THE USE OF SELECTED APTITUDE TEST SCORES FOR PREDICTING ACHIEVEMENT IN MODERN FOREIGN LANGUAGES AT NORTH TEXAS STATE UNIVERSITY

DISSERTATION

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

For the Degree of

DOCTOR OF PHILOSOPHY

By

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Denton, Texas
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The problem of this study was to determine the value of certain selected aptitude test scores for predicting student achievement in Spanish, French, and German at North Texas State University. Particular emphasis was placed on freshmen enrolled in beginning courses.

Sources of data were scores from the Scholastic Aptitude Test, including both the verbal and mathematical measures of ability; auditory and interest scores on the "Sound Discrimination," "Sound-Symbol Association," and "Interest" parts of the Pimsleur Language Aptitude Battery; scores from the MLA -- Cooperative Foreign Language Tests, Form LA; and teacher-assigned semester marks.

Data were complete for 105 first-semester freshmen in Spanish, 80 first-semester freshmen in French, and 24 first-semester freshmen in German. Separate data for each language were treated statistically to derive the following:

1. Product-moment coefficients of correlation between the selected measures of aptitude and the measure of learning achievement.

2. Coefficients of multiple correlation between the measure of learning achievement and combinations of the selected measures of aptitude.

3. The proportion of variance of a measure of learning achievement attributable to the joint action of the selected measures of aptitude, including the proportion of variance explained by each.

4. Partial coefficients of correlation used in the construction of regression equations for the prediction of scores on a measure of learning achievement.

5. Product-moment coefficients of correlation between teacher-assigned semester marks and the measure of learning achievement.

6. Product-moment coefficients of correlation between teacher-assigned semester marks and the selected measures of aptitude.

7. Coefficients of multiple correlation between teacher-assigned semester marks and combinations of selected measures of aptitude.

8. The proportion of variance of teacher-assigned semester marks attributable to the joint action of

selected measures of aptitude, including the proportion of variance explained by each.

9. Partial correlation coefficients used in the construction of regression equations for the prediction of teacher-assigned semester marks.

The study contains five chapters and an appendix. Chapter I includes an introduction and the statement of the problem. Chapter II contains a review of the related literature. Chapter III describes the population and instruments used and outlines the procedures for the collection and analysis of the data. Chapter IV presents the treatment of the data and the findings of the study in relationship to the hypotheses formulated. Correlations between the MLA - Cooperative Foreign Language Tests, Form LA, and teacher-assigned semester marks in Spanish, French, and German were .706, .800, and .336 respectively. Chapter V summarizes the investigation and includes the following conclusions:

1. The best predictors of Spanish achievement scores were verbal and interest scores.

2. The best predictors of French achievement scores were mathematical and interest scores.

3. It was clear that no predictions of German achievement scores would be possible on the basis of the study.

4. The mathematical and auditory scores were the best predictors of teacher-assigned semester marks in Spanish. Consideration of the interest scores as another predictor seemed to be advantageous as well.

5. The auditory and interest scores were the best predictors of teacher-assigned semester marks in French. Consideration of the mathematical scores as another predictor seemed to be advantageous as well.

6. The mathematical and auditory scores were the best predictors of teacher-assigned semester grades in German.

7. Additional pertinent information available should also be considered in attempts to predict modern foreign language learning achievement.

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PREFACE

For permission to collect the data for this study, special acknowledgment is given to the Chairman and the Executive Committee of the Foreign Language Department at North Texas State University. Appreciation is also extended to all of those in the Department whose cooperation made possible the execution of the study.

A very special expression of sincere gratitude is also offered to The Delta Kappa Gamma Society International for its assistance in making this research possible.

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CHAPTER I

INTRODUCTION

With regard to many questions remaining to be answered through research in the area of foreign language teaching, John B. Carroll states:

> Information is desired on which to base decisions concerning who should be taught foreign languages, at what ages instruction should be started and how long it should be continued, what languages should be taught, what skills should be emphasized, and what kind of outlays of staff, space, and equipment are required to support the resulting instructional program (2, p. 1094).

There have long been differences of opinion about who should be taught foreign languages; traditions and observations, rather than scientific evidence, have largely been used to support these different opinions (4, p. 3).

Further, Turner has suggested that in spite of a renewal of interest in the teaching of foreign languages the weakest link in the chain of foreign language instruction that extends from the elementary school through the postdoctoral level is the college and university undergraduate program (5, p. 358).

