

The initial chapter of this dissertation reviews the literature: first, that pertaining to Manifest Structure Analysis, and subsequently, that concerned with academic prediction at the college level. The nature and rationale of Manifest Structure Analysis is especially stressed in an attempt to arrive at a preliminary appreciation of the merits claimed for this method. The survey of the literature is concluded by exposing the plan of the present investigation.

The design of the study is elaborated in the second chapter. It includes a description of the psychological instruments used, the subjects making up the sample surveyed, and the statistical procedures followed, as well as the reasons underlying their choice.

The results obtained from the survey are then presented and discussed. The discussion treats at length of

the evaluation of the different methods used by comparing the results obtained with each. The report closes with a brief statement of the conclusions drawn from the study.

## CHAPTER I

### REVIEW OF THE LITERATURE

The problem at hand is to determine whether Manifest Structure Analysis (henceforth abbreviated MSA) can be used successfully in the prediction of academic success. The main emphasis is therefore on MSA, whereas scholastic prediction is of secondary importance, being merely a particular area to which this method is applied.

In order to evaluate the current state of knowledge concerning the problem, the pertinent findings reported in the literature will be presented. Because of the dual nature of the topic of research, the survey of the literature likewise will be two-fold: first, MSA itself will be considered, then college prediction will be reviewed.

#### 1. Manifest Structure Analysis

In 1956, du Mas<sup>1</sup> described a method of data analysis which he termed Manifest Structure Analysis. The central idea contained in his monograph is that quantitative and qualitative data can be categorized to yield a quantitative measure of the criterion with which they are associated.

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<sup>1</sup> Frank M. du Mas, Manifest Structure Analysis, Vol. 3, Montana State University Studies, Montana State University Press, Missoula, Montana, 1956, p. ix-193.

The procedure to quantify categorical data depends upon the degree of association and the pattern of association existing between the categories<sup>2</sup> and the continuum<sup>3</sup>. Emphasis on different aspects of the degree and pattern of association leads to three different MSA techniques based on what du Mas has labeled the segmental model, the intensive model, and the clustery model. At this point it would be helpful to describe very briefly an ideal version of each of these models with its corresponding analytic technique. Such a presentation - based on du Mas' book - would facilitate the understanding of the basic MSA rationale thereby permitting its critical evaluation and comparison with conventional methods.

a) The segmental model. -- The segmental model consists of a number of categories associated with unique but consecutive segments of the continuum. A series of these segmental categories is selected so as to extend over the entire range of population values. This notion is depicted schematically in Figure 1 on page 3.

In this instance the task of MSA is first to locate and identify such segmental categories, and then to assign.

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2 By category is meant a class whose members have the same specified characteristics.

3 The continuum is made up of a series of numerical quantities which are arranged in order of magnitude. This magnitudinal continuum - which is simply the criterion or result to be predicted - is termed the manifest variable.

<u>Individual</u>	<u>Continuum</u>	<u>C a t e g o r i e s</u>									
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
R	20										X
A	19								X	X	X
F	18								X	X	X
J	17							X	X	X	X
Q	16						X	X	X	X	X
B	15					X	X	X	X	X	X
S	14					X	X	X	X	X	X
E	13					X	X	X	X	X	X
K	12				X	X	X	X	X	X	X
C	11			X	X	X	X	X	X	X	X
P	10			X	X	X	X	X	X	X	X
I	9			X	X	X	X	X	X	X	X
N	8		X	X	X	X	X	X	X	X	X
D	7		X	X	X	X	X	X	X	X	X
T	6		X	X	X	X	X	X	X	X	X
H	5	X	X	X	X	X	X	X	X	X	X
M	4	X	X	X	X	X	X	X	X	X	X
O	3	X	X	X	X	X	X	X	X	X	X
G	2	X	X	X	X	X	X	X	X	X	X
L	1	X	X	X	X	X	X	X	X	X	X

Figure 1. - The segmental model of Manifest Structure Analysis<sup>a</sup>.

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<sup>a</sup> Based on hypothetical data designed for purposes of illustration. The fact of an individual's association with a particular category is indicated by an X at the intersection of the appropriate row and column.

a numerical value to each. The value of a specific category is the average of those scores on the continuum of all individuals belonging to that category. The score of a given individual is the average of the values of those segmental categories with which he is associated. This score is his predicted score on the criterion.

b) The intensive model. -- The general notion underlying the intensive model is that categories may be differentially associated with some manifest variable so as to overlap one another in a systematic cumulative manner. All the categories which make up the intensive model extend from one common end of the continuum, but they vary in extension. Successive categories cover progressively more of the continuum, and they are arranged in a cumulative step-like fashion so as to extend throughout the range of population values. An ideal form of this structure is portrayed in Figure 2 on page 5.

Again in this case MSA is concerned with the selection of appropriate categories and the assignment of a numerical value to each. In the intensive model as in the segmental model, the value of a specific category is the average of those scores on the continuum of all individuals belonging to that category. Also, the score of a given individual is the average of the values of those intensive categories with which he is associated. Here the similarity of the techniques ends. These score averages for all individuals

<u>Individual</u>	<u>Continuum</u>	<u>C a t e g o r i e s</u>									
		<u>C1</u>	<u>C2</u>	<u>C3</u>	<u>C4</u>	<u>C5</u>	<u>C6</u>	<u>C7</u>	<u>C8</u>	<u>C9</u>	<u>C10</u>
R	20										X
A	19										X
F	18									X	X
J	17									X	X
Q	16								X	X	X
B	15							X	X	X	X
S	14							X	X	X	X
E	13					X		X	X	X	X
K	12					X		X	X	X	X
C	11					X		X	X	X	X
P	10					X		X	X	X	X
I	9					X		X	X	X	X
N	8				X	X		X	X	X	X
D	7				X	X		X	X	X	X
T	6			X	X	X		X	X	X	X
H	5		X	X	X	X		X	X	X	X
M	4		X	X	X	X		X	X	X	X
O	3	X	X	X	X	X		X	X	X	X
G	2	X	X	X	X	X		X	X	X	X
L	1	X	X	X	X	X		X	X	X	X

Figure 2. - The intensive model of Manifest Structure Analysis<sup>a</sup>.

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<sup>a</sup> Based on hypothetical data designed for purposes of illustration. The fact of an individual's association with a particular category is indicated by an X at the intersection of the appropriate row and column.

are assumed to be linearly related to the continuum. Thus a straight line may be fitted to the data and from its equation the individual's criterion score may be predicted.

c) The clustery model. -- A general property of the clustery model is that each interval along the continuum is associated with a single cluster<sup>4</sup> which is different from the cluster associated with any other interval. Figure 3 represents a simple example of the ideal structure of the clustery model.

In analyzing the structure of this model, MSA first must select the appropriate categories, identify the resulting clusters, and then assign a value to each cluster. The value given to each cluster may be described in general as being the mean of the scores on the continuum of all those individuals associated with that cluster. The score of a given individual is merely the value of the specific cluster with which he is associated. This value is his predicted score on the criterion.

d) Assumptions and rationale. -- In the course of this summary outline, similarities between the three MSA

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<sup>4</sup> A cluster is a set of categories found to be common to a group of adjacent scores on the continuum.

Individual	Continuum	Categories										Clusters
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	
R	20	X		X				X				C1, C3, C7
A	19	X		X				X				
F	18	X		X				X				
J	17	X		X				X				
Q	16			X			X		X	X		C3, C6, C9, C10
B	15			X			X		X	X		
S	14			X			X		X	X		
E	13			X			X		X	X		
K	12			X			X		X	X		
C	11	X	X						X			C1, C2, C9
P	10	X	X						X			
I	9	X	X						X			
N	8	X	X						X			
D	7	X			X					X		C1, C4, C10
T	6	X			X					X		
H	5	X			X					X		
M	4	X			X					X		
O	3				X	X			X			C4, C5, C8
G	2				X	X			X			
L	1				X	X			X			

Figure 3. - The clustery model of Manifest Structure Analysis<sup>a</sup>.

<sup>a</sup> Based on hypothetical data designed for purposes of illustration. The fact of an individual's association with a particular category is indicated by an X at the intersection of the appropriate row and column. The continuum has been separated by a space at the points of demarcation of the different clusters to accentuate their grouping.

techniques will have been noticed. These similarities are largely due to the fact that the clustery model is the most general model, the segmental and intensive models being but applications to special conditions. Consequently all these techniques have certain underlying assumptions in common: (1) the continuum consists of consecutive scores; (2) every individual belongs to a particular cluster of one or more categories; and (3) more than one individual is associated with a particular cluster. The purpose of these assumptions seems to be to ensure that the entire continuum is covered by the various clusters, that a prediction can be made for every individual, and that predictions will not be based on one isolated instance.

Even more fundamental than these assumptions and lying at the very root of MSA is the idea that the relationship between predictive data and criterion, in order to be useful, need not be based on the complete set of information but only on that portion of it closely related to the criterion. Accordingly, MSA is essentially an associational method. It differs from conventional correlational techniques primarily in that correlational methods utilize the results of all individuals on a given variable, whereas MSA makes use of only that portion of results which bears a

marked relationship to the criterion. Furthermore, correlation ordinarily involves the actual scores; MSA, on the other hand, requires categorization which may be carried out so as to maximize the association between variables. On the face of it then, MSA appears to be a generally applicable method which seems to offer the possibility of certain advantages over customary practices.

e) Studies employing MSA. -- To date there have been published relatively few studies making use of MSA techniques. The very few reports which have appeared in print are of projects conducted by du Mas in collaboration with others. One study was an application in the field of industrial psychology: it consisted in analyzing data from information files and weighting it in terms of hourly rate of pay. The result seems to have been highly successful since the formula employed gave a Pearson  $r$  of .95 in the initial sample and .80 in a subsequent sample as the correlation between predicted hourly wage and actual dollars-per-hour earnings<sup>5</sup>. A second application of MSA was an attempt to shorten the Otis Self-Administering Test of Mental

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<sup>5</sup> Frank M. du Mas, Carl H. Frost, and Clayton H. Rashleigh, "A Manifest Structure Analysis of Information Files", in the Journal of Clinical Psychology, Vol. 12, No.3, issue of April 1956, p. 139-143.

Ability. This resulted in a 20-item test yielding a correlation of .72 between the obtained score on the regular administration of the test and the predicted score on the short form<sup>6</sup>. In both studies the correlations obtained were statistically significant beyond the 1% level of probability.

f) Published reviews of MSA. -- In view of the paucity of studies utilizing the techniques of MSA, it would be well to consider how the manual expounding these methods has been received by experts in the field. Three reviews of du Mas' book were located. Of the three, one evaluation was moderately favourable, one somewhat hostile, and one rather non-committal. Ammons<sup>7</sup> concluded his review by saying:

This book may well become both a classic in the field of psychological theory and a cookbook of recipes for dishing out fast, practical research results<sup>8</sup>.

Hays<sup>9</sup>, on the other hand, was quite critical of du Mas'

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6 Frank M. du Mas and King MacBride, "A Manifest Structure Analysis of the Otis S-A Test of Mental Ability, Higher Examination: Form B", in the Journal of Applied Psychology, Vol. 42, No.4, issue of August 1958, p. 269-272.

7 R.B. Ammons, reviewing Frank M. du Mas, Manifest Structure Analysis in Perceptual and Motor Skills, Vol. 6, issue of June 1956, p. 152, quoted by Oscar Krisen Buros, Ed., The Fifth Mental Measurements Yearbook, Highland Park, N.J., Gryphon Press, 1959, p. 1027.

8 id., op. cit., p. 1027

9 David G. Hays, reviewing Frank M. du Mas, Manifest Structure Analysis in Educational and Psychological Measurement, Vol. 17, No.4, Winter 1957, p. 634-636.

work, maintaining that there was confusion between efficiency of prediction and internal consistency, and that there was ambiguity as to the direction of prediction. A review by Schuessler<sup>10</sup> saw MSA fundamentally as an application of multiple regression methods which might be useful in examining the connection between a variable and a set of attributes.

All in all, one might consider that no incontrovertible evidence has yet been advanced to reject MSA, and, quite to the contrary, there are some indications that du Mas' methods may be promising and useful.

## 2. College Prediction.

It is common knowledge that the prediction of college success is affected by a number of variables such as the range of talent of those admitted, the varying patterns of courses within the university, the reliability and validity of University marks, as well as the reliability and validity of the predictive measures themselves. Notwithstanding this fact, it is well established that certain measures are predictive of academic success. Furthermore, these measures

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<sup>10</sup> Karl F. Schuessler, reviewing Frank M. du Mas, Manifest Structure Analysis, in American Sociological Review, Vol.21, issue of Dec. 1956, p. 793-794, quoted by Oscar Krisen Buros, Ed., The Fifth Mental Measurements Yearbook, Highland Park, N.J., Gryphon Press, 1959, p. 1025-1026.

have been found quite consistently to follow a uniform order in their capacity as prognosticators. Thus in terms of correlation with college success, it has been generally found that the high school average is the best single predictor (median  $r$  : .56) while achievement tests place second with a median  $r$  of .49, followed closely in turn by tests of mental ability ( $r$  : .47) and aptitude tests ( $r$  : .43)<sup>11</sup>.

Since the above measures taken singly are not very high in forecasting ability, they have frequently been used in various combinations. The research findings in this area are well summarized by Garrett<sup>12</sup> who reported that the co-efficient of multiple correlation is rarely higher than .80, regardless of the number and nature of the variables combined. He further observed that ordinarily the multiple correlation coefficient between scholastic success and tests of achievement and intelligence does not exceed .60 to .70 as a maximum.

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11 S.C.T. Clarke, "Review of Some Previous Studies on Matriculation Problems", in The Alberta Journal of Educational Research, Vol. 4, No.1, issue of March, 1958, p. 30-39.

12 Harley F. Garrett, "A Review and Interpretation of Investigations of Factors Related to Scholastic Success in Colleges of Arts and Science and Teachers' Colleges", in the Journal of Experimental Education, Vol. 18, No.2, issue of December 1949, p. 91-138.

The foregoing appears to summarize rather succinctly the general consensus of research in the area of educational prognosis at the college level. It would be nonetheless enlightening to examine the specific findings in this field. For this purpose the literature has been classified under four sections: measures of high school performance; achievement tests; intelligence tests; measures of non-intellective traits. Accordingly, the findings in the literature will be reported under these headings. It must be stressed however that only a limited number of representative studies will be reported here because of the voluminous literature of redundant results.

a) Measures of High School Performance. -- Although the high school average is the one variable most closely related to college success, there are numerous difficulties in its application as a predictor. The high school records themselves vary depending on the program of studies, examining practices, grading policies, and the educational system itself. At times, because of the diversity of sources from which entering students are drawn, it is next to impossible to reduce these different conditions to a uniform basis of comparison for purposes of evaluation. Consequently, in practice, the high school average is of rather limited applicability particularly where university students are

heterogeneous in background. In an attempt to minimize such difficulties while retaining some of the benefits inherent in high school records, use has been made of departmental matriculation examinations as an index of collegiate promise.

Matriculation examinations have the advantage of uniformity in that the same examination is administered throughout the individual educational system. In this practice there is both strength and weakness: strength in that all students are evaluated more uniformly on a common ground; weakness in the fact that the examination result is only one sample of student behaviour rather than a long term cumulation of pupil performance. Furthermore, in all likelihood, this measure will be no more applicable than the high school record which it was designed to replace because the matriculation examination is restricted, in practice, to those persons who studied under that specific school system. It still does not solve the problem of how to evaluate and compare the worth of applicants from other and different systems. Conceivably the matriculation examination results could be a useful predictive index of university success, especially in those circumstances where a sizeable number of the entering class has been subjected to them. Indeed, just such a conclusion has been reached

in a number of large-scale studies. For instance, in Ontario the Atkinson study has discovered a coefficient of correlation of .604 between Grade XIII departmental examination average and first year university average based on 3052 cases in all Ontario universities<sup>13</sup>. Likewise the Alberta study has revealed that:

The data at hand indicate that the Grade XII examinations of the Province of Alberta represent the best single predictor of success at the University of Alberta<sup>14</sup>.

The over-all relationship between departmental matriculation examinations and tests of achievement and aptitude is well exemplified in a further comparison made in Alberta. Black<sup>15</sup> reported the correlation with Freshman average to be higher for the departmental examinations than for the College Entrance Examination Board achievement tests which, however, surpassed aptitude tests in relationship to the criterion.

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13 W.G. Fleming, "Personal and Academic Factors As Predictors of First Year Success in Ontario Universities", Report No.5, Atkinson Study of Utilization of Student Resources, Department of Educational Research, Ontario College of Education, University of Toronto, 1959, p. xi-137.

14 A.B. Evenson and D.E. Smith, "A Study of Matriculation in Alberta", in The Alberta Journal of Educational Research, Vol. 4, No.2, issue of June 1958, p. 82.

15 D.B. Black, "A Comparison of the Performance on Selected Standardized Tests to That on the Alberta Grade XII Departmental Examination of a Select Group of University of Alberta Freshmen", in The Alberta Journal of Educational Research, Vol. 5, No.3, issue of September 1959, p. 180-190.

b) Achievement Tests. -- Achievement tests also have proven themselves to be effective means of scholastic prediction. As has been reported in the reviews of the literature by Garrett<sup>16</sup> and by Clarke<sup>17</sup>, achievement tests are second in predictive worth only to high school scholarship. Their usefulness seems to depend largely on the nature of the prediction to be made: forecasts in specific subject matter fields can be made with greater accuracy than can over-all predictions<sup>18</sup>. Naturally, the prognostic value of a particular achievement test depends upon the individual situation. Thus French and his collaborators<sup>19</sup> found, through factor analytic techniques, that mathematical, verbal, reading, and spatial abilities were important for success at the U.S. Coast Guard Academy. Such abilities tend to be typical of success in engineering curricula since most engineering selection test batteries incorporate similar

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16 Harley F. Garrett, ibid.

17 S.C.T. Clarke, ibid.

18 Id., ibid.

19 John W. French, et al., "A Factor Analysis of Aptitude and Achievement Entrance Tests and Course Grades at the U.S. Coast Guard Academy", in the Journal of Educational Psychology, Vol. 43, No.2, issue of February 1952, p. 65-80.

measures. For example, Jones and Case<sup>20</sup>, in their engineering examination for selecting undergraduates for the University of California at Los Angeles and at Berkeley, included tests of mathematical reasoning, the understanding of scientific relationships, spatial visualization, and general scholastic ability. To summarize in the words of Travers<sup>21</sup>:

Numerous studies have been made of the measurement of those factors which make for scholastic success in engineering schools. These studies may be summarized by saying that predicted grades in the first two years of engineering school may be expected to correlate between 0.6 and 0.7 with actual grades if predictions are made from tests in mathematical and scientific fields.<sup>22</sup>

c) Intelligence Tests. -- Group tests of general mental ability have also been widely used in the search for more efficient college prediction. In fact, over the years, intelligence tests have been the most frequently studied element in relation to academic achievement. Garrett<sup>23</sup>, in reviewing 94 such studies made prior to 1947, reported a

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20 Margaret Hubbard Jones and Harry W. Case, "The validation of a New Aptitude Examination for Engineering Students", in Educational and Psychological Measurement, Vol. 15, No.4, issue of Winter 1955, p. 502-508.

21 Robert M.W. Travers, "Significant research on the Prediction of Academic Success", p. 147-190 in The Measurement of Student Adjustment and Achievement, edited by Wilma T. Donahue, Clyde H. Coombs, and Robert M.W. Travers, Ann Arbor, University of Michigan Press, 1949, p. ix-256.

22 Id., op. cit., p. 165

23 Harley F. Garrett, ibid.

median correlational coefficient of .47. He noted that of the many tests used, three have been consistently the most popular: the American Council on Education Psychological Examination ( $r : .49$ ), the Ohio State University Psychological Test ( $r : .49$ ), and the Otis Self-Administering Tests of Mental Ability ( $r : .48$ ).

Although it was initially found that the Quantitative and the Linguistic sub-test scores on the ACE had differential predictive value,<sup>24</sup> later studies have established that the ACE Total Score was a more effective predictor than the Quantitative and Linguistic Scores<sup>25</sup>.

With the withdrawal from circulation of the ACE, a number of new tests have appeared on the scene, competing with one another for the vacated position of pre-eminence. Noteworthy among the contenders are the Cooperative School and College Ability Tests (the SCAT), the College Entrance Examination Board Scholastic Aptitude Test (the SAT), and the Psychological Corporation's College Qualification Test (the CQT). However, their respective claims to fame have

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24 Louise M. Thompson and Eleanor A. Haines, "The Relation of College Aptitude Scores to Performance in College Courses", in Canadian Journal of Psychology, Vol. 1, No.1, issue of March 1947, p. 37-40.

25 R. Travis Osborne, Wilma B. Sanders, and James E. Greene, "The Differential Prediction of College Marks by A.C.E. Scores", in Journal of Educational Research, Vol. 44, No.2, issue of October 1950, p. 107-115.

not as yet been fully evaluated by research, although preliminary reports are quite promising<sup>26</sup>.

d) Non-intellective Traits.-- Over the years increasing attention has been focused upon non-intellective traits in an attempt to improve scholastic prediction. In view of the claim that interest and achievement are closely related, interest inventories have been investigated frequently, but they seldom have been used despite their predictive capacity as reported by Travers<sup>27</sup>. However, more recently Berdie<sup>28</sup>, describing the findings of Darley in a 10-year study of more than one thousand entering freshmen at Minnesota, stated that interests as measured on the Strong differentiated better among curricular groups than did either aptitude or achievement tests.

Methods of study in relation to college success have also come in for a great deal of scrutiny. Evidence has been

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26 Descriptions and evaluations of these tests may be found in Cesar Krisen Buros, Editor, The Fifth Mental Measurements Yearbook, Highland Park, N.J., The Gryphon Press, 1959, p. xxvii-1292.

27 Robert M.W. Travers, ibid.

28 Ralph F. Berdie, "Aptitude, Achievement, Interest and Personality Tests: A Longitudinal Comparison", in the Journal of Applied Psychology, Vol. 29, No.2, April 1955, p. 103-111.

produced that aspects of study procedure contribute to the prediction of course grades<sup>29</sup>. Strang<sup>30</sup> wrote that Traxler and Townsend found an experimental edition of A Survey of Study Habits to have satisfactory reliability but that its correlation with school marks was low. Brown and Holtzman<sup>31</sup> reported that their Survey of Study Habits and Attitudes (the SSHA) is a fairly good predictor of college success since it correlates to a moderate degree with grades, and very slightly with academic aptitude, yet its combination with the ACE raised appreciably the correlation between the ACE and course grades. A cross-validation study<sup>32</sup> at Emory University tended to confirm the relation of the SSHA to grades, although the coefficients obtained were somewhat lower, viz.  $r : .24$  and  $r : .32$ , than those reported by the

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29 Harold D. Carter, "Correlations between Intelligence Tests, Study Methods Tests, and Marks in a College Course", in the Journal of Psychology, Vol. 30, Second Half, issue of October 1950, p. 333-340.

30 Ruth M. Strang, "Homework and Guided Study", in the Encyclopedia of Educational Research, 3rd. edition, New York, Macmillan, 1960, p. 675-680.

31 William F. Brown and Wayne H. Holtzman, "A Study-Attitudes Questionnaire for Predicting Academic Success", in the Journal of Educational Psychology, Vol. 46, No.2, issue of February 1955, p. 75-84.

32 Dolores Garcia and Neil Whigham, "Validity of SSHA administered Before and After College Experience", in Educational and Psychological Measurement, Vol. 18, No.4, issue of Winter 1958, p. 845-851.

test authors with students at the University of Texas.