The undergraduate student population has potentially variable needs which ought to be taken into account in program development. Jakobovits has stated that the student should be given more help in his choice of a foreign language (3, p. 449). This help is needed so that students may be more adequately assured of success and so that an institution may be more effectively assured of the full utilization of its resources. In order to provide this type of counseling, educators need scientific ways of identifying students with aptitudes for learning foreign languages (4, pp. 3-4). This kind of information can be very useful in the selection and placement of students for university foreign language instruction.

Statement of the Problem

The problem of this study was to determine the value of the use of selected aptitude test scores for predicting student achievement in modern foreign languages at North Texas State University. Particular emphasis was placed on freshmen enrolled in beginning courses.

Purposes of the Study

The purposes of this study were (1) to investigate and ascertain the value of Scholastic Aptitude Test

scores for predicting a student's achievement in modern foreign language study at North Texas State University, both when the scores are used exclusively and when they are used in combination with scores on certain foreign language aptitude tests selected from the Pimsleur Language Aptitude Battery, and (2) to analyze, compare, and report the findings for educators who are interested in predicting a student's achievement in modern foreign languages.

Hypotheses

The following hypotheses were formulated:

1. There will be a significant positive relationship between learning achievement in selected modern foreign languages, as measured by the MLA - Cooperative Foreign Language Tests, Form LA, and the following measures:

   a. Verbal ability as determined by the Scholastic Aptitude Test.

   b. Mathematical ability as determined by the Scholastic Aptitude Test.

   c. Auditory ability as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery.

d. Student interest as determined by the "Interest" part of the Pimsleur Language Aptitude Battery.

2. There will be a significant positive relationship between learning achievement in selected modern foreign languages, as measured by the MLA - Cooperative Foreign Language Tests, Form LA, and the following combinations of measures:

a. Verbal and mathematical abilities as determined by the Scholastic Aptitude Test.

b. Verbal ability as determined by the Scholastic Aptitude Test and auditory ability as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery.

c. Verbal ability as determined by the Scholastic Aptitude Test and student interest as determined by the "Interest" part of the Pimsleur Language Aptitude Battery.

d. Mathematical ability as determined by the Scholastic Aptitude Test and auditory ability as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery.

e. Mathematical ability as determined by the Scholastic Aptitude Test and student interest as determined by the "Interest" part of the Pimsleur Language Aptitude Battery.

f. Auditory ability, as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery, and student interest, as determined by the "Interest" part of the Pimsleur Language Aptitude Battery.

g. Verbal and mathematical abilities as determined by the Scholastic Aptitude Test and auditory ability as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery.

h. Verbal and mathematical abilities as determined by the Scholastic Aptitude Test, auditory ability and student interest as determined by the "Sound Discrimination," the "Sound-Symbol Association," and the "Interest" parts of the Pimsleur Language Aptitude Battery.

3. There will be a significant positive relationship between teacher-assigned semester marks in selected modern foreign languages and the following measures:

a. Learning achievement in the respective languages, as determined by the MLA - Cooperative Foreign Language Tests, Form LA.

b. Verbal ability as determined by the Scholastic Aptitude Test.

c. Mathematical ability as determined by the Scholastic Aptitude Test.

d. Auditory ability as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery.

e. Student interest as determined by the "Interest" part of the Pimsleur Language Aptitude Battery.

4. There will be a significant positive relationship between teacher-assigned semester marks in each modern foreign language and a combination of the two best predictors of such evaluations of learning achievement in the language as revealed by first-order coefficients of correlation.

Background and Significance of the Study

There is a recognition of the desirability of having foreign language instruction which is geared to individual needs and which is offered in full cognizance and acceptance of the variation that exists in foreign

language aptitude. Bernard points out the importance of this kind of instruction throughout the school situation:

> Good teaching, which recognizes differences, illustrates acceptance, and challenges potentials, thus providing every pupil a chance to achieve success in effective learning, is a most positive approach to mental health. More teachers should realize that when they are teaching well, they are practicing mental hygiene (1, p. 423).

An awareness of the desirability of providing for a wide range of individual differences should lead foreign language educators to establish bases for counseling each student in the choice of a language appropriate to his own particular needs, aptitude, and interest. Such counseling will benefit the institution by helping to insure that students will experience success and by making possible a more effective utilization of resources.

Because each entering freshman at North Texas State University is required to submit Scholastic Aptitude Test scores, already available to the student as well as to his counselor or adviser, counseling can be made more effective in accomplishing advantageous placement of students for foreign language study. Use of statistical analyses of the test data is a potential source of help to the counselor or adviser in providing guidance for the student.