Personality traits and adjustment long have been thought to have some bearing on academic achievement. They have on that account been studied with some degree of hopefulness. Travers<sup>33</sup>, in his overview, stated flatly however that studies of social adjustment in relation to scholastic success have produced uniformly negative results: both the Bernreuter Personality Inventory and the Bell Adjustment Inventory yield correlations of approximately zero with college grades. The situation with regard to traits, on the other hand, appears more promising. Farwell and his colleagues<sup>34</sup>, in their survey of the literature, found evidence that students could be differentiated on the basis of several traits such as introversion, responsibility, complexity of outlook, originality, and authoritarianism, in addition to their MMPI profiles.

In the Atkinson study recently conducted in Ontario, a number of elements have come to light as being useful in

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33 Robert M.W. Travers, ibid.

34 Elwin D. Farwell, Paul A. Heist, and T.R. McConnell, "Colleges and Universities - Student Population", in the Encyclopedia of Educational Research, 3rd. edition, New York, Macmillan, 1960, p. 289-300.

academic prediction. Among these are the age of the student, the time taken to complete Grade XIII, and the high school teachers' appraisal of the student's probable success in university, as well as their rating of his reliability, industry and initiative<sup>35</sup>. These results confirm those previously reported by Garrett<sup>36</sup> in his very comprehensive summary of the literature.

\* \* \*

In 1955, the present writer, in reporting that the Otis and the Otis-Ottawa could serve as predictors of college success at the University of Ottawa<sup>37</sup> suggested that their predictive value might be increased by combining them with other predictive measures. In line with related findings and recommendations in the literature, it seemed that a promising approach to the problem might be the investigation of personality factors and study habits and attitudes. Therefore, it appeared worthwhile

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35 W.G. Fleming, ibid.

36 Harley F. Garrett, ibid.

37 Raymond F. Vaillancourt, Local College Prediction with the Otis and the Otis-Ottawa, unpublished Master's thesis, University of Ottawa, Ottawa, 1955, p. xi-91.

to inquire whether the combined use of such devices might improve academic prediction at this institution.

The utilization of MSA in such an inquiry would permit the objective assessment of some of the conflicting contentions pertaining to du Mas' techniques. By using conventional methods of multiple correlation and regression in addition to the MSA of the same data, a comparative evaluation of the two techniques could be made. This in fact constitutes essentially the nature and purpose of the present survey. The details of the design of this study are described fully in the following chapter.

## CHAPTER II

### THE DESIGN OF THE SURVEY

The present research is concerned with the comparative evaluation of two predictive techniques applied to college achievement. There are three main elements involved in studying this problem: The measuring instruments used, the group to which they are applied, and the manner of comparison of the results obtained. Each of these aspects of the problem will now be developed in turn.

#### 1. The Instruments Employed.

According to the broad plan of the study presented at the close of the preceding chapter, this survey is to make use of three different types of measures: scholastic aptitude study habits, and personality traits. This section will therefore discuss each of these measures in succession.

a) Scholastic aptitude. -- The survey of the literature has revealed that the Otis Self-Administering Tests of Mental Ability<sup>1</sup> can be used to predict college

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<sup>1</sup> Arthur S. Otis, Otis Self-Administering Tests of Mental Ability, Yonkers-on-Hudson, N.Y., World Book Co., 1922.

success.

The Otis has been labeled a measure of scholastic ability because, in the standardization of the test, the criterion reflected the rapidity of advancement in school: only those items were selected which discriminated between the younger and the older pupils in the same grade<sup>2</sup>. It is for this reason that this test is mentioned here under the heading "scholastic aptitude".

The Otis Self-Administering Tests of Mental Ability, and their French-language Canadian adaptation, Les examens Otis-Ottawa d'habileté mentale<sup>3</sup>, have been found to be approximately equivalent<sup>4</sup>. The higher form of these two series of tests has also been shown to be correlated with class marks at the University of Ottawa<sup>5</sup>.

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2 Arthur S. Otis, Manual of Directions and Key (Revised) for the Otis S.-A. Tests of Mental Ability Yonkers-on-Hudson, N.Y., World Book Co., 1928, p. 3.

3 R.-H. Shevenell, O.M.I., Les examens Otis-Ottawa d'habileté mentale, Ottawa, Canada, University of Ottawa Press, 1942.

4 R.-H. Shevenell, O.M.I., Manuel et normes (quatrième édition, revue et corrigée) of Les examens Otis-Ottawa d'habileté mentale, Ottawa, Canada, University of Ottawa Press, 1948, p. 30.

5 Raymond F. Vaillancourt, Local College Prediction with the Otis and the Otis-Ottawa, unpublished Master's thesis, University of Ottawa, Ottawa, 1955, p. xi-91.

Because of the bilingual character of the University of Ottawa, it was desirable to employ a test which the students could take in their mother tongue, whether French or English. These circumstances strongly suggested the Otis SA and Otis-Ottawa as the appropriate instruments.

In this study the Otis Self-Administering Tests of Mental Ability, Higher Form have been used interchangeably with their French-language equivalent, Les examens Otis-Ottawa d'habileté mentale, examen supérieur. Because of the fundamental similarity of the two tests and for the sake of simplicity in this report, the term Otis will be used to refer to the higher forms of both the Otis SA and the Otis-Ottawa tests of mental ability.

The Otis-Ottawa tests are similar to the Otis SA in regard to scope, content, form, administration, scoring, and interpretation, as well as in their standardization<sup>6</sup>. On account of the general familiarity of the Otis SA and the equivalence of the Otis-Ottawa to it, the description of these tests is superfluous.

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<sup>6</sup> R.-H. Shevenell, C.M.I., Manuel et normes (quatrième édition, revue et corrigée) of Les examens Otis-Ottawa d'habileté mentale, Ottawa, Canada, University of Ottawa Press, 1948, 40 p.

b) Study habits. -- Past studies have tended to find some relationship between study habits and scholastic success. However, these results are open to question because of the common tendency of study habits inventories to stress knowledge of how to study and to infer from this the actual implementation of those study methods.

Furthermore, the study habits type of instrument does not concern itself with certain attitudinal characteristics that could affect the utilization of whatever skills the individual does possess. A tool designed to assess both study skills and attitudes should be a decided improvement. The Survey of Study Habits and Attitudes<sup>7</sup> claims to be just such an instrument. For that reason, this device was selected as part of the test battery of this survey.

The Survey of Study Habits and Attitudes (henceforth referred to as the SSHA) is an inventory comprising 75 items of two different kinds: "... those dealing primarily with the mechanics and conditions of studying; and those concerned with attitudes toward studying and motivation

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<sup>7</sup> William F. Brown and Wayne H. Holtzman, Survey of Study Habits and Attitudes, New York, Psychological Corp., 1953.

to do well in academic work<sup>8</sup>."

The criterion used in developing the inventory was the ability of the items to discriminate between matched pairs of good and poor students, one of each pair being on the Dean's List, the other on scholastic probation<sup>9</sup>. The validity coefficient, as determined by the correlation between SSHA scores and first semester college grade-point average, is reported as averaging .42 for men and .45 for women. The reliability coefficient of the SSHA, as given in the Manual, is about .90. The exact value varies somewhat depending on the method of evaluation, the sex of the examinees, and the time interval between repetitions in the case of the test-retest reliability.

The items -- simple declarative statements written in the present tense and in the first person -- are printed in numerical order on a reusable test booklet. The answer to each item is recorded on a separate IBM answer sheet by blocking-out the appropriate space next to the number corresponding to the statement. Each answer is arranged on a five-point scale according to a clearly defined percentage basis

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<sup>8</sup> William F. Brown and Wayne H. Holtzman, Manual (Revised) for the Survey of Study Habits and Attitudes, New York, Psychological Corporation, 1956, p. 10.

<sup>9</sup> Loc. cit.

of incidence. Although untimed, the SSHA requires about twenty minutes to administer.

Scoring can be done by machine or by hand with stencils. There are separate keys for men and women: that for men is based on 36 items, while that for women involves 29 items. Answers to key items are given a weight of 1 or 2; the total of these weights is the score. Centile norms for each sex are given separately for college and for high school level.

c) Personality traits. -- The literature has revealed that measures of adjustment have been generally unsuccessful in forecasting college success, although particular personality traits might be advantageous. Accordingly, the Guilford-Zimmerman Temperament Survey<sup>10</sup> (henceforth to be referred to as the G-ZTS) was selected for inclusion in the test battery of this study. This inventory was chosen not only on account of the relative purity of the factors involved but mainly because it is a composite of three pre-existing instruments of proven worth -- the Guilford Inventories of Factors S T D C R, and the Guilford-Martin Personnel Inventory and Inventory of Factors G A M I N.

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<sup>10</sup> (J.P. Guilford and Wayne S. Zimmerman), Guilford-Zimmerman Temperament Survey, Beverly Hills, Calif., Sheridan Supply Co., 1949.

The reliability of the G-ZTS scores on the various traits is reported by the authors as being approximately .80. The validity of this inventory rests on factor-analytic studies and upon item-analyses directed toward internal consistency and uniqueness<sup>11</sup>. The norms of the inventory, except for trait T, are based on the scores of nearly 1000 college men and women in California.

The G-ZTS consists of 300 items measuring ten different personality traits, each trait being based on 30 items. The items -- affirmative statements using the second person -- are systematically rotated and arranged numerically on a reuseable test booklet. Responses are indicated by crossing out a "yes", "?", or "no" on a separate IBM answer sheet opposite the corresponding item. Responses are scored by stencil, the score on each trait being simply the sum of recorded constituent items. The same scoring keys are used for both men and women, and the norms, expressed in terms of centiles, C-scores, and T-scores for each trait, are common to both sexes, except on three factors. The administration of the inventory requires about 45 minutes.

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<sup>11</sup> J.P. Guilford and Wayne S. Zimmerman, Manual of Instructions and Interpretations for the Guilford-Zimmerman Temperament Survey, Beverly Hills, Calif., Sheridan Supply Co., 1949, p. 6.

## 2. The Population Sampled.

In attempting to ascertain whether the measures just outlined are associated with academic achievement, it was thought that a relatively large homogeneous group of students would be desirable. The students of the Faculty of Science at the University of Ottawa appear to constitute such a group. They are numerous, being approximately 100 in each class; the courses are so arranged that the first and second years are common to practically all students regardless of their later specialization.

These conditions presumably make for greater homogeneity of the group, and they likewise tend to minimize the problems concerning the comparability of the criterion, since all candidates are subject to the same policies and practices.

a) Language. -- Notwithstanding the over-all homogeneity of the Science student body, there is considerable variation in the group as to language. Though most students claim English as their mother tongue, there is a large enrollment of predominantly French-speaking Canadian students. It was for the sake of the latter group that the French version of the Otis was used: a speeded test of mental ability could provide a suitable measure of aptitude only if the individual was not handicapped by language.

Most students understand English readily: a normal expectation in view of the fact that courses are taught in that language. In the case of foreign students of other languages, it was assumed that in registering for admission to this Faculty, they were aware of the language requirements and could comply with them. Of course, it does not follow that such persons will be adequately evaluated on English-language psychometric instruments.

b) Class. -- Students in the first two years of the under-graduate course of the Faculty of Science have been studied in this survey. To be accepted in 1st Year Science, applicants must have Ontario Grade 12 standing, or its equivalent, in accordance with the admission requirements laid down in the Calendar of the Faculty. Those applicants who have Ontario Grade 13 standing, or its equivalent, are eligible for admission to 2nd Year Science, provided that requisite conditions specified in the Calendar have been fulfilled.

In fact, the 1st Year Science at the University of Ottawa is a particular form of the Ontario Grade 13 program geared to prepare students for undergraduate training in science. The 2nd Year Science therefore is really the introductory stage of the regular university program.

Because of the large number of students who enter in either 1st Year or in 2nd Year, it was deemed advisable to study both these groups since local experience indicates that these two classes are the points of greatest student mortality.

There is a further advantage to the inclusion of the 2nd Year in this study. The students in 2nd Year are quite homogeneous with respect to their immediate past educational experience: either they have been successful in 1st Year, or they have attained Ontario Grade 13 standing, or its equivalent, elsewhere. In either case they should exhibit fairly well-defined characteristics -- if such there be -- associated with their highly similar level of achievement. A comparison of such features with those found in 1st Year might provide information concerning level of attainment in relation to specific characteristics.

### 3. Accumulation and Treatment of Data.

Having described the general setting of the investigation, it is now necessary to deal with the specific manner in which the actual research was conducted. This includes the testing procedure as well as the actual measures of test performance, the criterion and its measurement, the description of the sample selected, and finally, the statistical

treatment of the data.

a) Test Administration and Scoring. -- The Faculty of Science has a psychological testing program which is compulsory for all full-time regular students in 1st Year and in 2nd Year. The testing is done ordinarily in October of each year and is planned by, and carried out under the supervision of, the Guidance Centre of the University of Ottawa.

In October 1959, the particular series of tests administered included the battery of this survey, i.e., the Otis, the Guilford-Zimmerman Temperament Survey, and the Survey of Study Habits and Attitudes. At that session, 216 students were to be examined, 117 being in 1st Year, and 99 in 2nd Year.

Because of the large number of students involved, the testing was done at two different times. One session was held for 2nd Year in the forenoon of October 28th, whereas the 1st Year was tested on the morning of October 30th. Both testing periods were conducted under the joint supervision of the instructor in Aptitude Testing and the writer, assisted by graduate students undergoing training in psychometrics.

Scoring of results was done by this same group of test administrators. results were independently checked

and double-checked either by different individuals or by the same individual at different times.

Since the Otis is a timed test, it was given first, followed by the briefer of the two inventories, the SSHA, then the G-ZTS.

1. The Otis: - The 20-minute time limit was applied to the Otis because of the educational level of the subjects. These raw scores were then transformed to the 30-minute score equivalent by means of the conversion table in the Manual for the Otis. The converted scores then were interpreted in terms of Otis IQ.

There is little advantage in using more than one measure of Otis performance, e.g., Raw Score, Converted Score, or IQ, since they are practically linear transformations of one another. However, using the IQ could be advantageous, especially in the case of younger students, because the IQ is affected by age up to 18 years. For this reason and on account of the widespread practice of reporting IQs, the Otis IQ was employed in this study as an index of scholastic aptitude.

ii. The SSHA: - On the SSHA there were obtained four different but related scores: the "Right" score, the "Elimination" score, the Raw Score, and the Centile Rank. The "Right" and "Elimination" scores are simply the results

obtained by direct application of each of the corresponding correction keys to the answer sheet. The total of these two scores gives the raw Score which can then be read from the table of norms as a Centile rank in the college standardization group.

Although these four scores are presumably inter-related, it seemed that there could be special features of each which might show up only in actual use. Accordingly, all four measures were retained for subsequent examination and evaluation.

iii. The G-ZTS: - In the case of the G-ZTS, the only measures to be had are the raw scores on each of the ten traits. The table of norms accompanying the Manual does supply the corresponding C-score, T-score, and Centile, but it was not consulted. On account of the exploratory nature of this inquiry, it might be more helpful to study the raw scores.

b) The criterion. -- In this survey, the criterion for evaluating scholastic achievement was the final average grade as reported in the official records of the Faculty of Science. This grade is the simple average of the final standing of the student in each subject, as determined by the grading procedures described in the Calendar. There are also other considerations involved in deciding whether the

candidate passes or fails. In first and second years, in order to be promoted, the student must obtain a minimum final mark of 50% in each subject, and must have a general average of 60% for the year. An additional requirement in first year is that the student have at least an average of 60% over the three mathematics courses in the program. Various other conditions, described in the Calendar, determine whether the individual is eligible to attempt supplemental examinations; whether the student is allowed to repeat the year; or whether the student must withdraw.

The record of each student at the Faculty of Science identifies the courses taken, the final grade on each, the final average grade for the year, and a statement as to the final outcome. This statement merely reads: "Promoted", "Must Repeat", "Must Withdraw", or it lists the subjects in which the individual must write supplemental examinations.

It was this specific remark which was used in conjunction with the final average grade and which determined the manner of classification of the individuals surveyed. It is clear that "Must Repeat" or "Must Withdraw" indicates an outright failure, while "Promoted" shows success. For the purpose of this survey, those individuals who had to write supplemental examinations were judged to be successful.

This decision was taken because supplemental examinations can be taken only by candidates who have obtained a minimum general average of 60% and who have failed less than four subjects. Because of the high level of achievement of such persons, even after undergoing some failure, this decision seemed warranted.

c) The sample. -- Of the total number of 216 students, in both 1st Year and in 2nd Year Science, tested in the course of this project, only 180 subjects were retained in the sample.

There were two major requirements to qualify for inclusion in the sample. The first condition was that there must be on file in the Faculty of Science a report of the final standing of the student. The second requirement was that the student must have taken the complete test battery.

The first condition -- to have a final average grade for the year -- eliminated 'drop-outs'. Those students who for any reason abandon the program of studies during the academic year are excluded from this study, chiefly because they do not have a criterion score. The limited evidence available tends to indicate that drop-outs do not differ appreciably from their class-mates in regard to academic performance. Consequently, their

elimination does not appear to be prejudicial to the findings of this study.

The second condition -- to have a complete test battery -- eliminated any student who did not complete every test. In effect, this requirement served to insure that the subject had sufficient comprehension of the English language in order to be assessed fairly by the battery. The English-language comprehension of the subject was inferred from the fact of his completion of the test battery. A testee who showed extensive difficulty in understanding items, or who could not finish the battery in the allotted time because of lack of comprehension of terms, was excluded from the sample.

As a result of the foregoing restrictions, approximately 20 subjects were eliminated in each class. Of the original group there now remained 180 as the final sample. In 1st Year Science, the sample was made up of 85 males and 10 females; in 2nd Year, there were 77 males and 8 females.

d) Statistical treatment of the data. -- The two Science classes were treated as separate groups because of the possible existence of differences between them. Likewise, the men students were grouped apart from the women students on account of possible sex differences. Consequently,

the first question to be answered was in regard to the existence of such differences. Accordingly, the means and standard deviations of every variable were computed for each of the four sections of the sample. These statistics were then tested for significance of dif-

on the same data. The difference between these correlational coefficients was tested for statistical significance. The result of this test would be a direct indication of the comparative value of the two predictive techniques.

## CHAPTER III

### PRESENTATION AND DISCUSSION OF RESULTS

As it has been noted previously, this study has two objectives. The primary aim is to attempt the evaluation of Manifest Structure Analysis in comparison with conventional regression techniques. A secondary and more incidental purpose consists in probing the relation of college achievement to study habits, personality, and scholastic aptitude.

In order to accomplish these purposes, it is necessary first to determine the reliability of the instruments as they apply to the local situation. Then the relationship of the test variables with the criterion must be established. As a consequence of this relationship, prediction may be attempted both by methods of regression and by MSA. Finally, the two approaches to prediction are to be compared, and the results discussed. Broadly, such is the outline to be followed in this chapter.

#### 1. Local Reliability of the Instruments.

The three psychometric tools employed in this survey are the Otis, the Guilford-Zimmerman Temperament Survey, and the Brown-Holtzman Survey of Study Habits and Attitudes. The reliability of each will be presented briefly as it has been

found to apply to the student population of the Faculty of Science at the University of Ottawa.

a) The Otis. -- As reported in the Manual<sup>1</sup>, the Otis SA has a reliability of approximately .92 between parallel forms. Comparable results have been obtained with the Otis-Ottawa, the coefficients of correlation being generally .90 or better in a test-retest administration of two forms at the high school level<sup>2</sup>.

In the annual testing program in the Faculty of Science at the University of Ottawa, the Otis yields a test-retest reliability coefficient of .84<sup>3</sup>. Because of the restriction in range in this group as compared with a high school group, this value is approximately of the same order of magnitude as those reported above. Accordingly, the Otis appears to have sufficient reliability to justify its use in this situation.

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1 Arthur S. Otis, Manual of Directions and Key (Revised) for the Otis S.-A. Tests of Mental Ability, Yonkers-on-Hudson, N.Y., World Book, 1928, p. 12.

2 R.-H. Shevenell, O.M.I., Manuel et normes (quatrieme edition, revue et corrigee) of Les examens Otis-Ottawa d'habilete mentale, Ottawa, Canada, University of Ottawa Press, 1948, p. 19.

3 Laurent A. Isabelle, Actuarial versus Clinical Methods in Predicting achievement in a Science Faculty, unpublished Ph.D. thesis, University of Ottawa, Ottawa, 1961, p. 73.

b) The SSHA. -- Brown and Holtzman<sup>4</sup> report that their SSHA has a reliability of approximately .92 for men and .84 for women college freshmen.

In the present study, because of the limited accessibility of the student body for testing purposes, the writer was unable to determine the reliability of this inventory in this particular situation. However, a test-retest administration to a group of 27 male and 28 female students from this same institution gave coefficients of .90 and .84 respectively. There is good reason to think that in most respects this student group is rather similar to that in Science. Therefore it seems reasonable to infer that the SSHA has satisfactory reliability to warrant its application to the sample under investigation.

c) The G-ZTS. -- The authors of the G-ZTS report<sup>5</sup> the reliability coefficients of the ten traits, as administered to samples of 523 male and 389 female college students, range from .75 to .87, the average being approximately .81.

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<sup>4</sup> William F. Brown and Wayne H. Holtzman, Manual (Revised) for the Survey of Study Habits and Attitudes, New York, Psychological Corp., 1956, p.5.

<sup>5</sup> J.P. Guilford and Wayne S. Zimmerman, Manual of Instructions and Interpretations for the Guilford-Zimmerman Temperament Survey, Beverly Hills, California, Sheridan Supply, 1949, p. 6.

Again, unfortunately, the reliability of this inventory could not be determined directly with respect to the population being studied, on account of the investigator's limited access to the group. However, a seemingly similar student group on the campus was examined. This mixed group of 27 college students, 12 male and 15 female, gave test-retest coefficients ranging from a low of .69 to a high of .94, the average being approximately .85. The coefficients for the individual traits are presented in Table I. It is to be noted that despite the small size of the group, all of these values are statistically significant beyond the 1% level of probability. Therefore, it follows that these measures could be applied to the population with some assurance of their reliability.

## 2. Relationship of the Test Variables with the Criterion.

The crucial element in any predictive study is the correlation between the predictor and the outcome to be predicted. The assessment of this relationship will constitute the core of this section.

The raw data of the survey may be found in condensed tabular form in Appendix 1. All the information about to be presented for discussion has been derived from this material.

Table I. - Test-retest Reliability Coefficients for the Individual Traits of the Guilford-Zimmerman Temperament Survey<sup>a</sup>.

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<u>G-ZTS</u> Trait	Coefficient of Correlation <sup>b</sup>
G	.85
R	.91
A	.89
S	.94
E	.93
O	.69
F	.89
T	.76
P	.71
M	.89

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<sup>a</sup> Based on data obtained from 27 college students (12 males, 15 females) at the University of Ottawa re-tested after one week.

<sup>b</sup> Pearson  $r$  of .487 is required for statistical significance at the 1% probability level.

a) The findings. -- The correlations were computed between the criterion of scholastic achievement -- the final average grade -- and the results on the test variables, grouped by class and sex. These Pearson product-moment coefficients are reported in Table II on the following page.