Although foreign language aptitude tests are not being used at North Texas State University, one significant aspect of this study was an attempt to determine whether an advantageous use of such tests might be considered for the future.

Definition of Terms

For the purposes of this study the principal terms were defined as follows:

1. Achievement was defined in terms of student performance in beginning Spanish, French, and German at North Texas State University, as measured by the MLA - Cooperative Foreign Language Tests, Form LA, and as indicated by teacher-assigned semester marks.

2. Auditory was interpreted as the sum of the measures of sound discrimination and sound-symbol association, as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery.

3. Interest was interpreted as the measure of the student's desire to study a foreign language, as determined by the "Interest" part of the Pimsleur Language Aptitude Battery.

4. Mathematical was interpreted as the sub-test measure of mathematical ability as determined by the Scholastic Aptitude Test.

5. Verbal was interpreted as the sub-test measure of verbal ability as determined by the Scholastic Aptitude Test.

Limitations

This study was limited to first-semester freshmen who were enrolled in Spanish 101, French 101, and German 101 at North Texas State University during the fall semester of the 1970-1971 academic year. The time length of language instruction was limited to this one-semester period.

The setting, the instructional staff, and the nature of the population restrict interpretation beyond the population used in the study.

Basic Assumptions

It was assumed that the subjects responded honestly to the instruments being used in measurement. It was further assumed that the instruction in all of the language sections was comparable, and that the use of all Spanish 101, French 101, and German 101 classes and of subjects who had many teachers would negate the effect of any one teacher upon achievement.

There was no reason to suppose that freshman students selected in like manner at other institutions with foreign language requirements or that similarly chosen future

North Texas State University freshman students would differ in significant ways from those included in this study.

Summary

There appear to be unused sources for help in guiding a student in his election and/or selection of a modern foreign language for study. This research evolved as a plan to provide evidence for the potential improvement of the usefulness of such sources. The problem was to determine the value of the use of selected aptitude test scores for predicting learning achievement in Spanish, French, and German at North Texas State University.

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CHAPTER II

RELATED LITERATURE

The purpose of this chapter is to present a brief review of the literature which relates to the prognostic value of measures of aptitude and interest for determining student achievement in the learning of modern foreign languages.

The literature is quite extensive in regard to a number of factors believed to be important in foreign language learning achievement. A more comprehensive review of the historical development and recent status of prediction in regard to foreign language learning may be found in the 1968 study by Kannwischer, "Prediction of Foreign Language Learning: Development and Present Status" (12).

Aptitude and Learning Achievement

In an attempt to identify abilities related to or involved in language aptitude, investigators have considered such factors as intelligence, verbal and mathematical abilities, grades in other subjects, and auditory ability. Summaries of a representative sample

of the investigations are being presented chronologically, in order to furnish an overview of the developmental trend in the thinking of interested investigators.

Glover (10), in 1917, using English composition as a criterion of future success in elementary foreign language study, reported a positive correlation of .632. He also found correlations of .513 between records of performance in arithmetic and subsequent foreign language achievement, and .355 between performance in history and later achievement in elementary foreign language study.

In 1929 Kaulfers (13) reported the results of his study of the mean grade-point averages of some one thousand pupils with varying degrees of intelligence, as measured by the Terman Group Test of Mental Ability, Forms A and B. His data showed, with a few extreme exceptions, a strongly consistent rise in mean Spanish language achievement for every significant increase in intelligence. Among his conclusions were that intelligence significantly influences pupil achievement in Spanish, as measured by teacher-assigned grades, and that pupils in the lower levels of mental ability ordinarily need superior application habits in order to succeed.

Writing about the foreign language prognosis test which he designed, Symonds (33) described a correlation

study undertaken in the fall of 1928 and concluded in May, 1929. The correlation between Form A and achievement, as determined by an achievement test, was .60 (average of 10 schools), while the corresponding correlation coefficient for Form B was .61 (average of 6 schools). The correlation coefficient between both forms combined and final achievement was .71 (average of 4 schools).

In 1931 Parker (22) summarized the evidence up to that time, concluding that special tests were more effective prognostic instruments than were general intelligence tests. Such special prognoses, together with objective measurements in a trial period, were recommended as the best bases of prediction and classification.

The types of memory in language study received the attention of Hagboldt (11), who in 1932 asserted that all phases of memory--auditory, visual, and motor--are implied in language learning, and that lasting success can only be achieved through habitual, effective use of all kinds of images.