It is evident from that tabulation that not a single statistically significant correlation was obtained in First Year Science, nor was any found in the group of Second Year women students. The only significant correlations were therefore in the Second Year male group. In that group, all measures of the Otis and of the SSHA gave significant values, whereas not one G-ZTS measure yielded a correlation very likely different from zero.

b) Interpretation of findings. -- In the Second Year male group, the somewhat low but statistically significant correlations on the Otis and on the SSHA demonstrate that both scholastic aptitude and study habits and attitudes are meaningfully related to scholastic achievement in that group. By the same token, it appears that personality traits as measured by the G-ZTS are not significantly related to academic success.

Considering the non-significant correlations obtained for all variables in the Second Year female group

Table II. - Correlations of the Otis, the SSHA, and the G-ZTS, with the Final Average Grade in the Faculty of Science, 1959-1960<sup>a</sup>.

Measure Used	1st Year Science		2nd Year Science		
	Men (N:85)	Women (N:10)	Men (N:77)	Women (N:8)	
<u>Otis</u>					
IQ	.1459	.5293	.4354	.4611	
Converted Score:	.1437	.4918	.4354	.4611	
Raw Score	.1374	.4090	.4246	.4451	
<u>SSHA</u>					
Centile	.2451	.2909	.3885	.4346	
Raw Score	.2350	.2979	.3977	.4281	
Elimination Score	.2075	.3872	.3830	.4971	
Right Score	.2266	.2132	.3706	.2964	
<u>G-ZTS</u>					
Trait	G	.2043	.0790	.0227	.3114
"	R	.2704	.1403	.2411	.3662
"	A	.2111	.2113	.0111	.6064
"	S	.1789	.1855	.1108	.3031
"	E	.1315	.0474	.0950	.4318
"	O	.1781	.3468	.0727	.0947
"	F	.1379	.2181	.1649	.3604
"	T	.0904	.1776	.0248	.0449
"	P	.0740	.4584	.0633	.7660
"	M	.0727	.3391	.0606	.5552
Size of r required for significance at 1% probability level					
		.278	.765	.296	.834

<sup>a</sup> Computations based upon the data reported in Appendix 1.

and in both sub-groups of the First Year, several points must be made clear.

The female sections of each class may have yielded insignificant correlations because of their extremely small numbers. At best, their results can be little more than suggestive, although the indications are in the direction of very low correlations if any.

But surely this argument of small numbers does not apply to the First Year male group. Furthermore, it has been established in the preceding section that all the instruments included in the test battery appear to have satisfactory reliability in so far as regards the Science student body at the University of Ottawa. This latter fact leads to two alternative conclusions: either these measures are actually uncorrelated with the criterion, or the criterion is faulty. Both these possibilities must be examined further before a decision can be reached.

That there be no relation between scholastic success and these measures, especially scholastic aptitude and study habits, seems an outright contradiction. A more acceptable explanation of this startling conclusion may be that perhaps these students have the required minimum of each of these characteristics and that any excess is of no consequence

in determining school achievement. Such an account would be consistent with the practice of screening candidates for admission to this Faculty.

If the criterion, the final average grade, is faulty, it could be so in two respects: it could be lacking in reliability and/or in validity.

Investigation<sup>6</sup> has shown the marks in the Faculty of Science to be highly reliable, as determined by correlations between first term and final grades in both First Year and in Second Year classes. However, a large part of this remarkably high correlation ( $r$  is .88 and .82 in First and Second Years<sup>7</sup> respectively) is due to the weighting system used in determining the final average grade<sup>8</sup>. But even if this inflated reliability coefficient were genuine, this would in no way guarantee the validity of the marks.

The validity of the marks utilized in this research is unknown. On that account, numerous objections can be raised to their use as the criterion. To all these

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6 Laurent A. Isabelle, op. cit. p. 71.

7 Id., ibid.

8 Calendar of the Faculty of Pure and Applied Science, University of Ottawa, Ottawa, Canada, issue of 1960-1961, p. 37-41.

objections there is one very cogent reply: marks are used by the school as the sole basis for evaluating academic achievement. Using as criterion that which is generally conceded to be a poor measure does not invalidate the research, although it does make the study more difficult.

In summary, marks are certainly not as reliable as they are made out to be, and their objective validity is largely unknown.

Now to return to the point at issue: whether the insignificant obtained correlations indicate the absence of correlation, or the use of an unsatisfactory criterion. The foregoing discussion of these alternatives has not settled the issue. Perhaps an indirect approach may resolve the difficulty.

It has been observed in the group of Second Year men that all correlations between the criterion and the various measures of the Otis and the SSHA were statistically significant. This indicates that both marks and test variables functioned in this instance. If it can be established that the other sub-groups in the sample do not differ appreciably from the Second Year male group with regard to test scores, then it is very likely that the apparent lack of correlation between grades and psychometric

instruments is attributable primarily to the poor measuring qualities of the criterion.

Just such comparisons have been made. In each subgroup the mean and the variance of every measure were tested as to the significance of the difference from the corresponding values obtained from Second Year men students. These comparisons with Second Year men revealed no significant differences on any test variable for any of the sub-groups. Only the comparisons for the two male groups are reported in Table III, principally on account of the more reliable values obtained because of the more numerous sub-samples.

Table III indicates that the sub-groups are similar with respect to their test scores. That is to say, the tests seem to function similarly for all groups. But significant correlations with the criterion were obtained only on the Second Year men. Therefore, it appears very likely that, since the tests are functioning consistently, the fault lies with the criterion.

\* \* \*

These initial findings concerning the relationship of the test battery to the criterion in the various sections of the sample, have considerable bearing on the subsequent

Table III. - Means, Standard Deviations, and "t" and 'F' Ratios of Differences on the Otis, the SSHA, and the G-ZTS in the Faculty of Science, 1959-1960<sup>a</sup>

Test Measure	1st Year Men (N : 85)		2nd Year Men (N : 77)		Difference Tested		
	M	S.D.	M.	S.D.	t <sup>b</sup>	F <sup>c</sup>	
<u>Otis</u>							
IQ	110.53	11.54	112.99	10.88	1.38	1.12	
Converted	52.13	11.37	54.99	10.88	1.62	1.09	
Raw	41.23	9.90	43.74	9.67	1.61	1.05	
<u>SSHA</u>							
Centile	50.29	26.70	52.49	27.54	.51	1.07	
Raw	37.25	11.20	38.18	11.21	.52	1.00	
Elimination	25.09	6.07	25.03	5.77	.06	1.11	
Right	12.15	6.06	13.16	6.06	1.05	1.00	
<u>G-ZTS</u>							
Trait	G	16.12	4.87	16.42	4.94	.39	1.03
"	R	15.27	4.70	16.45	4.57	1.61	1.06
"	A	15.09	5.70	14.66	5.59	.48	1.04
"	S	16.47	6.01	15.12	6.32	1.38	1.11
"	E	16.60	5.51	16.49	5.94	.12	1.16
"	O	15.18	5.24	16.56	5.28	1.66	1.02
"	F	11.39	5.49	12.14	4.98	.90	1.21
"	T	18.73	4.37	19.17	4.57	.62	1.09
"	P	13.80	4.79	15.32	5.10	1.94	1.14
"	M	19.51	4.13	19.30	4.48	.31	1.17

a Calculations based on the data contained in Appendix 1.

b Required "t" at 1% probability level is 2.576

c Required 'F' at 1% probability level is 1.70

course of this research. First, they preclude any combination of groups, and, secondly, they permit the possibility of forecasting by regression methods only to Second Year men students. In addition, the extremely small number of women students prevents any attempt at reliable prediction of achievement. Accordingly, the remainder of this report will necessarily be limited by these restrictions.

### 3. The Prediction of Scholastic Achievement.

This section will report the results of attempts to predict academic success using two different techniques. The first part will deal with the results obtained by multiple regression, whereas the forecast by Manifest Structure Analysis will be treated in the second part.

a) The prediction by multiple regression. -- In the group of Second Year men students, the only significant correlations found were between the final average grade and the various measures of the Otis and the SSHA. Among these measures, two were selected for tentative use as predictors: the Otis IQ and the SSHA raw score.

In order to determine whether the correlational technique had been applied legitimately in their case, both measures were tested for rectilinearity of regression and for homoscedasticity. The tests of linearity gave 'F' ratios

of .13 for the Otis IQ and .97 for the SSHA raw score, both of which values fall far below the 5% level of probability. Welch's formula for the  $L_1$  test, as described by Johnson<sup>9</sup>, was used to examine the same two variables for homoscedasticity. The obtained  $L_1$  values for the Otis IQ (.876) and for the SSHA raw score (.823) were so far from the tabular value at the 5% level as to leave no doubt that the measures are homoscedastic.

In this instance, since the assumptions underlying correlation are satisfied, it is permissible to proceed to the calculation of the coefficient of multiple correlation.

As previously reported in Table II on page 48, the correlations between the criterion and the Otis IQ and the SSHA raw score are .4354 and .3977<sup>2</sup> respectively. Between these Otis and SSHA measures there was found a correlation of .3566.

The multiple R was calculated by direct substitution in the equation for a three variable problem.

$$R^2_{1.23} = \frac{r^2_{12} + r^2_{13} - 2r_{12}r_{13}r_{23}}{1 - r^2_{23}}$$

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<sup>9</sup> Palmer O. Johnson, Statistical Methods in Research, New York, Prentice-Hall, 1949, p. 242-243.

The resulting coefficient of multiple correlation was .5069 which was statistically significant beyond the .001 level of probability.

This multiple R of .5069 indicates that, for men in Second Year Science, 25.69% of the variance in final grades is accounted for by whatever is measured by the Otis IQ and the SSHA raw score. The contribution of each measure to this variance is 14.64% for the Otis IQ and 11.05% for the SSHA raw score.

In spite of this rather low degree of association between independent and dependent variables, prediction was attempted. The multiple regression equation calculated from the foregoing data is as follows:

$$X_1' = 17.7697 + .3058 X_2 + .2451 X_3$$

where  $X_1'$  is the predicted final average grade,  $X_2$  is the Otis IQ, and  $X_3$  is the SSHA raw score.

The predictions for Second Year men have been made on the basis of this equation and will be found in Table VI on page 64 in the section comparing the two predictive techniques.

b) The prediction by Manifest Structure Analysis. -- MSA is not concerned with the extent of the correlation existing between the criterion and the variables available.

Even the reliability of the measures is relatively unimportant. The essential requirement of MSA is that the particular sections of the variables used be consistently related to the criterion. This latter point is not established using mathematical tests, but it is simply inferred from the practical application of the selected predictors to other similar groups.

Consequently, the foregoing discussion concerning reliability, correlation, significance, etc., is unrelated to the application of MSA. As a result, MSA is not limited to forecasting in only the Second Year male group. However, in practice, predicting for the women students was not attempted because the groups were so small as to hardly be representative. Had prediction been attempted, there would have remained no one on whom to cross-validate the prognostic measures found. This would have therefore prevented the evaluation of the technique.

According to the design of the study, as a result of the facts brought to light thus far, the application of MSA only to Second Year men is mandatory. However, an attempt was made to forecast scholastic achievement among First Year men in the hope of finding out whether MSA would function when conventional techniques could not be used.

1. MSA applied to Second Year men. - The procedure

followed in setting up the data for analysis was as follows.

Categories were obtained for each variable by dividing the group arbitrarily into thirds. This was done to insure that a sufficient number of individuals would be associated with each category. The points separating each third of the group were used to define the limits of each category.

All members of the group were arranged in order of magnitude of the criterion score. From this entire group of 77 men, a sample of 26 students was obtained by taking every third person on the list. The raw data of each person in this arbitrarily chosen sample were then classified according to the previously determined categories. Because each of the seventeen psychometric measures obtained from the test battery had been divided into three parts, there were formed fifty-one categories. The specific seventeen categories to which a given individual belonged were then entered in the scaling frame.

At this point the procedures outlined in Chapter I were followed in order to find suitable scales. The various manipulations involved are designed primarily to choose enough categories to allow most individuals to belong to several of them. There are two reasons for this: no prediction

can be made for an individual unless he is associated with a category; belonging to several categories tends to decrease the errors involved in the forecast.

In applying the above mentioned procedures, a segmental scale was constructed on the basis of the information obtained from the 26-man sample. The sixteen categories selected from the original fifty-one are described in Table IV on the following page. It is apparent from the tabulation that a number of G-ZTS traits were included among the predictors.

These category values were then applied to all 77 male students of Second Year Science. The resulting predictions will be found in Table VI on page 64.

Both intensive and clustery models of MSA were tried without success.

In the case of the intensive model, very few categories were found to be graduated cumulatively on the criterion continuum. When a tentative intensive scale was applied to the total group, it was found to be grossly inadequate: it failed to predict at all in many instances, and was frequently erroneous.

The clustery model could not be applied because there were too few individuals associated with any given

Table IV. - Categories Selected for the Segmental Scale for Men Students in Second Year Science<sup>a</sup>.

Category	Score Range <sup>b</sup>	N <sup>c</sup>	Category Value <sup>d</sup>
G-ZTS R	19 - up	6	70.8
Otis IQ	121 - up	10	69.4
SSHA Elimination	29 - up	9	68.0
G-ZTS O	20 - up	8	66.9
SSHA Right	11 - 15	9	66.1
G-ZTS A	11 - down	7	64.1
SSHA Raw Score	34 - 43	11	64.0
G-ZTS T	17 - down	6	64.0
G-ZTS M	17 - 21	10	62.1
G-ZTS G	14 - 18	7	62.0
Otis IQ	112 - 120	10	59.9
G-ZTS R	15 - 18	11	59.6
G-ZTS O	14 - down	7	55.7
SSHA Elimination	22 - down	7	55.1
SSHA Right	10 - down	8	54.6
Otis IQ	111 - down	6	53.7

a Categories selected were based on the data from a sample of 26 students.

b All scores are inclusive.

c Indicates the number of individuals in the sample who are associated with a particular category.

d The mean criterion score of all individuals in the sample/are associated with a particular category.  
who

pattern of categories to yield reliable results. The trend was for the predictions to be applicable only to a few isolated individuals in the sample, and not to be typical of the group.

ii. MSA applied to First Year men. - The results obtained in First Year were very much like those found in Second Year.

Based on a sample of 23 students, a segmental scale was constructed. The characteristics of this scale are reported in Table V on the following page. Among the ten categories selected, eight are measures derived from the G-ZTS traits.

When this scale was applied to the 85 members of the First Year, only 47 correct predictions of pass or fail were made, a result not unlike what might be expected on the basis of chance. In fact, the Chi-Square calculated from the comparison of the actual versus the predicted outcome, classified as pass or fail, corresponded to a probability of 30%.

For the very same reasons as were found in Second Year, the intensive and the clustery scales proved to be inapplicable to First Year men students.

Table V. - Categories Selected for the Segmental Scale for Men Students in First Year Science<sup>a</sup>.

Category	Score Range <sup>b</sup>	N <sup>c</sup>	Category Value <sup>d</sup>
SSMA Right	16 - up	5	70.0
G-ZTS E	13 - down	8	66.3
G-ZTS O	13 - 18	7	65.1
G-ZTS P	11 - 16	10	64.3
G-ZTS M	23 - up	5	61.0
G-ZTS S	12 - down	6	58.7
Otis IQ	104 - down	10	56.0
G-ZTS R	13 - 18	8	54.9
G-ZTS P	10 - down	9	54.1
G-ZTS E	14 - 19	11	53.0

<sup>a</sup> Categories selected were based on the data from a sample of 23 students.

<sup>b</sup> All scores are inclusive

<sup>c</sup> Indicates the number of individuals in the sample who are associated with a particular category.

<sup>d</sup> The mean criterion score of all individuals in the sample who are associated with a particular category.

#### 4. The Comparative Evaluation of the Predictive Techniques.

The evaluation of MSA as a predictive method will be based primarily on the comparison of the predictions made by the two techniques employed in the study. In Table VI, on the following page, there is listed for each student his actual final average grade, and two predicted final averages determined in one case by the regression equation, and in the other case by the application of the segmental scale.

One way of comparing the two sets of predictions would be in terms of their correlation with the criterion. The coefficient of correlation between the criterion score and the final score predicted by the regression equation was .4869. A correlation of .4663 was found between the criterion and the score forecast by MSA. The significance of the difference <sup>of</sup> these coefficients was then tested using the procedure outlined by McNemar<sup>10</sup> for testing differences between correlated  $r$ 's, through the Fisher's transformation. The resulting critical ratio was .31, a value far from significant, leading to the conclusion that the  $r$ 's are probably not different. In other words, the two predictions

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<sup>10</sup> Quinn McNemar, Psychological Statistics, New York, Wiley, 1949, p.124-125.

Table VI. - The Actual and the Predicted Final Average Grades for the 77 men students in Second Year Science.

Actual Grade	Predicted Grade		Actual Grade	Predicted Grade	
	Regression	MSA		Regression	MSA
90	68.1	67.8	61	62.8	61.1
88	59.9	56.3	61	62.4	62.3
76	71.5	67.1	61	52.3	57.1
76	69.7	68.8	61	66.3	66.4
75	58.2	62.0	61	64.0	63.8
74	65.9	66.7	61	67.3	63.4
73	64.9	66.5	61	56.1	57.0
73	64.3	60.5	61	68.3	62.9
73	64.3	62.0	60	57.7	60.2
72	63.1	65.9	60	60.0	59.3
71	67.0	64.5	60	59.4	58.9
70	66.2	64.3	60	69.6	68.7
69	62.4	65.0	60	53.9	57.1
68	69.3	68.7	58	62.9	65.0
68	64.5	63.7	58	57.4	56.1
68	63.4	64.2	58	63.2	62.9
67	64.8	63.1	57	65.6	63.3
67	65.1	63.8	56	65.7	65.5
67	65.1	63.1	56	58.0	57.9
67	61.0	62.2	56	60.8	60.3
66	69.5	64.8	56	60.8	62.2
65	68.0	64.1	56	56.5	57.3
72	59.6	61.0	54	61.7	61.9
70	63.8	65.5	54	64.0	61.9
70	67.2	64.2	52	61.8	59.8
69	67.1	64.8	51	51.7	55.1
66	62.6	62.0	58	58.3	62.1
65	58.0	61.3	55	58.1	58.7
65	52.8	57.0	51	55.8	58.3
65	60.5	62.0	50	53.7	57.8
64	62.7	58.9	50	58.0	59.5
63	64.4	65.7	50	48.0	57.5
63	58.1	63.9	50	52.2	59.8
63	60.9	61.4	49	65.1	61.3
63	60.8	62.4	47	65.7	59.8
62	63.8	64.1	42	59.9	59.1
62	64.6	66.9	41	60.1	64.1
62	57.0	60.0	37	54.1	54.8
			32	50.3	56.6

are about equally related with the actual outcome. This suggests that the two predictive techniques are equivalent.

It must be stressed, however, that the foregoing comparison centers upon the correlation of the predicted score to the criterion. In the case of the multiple regression equation, the resulting correlation is appropriate because this formula is a mathematical function of all the scores. In the case of MSA, on the other hand, the obtained correlational coefficient may be distorted by the fact that the mean values corresponding to the selected categories are not distributed along the continuum in the same manner as are the criterion values. For instance, inspection of the category values reported in Table IV on page 60 reveals that this MSA scale has a rather restricted range and has several values concentrated about the same point, with intermediate values missing between adjacent concentrations. As a consequence of this observation, it may well be that here the comparison of correlation coefficients is inappropriate.

Perhaps a more appropriate manner of dealing with this problem would be to compare the accuracy of the two techniques in predicting the final outcome. In the final analysis, the goal of academic prediction is to differentiate

between students who will be successful, and those who will not. The value of a prognostic measure is therefore indicated by its effectiveness in correctly identifying the actual outcome, whether favourable or unfavourable. This may be accomplished by comparing the percentage of correct predictions with the percentage of incorrect predictions.

Scrutiny of the final grades of all 180 persons in the sample has shown that the involved system of determining academic success or failure in the Faculty of Science is reducible, in this instance, to the simple matter of finding out whether the student has, or has not, obtained an average of sixty points at least.

A further simplification in the comparison of differences in percentages of accurate and inaccurate predictions is afforded by the use of a formula, devised by Wilks, as described in Johnson<sup>11</sup>. If the difference between the two percentages in the group exceeds  $258/N^{\frac{1}{2}}$  in value, then there is less than one chance in a hundred that a difference of this size could be obtained by chance. Wilks' formula, accordingly, provides a conservative, simple, critical

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<sup>11</sup> Palmer O. Johnson, Statistical Methods in Research, New York, Prentice-Hall, 1949, p. 119.

value of the percentage difference in the sample.

In this particular comparison, because the same group of 77 persons is involved in both predictions, the difference in percentage can be readily converted into a difference in frequency, thereby making the evaluation even more straight-forward. In the Second Year group of 77 men, the critical value of the difference in percentage is  $258/N^2$ , or 29.4%, which is 22.6 as a difference in frequency.

Table VII on the following page reports the comparative performance of the two prognostic techniques in terms of the actual scholastic outcome, classified as 'Pass' or 'Fail'. From the critical difference in frequency of 22.6 previously calculated, it is clear from the differences stated in Table VII that both techniques are predicting well beyond chance expectations.

Further analysis of the tabulated data revealed no statistically significant difference between the multiple regression equation and the MSA segmental scale as to ability to predict either 'Pass' or 'Fail'. For all practical purposes, therefore, the two techniques, as applied here are equivalent.

\* \* \*

Even though MSA has been found to be a satisfactory

**Table VII. - The Actual and the Predicted Scholastic Achievement of the 77 Men Students in Second Year Science<sup>a</sup>.**

Scholastic Achievement	P R E D I C T I O N			
	<u>Regression</u>		<u>MSA</u>	
	Fail	Pass	Fail	Pass
Pass (51)	12	39	8	43
Fail (26)	14	12	15	11
Total (77)	26	51	23	54
Correct Predictions	53		58	
Incorrect Predictions	<u>24</u>		<u>19</u>	
Difference	29		39	

<sup>a</sup> Information based on the data of Table VI.  
 'Pass' is equivalent to a grade of at least sixty points.

method of academic prediction, it must not be expected that all three techniques of MSA will be equally effective or applicable. This of course is a function of the different basic assumptions of each technique.

The unsatisfactory ability of the intensive scale of MSA to forecast academic achievement may be due to the possibility that the characteristics measured here are not related to academic success in a progressively cumulative fashion. That is to say, a trait such as IQ, for example, is not associated with scholastic achievement in such a manner that a student of low IQ obtains lower grades than does one of high IQ, while students of intermediate IQ attain intermediate degrees of success. This fact is apparent when one considers the low correlation between the individual measures and the criterion.

The failure of the clustery scale to predict school achievement is rather surprising. It is unexpected in view of the claim that the clustery model is the most general model of MSA, the other models being special cases of it. The inapplicability of the clustery scale may have been on account of the low intercorrelations between the various measures used, the G-ZTS traits being practically independent factors, and the SSHA not being highly related with the Otis.

A more general point of fundamental concern in the application of MSA is the specific mode of derivation of categories. This, in a sense, is a crucial issue because all scales are derived from the analysis of categorical data. It is most unlikely that the scale values obtained are independent of the definition of the categories employed. However, this aspect of the problem is not the direct concern of the present study and is left as a topic for future research.

## CONCLUSIONS

The data analyzed in the course of this survey have permitted the partial evaluation of Manifest Structure Analysis as a prognostic technique. The investigation has also contributed to the knowledge of the relationship of scholastic aptitude, study habits and attitudes, and personality traits, to academic achievement in the Faculty of Science at the University of Ottawa. A summary of the conclusions warranted by these findings follows.

For men students in Second Year, scholastic aptitude and study habits and attitudes as measured by the Otis and the SSHA respectively, are only moderately associated with scholastic performance. Personality factors as measured by the G-ZTS are unrelated to academic achievement in this group.

Among men students in First Year, scholastic achievement has been found to be unrelated to any of the characteristics measured by the test battery. However, First Year men do not differ appreciably from Second Year men in any of the traits measured. Accordingly, it was inferred that class marks in First Year are of doubtful reliability and/or validity. This inference is suggested as a possible explanation for the failure of an MSA segmental scale to predict, beyond chance expectations, the achievement of this group.

For Second Year men students, academic achievement can be forecast moderately well from a knowledge of their Otis and SSHA results when combined in a multiple regression equation. But, a segmental scale, based on the Manifest Structure Analysis of the G-ZTS, the Otis, and the SSHA scores of these same students, predicts their scholastic performance with equal effectiveness.

The MSA segmental model is a useful technique of academic prediction which is easy to apply and which is not wasteful of data.

## BIBLIOGRAPHY

Brown, William F. and Wayne H. Holtzman, Manual (Revised) for the Survey of Study Habits and Attitudes, New York, Psychological Corporation, 1956, 11 p.

In addition to supplying college norms for the interpretation of scores, the manual also gives information on reliability, validity, and the procedure used in the standardization.

du Mas, Frank M., Manifest Structure Analysis, Vol. 3, Montana State University Studies, Montana State University Press, Missoula, Montana, 1956, 193 p.

The treatise exposing the nature, rationale, and method of application of the predictive techniques studied in this research.

Garrett, Harley F., "A Review and Interpretation of Investigations of Factors Related to Scholastic Success in Colleges of Arts and Science and Teachers' Colleges", in the Journal of Experimental Education, Vol. 18, No. 2, issue of December, 1949, p. 91-138.

A most comprehensive summary of research findings in the field of scholastic prediction at the college level. Although the review is now rather old, the generalizations reported have not been superseded, and, in fact, more refined, large-scale recent investigations have generally confirmed these experimental findings. An extensive bibliography, including several reviews, is appended.

Guilford, J.P. and Wayne S. Zimmerman, Manual of Instructions and Interpretations for the Guilford-Zimmerman Temperament Survey, Beverly Hills, Calif., Sheridan Supply, 1949, 12 p.

Provides detailed descriptions of the personality traits inventoried, and includes college norms for the interpretation of the scores. The standardization procedure is outlined, and the reliability of the measures is specified.

Isabelle, Laurent A., Actuarial versus Clinical Methods in Predicting Achievement in a Science Faculty, unpublished Ph.D. thesis, University of Ottawa, Ottawa, 1961, 176 p.

Based in part on the sample of the present research, the study was useful in providing the reliability of the marks and of the Otis in the population surveyed.

Otis, Arthur S., Manual of Directions and Key (Revised) for the Otis S.-A. Tests of Mental Ability, Yonkers-on-Hudson, N.Y., World Book Co., 1928, 12 p.  
Useful particularly on account of the descriptive definition of terms, administrative procedure, and interpretation of results, the manual also treats of the standardization, the validity, and the reliability of the instrument.

Shevenell, R.-H., Manuel et normes (quatrieme edition, revue et corrigee) of Les examens Otis-Ottawa d'habilete mentale, Ottawa, Canada, University of Ottawa Press, 1948, 40 p.

Complete detailed manual including, besides the instructions for administration, scoring, and interpretation of test results, a lengthy treatment of the psychometric characteristics of the test and a discussion of the concepts involved.

Vaillancourt, Raymond F., Local College Prediction with the Otis and the Otis-Ottawa, unpublished M.A. thesis, University of Ottawa, Ottawa, 1955, 91 p.

A previous study establishing the general predictability of college success at this institution by means of the higher forms of the Otis and the Otis-Ottawa.

APPENDIX I

RAW DATA OF THE SURVEY

Table VIII. - Scores obtained on the Test Battery by the 10 Women Students in First Year Science.

Final Grade	G - Z T S										S S H A				O T I S		
	G	R	A	S	E	O	F	T	P	M	Rt	Elim	Raw	C	Raw	Conv.	IQ
71	13	20	12	21	18	13	16	17	12	5	17	26	43	80	44	56	116
65	8	17	13	13	8	17	19	19	24	12	5	20	25	20	45	58	117
60	11	14	13	19	15	13	12	23	15	11	15	27	42	80	55	67	125
58	22	16	12	13	13	14	19	23	12	17	9	19	28	30	50	63	121
57	22	6	13	23	8	12	8	21	17	18	15	18	33	50	42	54	113
50	18	25	16	20	25	26	26	15	25	19	25	27	52	98	45	58	116
48	7	14	4	10	16	13	16	11	20	8	8	20	28	30	38	49	107
48	16	9	8	11	15	13	16	9	22	13	8	17	25	20	53	65	124
40	8	23	13	12	19	16	21	18	29	15	18	26	44	80	57	68	126
26	14	18	11	19	8	19	17	20	19	14	4	15	19	10	25	32	90

Table IX. - Scores obtained on the Test Battery by the 85 Men Students in First Year Science.

Final Grade	G - Z T S										S S H A				C T I S		
	G	R	A	S	E	O	F	T	P	M	Rt	Elim	Raw	C	Raw	Conv	Ic
81	10	13	7	11	17	7	8	12	14	7	13	29	42	70	49	62	120
81	22	19	21	20	14	24	16	24	21	27	21	31	52	90	48	61	120
80	18	11	15	24	9	6	6	17	15	14	8	16	24	20	52	64	122
78	11	24	8	17	10	7	19	22	13	13	19	32	51	90	40	51	109
78	12	19	10	6	19	10	14	20	17	22	10	22	32	30	37	48	106
78	12	13	8	6	10	14	17	11	12	14	27	35	62	98	45	58	118
77	16	17	10	14	9	10	8	22	14	18	10	21	31	30	44	56	114
77	8	12	19	20	20	13	8	12	11	18	15	23	38	50	64	72	130
76	16	21	6	13	9	16	14	15	16	20	18	24	42	70	46	59	117
75	19	16	10	12	12	13	7	17	15	20	8	27	35	40	39	50	108
75	13	15	20	20	17	20	14	20	14	18	12	25	37	50	45	58	117
74	20	15	24	25	17	16	4	24	7	21	20	30	50	80	45	58	116
73	16	23	25	20	19	22	18	29	18	18	15	30	45	70	45	58	116
73	10	24	11	10	25	22	24	22	13	23	21	34	55	90	51	64	124
72	13	21	17	18	17	13	6	23	14	22	16	27	43	70	30	39	97
70	18	21	8	5	10	12	25	20	15	23	10	30	40	60	40	51	109
70	12	16	10	15	15	13	12	19	15	19	17	32	49	80	40	51	109
69	7	14	21	22	15	15	14	17	18	21	12	17	29	30	32	41	99
68	11	17	12	14	17	16	7	13	4	17	19	27	46	70	33	43	101
68	13	15	19	23	10	10	13	18	13	20	9	31	40	60	51	64	122
68	25	9	15	13	26	21	9	16	19	21	4	20	24	20	36	46	104
68	19	12	17	19	21	15	8	22	17	22	13	27	40	60	55	67	128
66	24	10	11	13	15	11	11	16	14	20	7	20	27	20	31	40	98
60	18	17	13	10	22	17	9	16	9	19	12	30	42	70	24	31	91
77	20	23	11	24	24	15	15	20	20	15	15	31	46	70	49	62	120
68	19	9	21	20	17	11	12	22	10	18	21	26	47	80	56	68	126
65	22	20	18	17	24	25	23	20	22	28	20	32	52	90	59	70	128
64	18	17	18	18	25	17	14	23	13	20	18	29	47	80	33	43	101
64	18	19	21	21	20	14	6	26	7	25	6	20	26	20	41	53	112
64	10	23	6	5	15	16	17	15	14	20	10	30	40	60	54	66	125
63	17	15	16	20	11	11	17	26	24	24	5	28	33	40	43	55	113
62	20	15	11	11	9	18	9	19	11	24	3	19	22	10	32	41	99
62	15	18	24	28	17	15	9	22	17	17	15	26	41	60	33	43	101
61	13	11	5	10	24	20	11	11	20	19	13	34	47	80	35	45	103
61	25	11	16	23	17	11	7	19	12	15	9	28	37	50	30	39	97
61	16	19	14	20	19	15	8	21	12	19	30	35	65	99	47	60	118

Table IX. - Scores obtained on the Test Battery by the 85 Men Students in First Year Science. (Continued)

Final Grade	G - Z TS											S S H A				O T I S	
	G	R	A	S	E	O	F	T	P	M	Rt	Elim	Raw	C	Raw	Conv	IQ
61	14	19	11	10	25	28	21	19	24	27	16	30	46	80	57	68	132
60	17	12	22	13	11	8	2	18	6	19	12	24	36	50	45	58	116
60	13	13	14	10	11	6	4	16	6	11	4	10	14	2	26	33	91
59	14	17	18	26	6	21	13	23	21	16	10	19	29	30	50	62	120
58	12	16	11	9	15	10	14	17	14	19	16	25	41	60	47	60	119
58	9	23	22	16	25	18	17	26	17	24	20	34	54	90	31	40	98
58	15	17	11	9	16	13	10	15	12	25	5	29	34	40	36	46	104
58	5	22	11	20	15	13	17	25	8	17	11	24	35	40	32	41	99
57	13	15	10	15	17	11	5	22	6	18	9	19	28	20	52	64	122
56	19	11	13	9	12	17	10	21	18	15	12	22	34	40	43	55	113
56	20	14	13	22	6	16	10	21	15	22	6	21	27	20	40	51	109
56	14	14	17	13	11	11	2	22	5	18	8	19	27	20	30	39	99
56	20	14	12	10	16	13	13	14	12	26	9	28	37	50	55	67	126
55	13	9	15	15	16	13	12	16	11	16	8	21	29	30	33	43	103
55	16	17	22	21	27	23	6	25	16	21	21	36	57	95	23	30	88
55	18	15	22	20	18	13	8	23	6	19	7	28	35	40	57	68	127
55	13	20	23	19	18	12	9	21	12	16	14	26	40	60	37	48	106
54	11	22	9	12	24	19	22	21	9	17	10	24	34	40	24	31	89
54	18	12	10	17	9	12	11	15	16	20	8	14	22	10	38	49	107
51	15	16	17	8	17	13	21	19	17	16	11	20	31	30	31	40	98
51	21	7	21	24	25	24	10	10	19	24	8	29	37	50	37	48	106
51	16	21	17	21	18	19	23	17	17	25	14	29	43	70	47	60	118
50	12	14	10	18	16	16	15	19	21	20	21	33	54	90	40	51	109
49	8	18	9	12	25	23	12	25	24	24	11	24	35	40	40	51	109
48	21	20	18	13	21	11	14	17	14	20	14	27	41	60	57	68	126
46	24	8	10	21	19	19	7	20	8	17	7	13	20	10	49	62	120
46	25	8	15	17	12	14	16	12	15	14	7	24	31	30	38	49	108
45	16	20	15	17	16	14	13	23	9	21	6	21	27	20	33	43	101
45	19	19	21	23	16	10	6	20	10	22	12	31	43	70	38	49	108
45	19	12	25	21	14	11	4	23	14	23	11	26	37	50	31	40	98
45	21	15	28	19	26	18	6	12	4	9	33	33	66	99	49	62	121
43	21	16	11	15	16	10	7	19	13	18	4	12	16	5	40	51	109
40	5	5	9	17	15	3	2	10	8	11	5	19	24	20	37	48	106
39	17	12	24	23	21	22	8	23	13	25	16	34	50	80	39	50	108
38	12	12	15	15	13	8	10	11	11	15	6	27	33	40	29	37	95
38	19	22	19	21	15	24	13	18	13	21	5	19	24	20	60	70	128

Table IX. - Scores obtained on the Test Battery by the 85 Men Students in First Year Science. (Continued)

Final Grade	G - Z T S										S S H A				O T I S		
	G	R	A	S	E	O	F	T	P	M	Rt	Elim	Raw	C	Raw	Conv	IQ
37	24	5	25	25	11	15	5	19	20	22	8	17	25	20	53	65	123
36	13	14	18	23	25	24	12	20	18	22	13	29	42	70	35	45	103
36	13	19	9	10	17	18	17	16	16	20	11	22	33	40	49	62	120
32	27	19	28	29	20	21	4	25	11	14	21	28	49	80	50	63	122
31	24	11	19	25	26	25	19	18	20	27	13	25	38	50	41	53	111
54	14	15	18	17	20	19	7	16	13	19	11	24	35	40	20	26	84
54	8	7	4	6	6	11	10	16	18	21	2	11	13	2	51	64	122
54	19	16	8	20	25	16	10	12	11	25	14	25	39	60	47	60	118
51	23	7	16	13	9	17	7	10	14	22	5	15	20	10	45	58	118
49	12	10	7	1	8	12	10	21	13	16	3	13	16	5	22	28	86
48	14	6	13	8	9	4	1	11	2	14	11	22	33	40	21	27	87
45	20	14	17	25	18	20	17	21	16	23	14	28	42	70	40	51	109
45	18	14	13	20	17	21	17	18	17	21	9	22	31	30	47	60	118

Table X. - Scores obtained on the Test Battery by the 8 Women Students in Second Year Science.

Final Grade	G - Z T S										S S H A				O T I S		
	G	R	A	S	E	O	F	T	P	M	Rt	Elim	Raw	C	Raw	Conv	IQ
74	15	11	13	16	17	15	11	17	15	9	10	21	31	40	38	49	107
73	18	15	5	15	21	15	11	23	19	7	17	26	43	80	53	65	123
69	15	21	1	0	8	3	8	24	16	5	8	26	34	50	61	71	129
67	15	26	15	6	21	16	17	24	23	9	21	27	48	90	64	72	130
61	14	15	15	18	22	23	13	21	21	16	13	21	34	50	62	71	129
60	17	28	22	17	17	19	23	27	17	25	21	28	49	95	42	54	112
48	14	21	16	28	18	9	6	19	8	14	12	26	38	60	42	54	112
42	20	21	19	9	5	12	5	23	4	16	7	13	20	10	37	48	106

Table XI. - Scores obtained on the Test Battery by the 77 Men Students in Second Year Science.

Final Grade	G - Z T S										S S H A				O T I S		
	G	R	A	S	E	O	F	T	P	M	Ht	Elim	Raw	C	Raw	Conv	IQ
90	12	19	8	5	11	20	15	19	9	15	20	33	53	90	51	64	122
88	8	13	6	1	7	3	2	19	3	11	7	19	26	20	46	59	117
76	22	23	16	16	19	16	14	17	17	22	27	35	62	98	57	68	126
76	12	24	20	14	21	20	15	28	22	14	22	34	56	90	55	67	125
75	15	22	8	5	18	7	7	24	16	14	11	24	35	40	36	46	104
74	26	11	20	19	23	25	12	13	22	27	19	25	44	70	52	64	122
73	27	13	16	13	17	15	7	26	19	22	11	28	39	60	53	65	123
73	17	16	15	12	17	17	12	20	11	24	16	24	40	60	49	62	120
73	17	13	13	24	24	22	10	12	12	24	8	17	25	20	69	74	132
72	20	10	18	18	23	17	12	16	16	26	11	23	34	40	50	63	121
71	17	18	10	16	27	20	18	19	15	17	21	29	50	80	50	63	121
70	19	23	15	10	21	17	10	22	17	17	20	28	48	80	49	62	120
69	18	22	25	25	17	23	10	25	20	21	12	29	41	60	43	55	113
68	13	21	20	20	23	20	14	24	18	23	24	34	58	95	52	64	122
68	16	12	12	3	22	15	10	14	9	17	13	29	42	70	48	61	119
68	23	24	14	20	12	15	15	27	9	20	18	26	44	70	44	56	114
67	16	18	16	14	19	17	15	20	18	19	12	24	36	50	55	67	125
67	21	15	5	8	7	5	12	19	15	22	12	30	42	70	50	63	121
67	16	15	24	26	29	23	4	13	10	21	19	33	52	90	43	55	113
67	12	19	13	12	20	19	16	22	19	14	16	28	44	70	37	48	106
66	23	18	21	22	11	16	9	18	20	20	20	30	50	80	61	71	129
65	25	11	27	25	21	28	11	15	19	21	31	34	65	99	42	54	112
72	18	20	16	23	8	19	7	17	15	21	10	21	31	30	42	54	112
70	15	22	21	25	22	22	11	23	25	23	16	32	48	80	42	54	112
70	11	16	4	8	5	14	15	21	14	21	15	32	47	80	54	66	124
69	17	16	12	4	22	19	10	10	16	13	14	30	44	70	56	68	126
66	14	19	15	21	13	13	13	20	14	11	16	31	47	80	40	51	109
65	18	16	21	17	15	18	10	24	13	18	15	27	42	70	31	40	98
65	11	14	6	12	11	7	10	19	11	16	4	23	27	20	27	35	93
65	14	20	21	22	17	14	7	19	17	25	11	25	36	50	41	53	111
65	11	17	14	14	7	13	9	18	18	24	10	20	30	30	53	65	123
63	18	19	21	12	15	18	12	22	19	20	14	24	38	50	51	64	122
63	14	23	12	21	28	22	27	22	14	22	14	27	41	60	32	41	99
63	9	14	8	6	22	17	9	8	6	25	5	20	25	20	50	63	121
63	9	22	9	14	10	13	10	24	11	12	16	26	42	70	38	49	107
62	13	21	8	5	16	15	9	27	6	18	19	29	48	80	42	54	112

Table XI. - Scores obtained on the Test Battery by the 77 Men Students in Second Year Science. (Continued)

Final Grade	G - Z T S											S S H A				O T I S		
	G	R	A	S	E	O	F	T	P	M	Rt	Elim	Raw	C	Raw	Conv	IQ	
62	13	24	18	16	20	28	20	17	27	23	12	27	39	60	51	64	122	
62	14	17	13	16	15	10	8	17	16	14	14	20	34	40	33	43	101	
61	24	18	20	14	11	15	2	21	10	18	13	21	34	40	49	62	120	
61	16	16	11	23	18	24	24	23	24	17	19	31	50	80	37	48	106	
61	21	18	15	13	15	12	12	24	14	19	8	23	31	30	23	30	88	
61	22	19	24	24	23	24	12	20	14	22	19	33	52	90	46	59	117	
61	24	9	13	19	23	21	9	9	15	19	12	28	40	60	48	61	119	
61	14	5	18	16	15	15	5	10	6	14	24	32	56	90	46	59	117	
61	15	15	16	10	8	17	15	24	22	25	6	12	18	5	41	53	111	
61	16	15	24	22	11	12	8	23	9	15	17	32	49	80	56	68	126	
60	9	13	10	17	15	21	14	21	19	17	8	25	33	40	36	46	104	
60	8	12	8	11	14	13	9	13	10	17	9	22	31	30	43	55	113	
60	17	16	12	18	16	15	17	22	19	21	10	19	29	30	43	55	113	
60	21	23	26	26	22	25	14	20	19	27	25	33	58	95	53	65	123	
60	12	17	9	10	4	2	0	18	6	16	5	20	25	20	31	40	98	
58	24	21	10	7	19	23	25	11	19	27	16	27	43	70	43	55	113	
58	20	10	9	13	10	14	11	14	9	15	9	18	27	20	39	50	108	
58	21	15	23	22	24	22	10	17	19	28	9	24	33	40	52	64	122	
57	16	25	11	11	25	19	22	19	23	15	20	29	49	80	46	59	117	
56	16	22	14	5	21	22	16	20	17	26	17	29	46	70	49	62	120	
56	22	14	10	14	12	7	14	21	17	25	6	17	23	10	43	55	113	
56	26	5	22	26	24	19	9	14	15	23	12	15	27	20	48	61	119	
56	12	19	8	8	18	14	14	23	15	15	14	22	36	50	42	54	112	
56	8	15	14	11	15	19	12	24	24	23	5	12	17	5	43	55	113	
54	10	15	9	13	21	21	22	11	23	21	5	22	27	25	52	64	122	
54	22	14	11	15	11	12	9	19	12	22	17	32	49	80	42	54	112	
52	12	21	24	17	10	14	9	25	9	20	16	29	45	70	39	50	108	
51	8	15	12	8	4	10	8	21	11	11	7	18	25	20	26	33	91	
58	20	17	12	15	21	20	16	21	17	16	12	25	37	50	35	45	103	
55	15	17	15	14	21	19	14	16	15	21	6	20	26	20	41	53	111	
51	19	15	22	15	21	13	17	18	16	20	8	26	34	40	30	39	97	
50	12	8	11	15	8	10	7	17	14	11	3	14	17	5	36	46	104	
50	9	5	8	17	11	15	14	9	22	14	1	21	22	10	44	56	114	
50	18	13	15	23	17	16	14	23	13	18	6	20	26	20	16	20	78	

Table XI. - Scores obtained on the Test Battery by  
the 77 Men Students in Second Year Science. (Continued)

Final Grade	G - Z T S										S S H A				O T I S		
	G	R	A	S	E	O	F	T	P	M	Rt	Klim	Raw	C	Raw	Conv	IQ
50	14	12	17	22	15	18	17	23	13	21	12	15	27	20	26	33	91
49	16	17	14	6	16	11	8	22	11	24	11	21	32	30	62	71	129
47	21	17	18	14	16	16	13	22	22	22	20	27	47	80	48	61	119
42	14	13	7	14	10	18	19	21	20	22	5	17	22	15	49	62	120
41	11	20	20	20	25	20	16	17	19	19	13	30	43	70	36	46	104
37	23	14	17	24	11	12	7	21	7	13	8	18	26	20	31	40	98
32	22	12	9	8	14	13	14	19	13	10	5	18	23	20	23	30	88

## APPENDIX 2

### ABSTRACT OF

#### Manifest Structure Analysis in Academic Prediction<sup>1</sup>.

The primary aim of the study was to evaluate Manifest Structure Analysis as a predictive method. Since college prediction was chosen as the particular field of application, a secondary goal of the research was to determine the relationship of scholastic aptitude, study habits and attitudes, and personality traits to academic achievement.

The higher examinations of both the Otis Self-Administering Tests of Mental Ability and of their French-language equivalent, the Examens Otis-Ottawa d'habileté mentale, were used to obtain measures of scholastic ability. The Brown-Holtzman Survey of Study Habits and Attitudes was used as a measure of these characteristics, while the Guilford-Zimmerman Temperament Survey provided measures of personality traits. Academic achievement was determined by the final average grade reported on the official record of each subject.

All regular students in the first two years of the Faculty of Science at the University of Ottawa during the 1959-1960 academic session were examined in the course of the annual testing program. There was included in the sample

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<sup>1</sup> Ph.D. thesis presented by Raymond F. Vaillancourt, to the School of Psychology and Education, University of Ottawa, 1961, 84 p.

every student who had completed the test battery and whose academic record contained a final average grade for the year. Of some 200-odd students examined, a final sample of 160 men and women was retained.

The accumulated data, classified separately by sex for First Year and for Second Year, were studied as to the relation between the test variables and the final average grade. Predictions, based on the resulting correlations, were attempted by use of multiple regression. The test data were studied separately by MSA, and suitable scales were derived for predictive purposes. The value of MSA as a prognostic technique was assessed by the comparison of results obtained by the two methods.

Among Second Year men students, only the Otis and the SSHA were significantly related to achievement, and this only to a moderate degree. No significant relationship was found between any test variable and grades for any other group.

In the case of Second Year men, the multiple regression equation and the MSA segmental scale predicted scholastic achievement with equal effectiveness.

It was concluded that the MSA segmental model is a useful technique of academic prediction which is easy to apply and which is not wasteful of data.