In 1933, after a study using the Symonds Foreign Language Prognosis Test, Form B, Richardson (27) reported a correlation coefficient of .64 between the prognostic test scores and first-semester grades, stating that the

placement ranks on the prognosis test were of greater predictive significance than were either mental test score placement ranks or intelligence quotient placement ranks from the Terman Group Test of Mental Ability.

Dexter and Omwake (6), in their college study of the relation between pitch discrimination and accent, obtained a correlation coefficient of .485 between intelligence and accent ratings in French. Among the general conclusions they reported in 1934 were that those with a high ability rating in pitch discrimination may be rated either high or low in French accent and may take much or little college French, but that those with a low ability rating in pitch discrimination are not rated high in accent, nor do they take more than two years of French in college. Dexter (5) reported a similar study on the high school level a few months later, citing a coefficient of correlation of .592 between intelligence and accent rating and another of .639 between pitch discrimination and accent rating. She concluded that the ability to discriminate pitch contributed as much as much as intelligence to the attainment of a good French accent; and that comparatively low intellectual ability accompanied by good pitch discrimination seemed to result in reasonable success in high school French, while low intelligence along with low pitch discrimination ability led to failure in French.

After experimentation, Eaton (8) concluded in 1934 that a general language course plus some consideration of an artificial language could be of value in the prediction of language aptitude.

In 1936 Sister Virgil (30) described an earlier study of the prognosis of success in German. The prognostic battery at the University of Minnesota consisted of an especially constructed German prognosis test and the Iowa Foreign Language Aptitude Test. In addition, data were available from the Minnesota College Aptitude Test and College Ability Ratings. The best single predictor was the Iowa Foreign Language Aptitude Test, with a correlation coefficient of .491 with first-quarter marks. The coefficients of multiple correlation were also reported, with an R of .497 between first-quarter marks and the IFLAT plus the German prognosis test, and an R of .505 between the same marks and the IFLAT plus the College Ability Rating. The College Ability Rating was defined as the average of a pupil's rank in his high school and his percentile rank on the College Aptitude Test.

Matheus (20), writing in 1937 after a study of 103 West Virginia State College freshmen who were modern language students, summarized the correlation coefficients obtained as follows: .414 between the George

Washington University Series Language Aptitude Test and semester grades; .417 between the Psychological Examination for High School Graduates and College Freshmen and semester grades; and .664 between the psychological test scores and the aptitude test scores.

In 1938 Tallent (34) reported three coefficients of correlation obtained with a random sample of 184 cases in French, German, and Spanish: .211 between modern foreign language grades and intelligence quotients, as determined by the Terman Group Test of Mental Ability; .487 between the foreign language grades and scores on an English placement test devised by the University of Tennessee; and .558 between English grades and the modern language grades.

Seagoe (29), also reporting in 1938, described a study of 120 students whose records were being followed during the Carnegie Guidance Experiment in Pasadena, California. Among the conclusions reached was that the Terman, the Kuhlmann-Anderson, and the Otis intelligence tests, the New Stanford Reading Test, the New Stanford Arithmetic Test, and the Luria-Orleans Modern Languages Prognosis Test all accurately differentiate degree of success in beginning foreign language study. The noteworthy coefficients of correlation secured were .63 between reading achievement and language prognosis, .73

between the Luria-Orleans and the Terman tests, .71 between the Luria-Orleans and the Otis Intermediate Examination, and .68 between the Luria-Orleans and the Kuhlmann-Anderson tests. It was pointed out that the total test picture, along with subjective judgments in regard to personal factors, would give a better estimate of probable future success than would any single test. The independence of the Stenquist Mechanical Aptitude Test was clearly demonstrated. Reading achievement, though reported as a reliable index of probable language grades, was shown to have less validity than either general intelligence or the language prognosis test used. It was regarded as questionable whether the prognosis test had proved to be superior to a general intelligence test in predictive value.

Spoerl (31) reported in 1939 the results of investigations of the possible factors involved in foreign language learning. The Henmon-Nelson Test of Mental Ability, Form A, was used to measure intelligence. The data showed a clear and definitely marked correlation of language grades with intelligence for the women, but not for the men. The coefficients of correlation obtained for the freshman men and women in the larger of Spoerl's studies were .385 and .611 respectively. The investigator concluded that intelligence seemed to be a significant

factor in the case of the females but not in the case of the males.

Maronpot (18) pointed out in 1939 that the discovery of pupils with "low-linguistic aptitude" was possible through a study of their intelligence quotients, their general scholastic averages, and their scores on a reliable prognostic test. He administered the Symonds Foreign Language Prognosis Test, Form A, to 170 pupils who were taking a foreign language for the first time, obtaining the following coefficients of correlation: .273 between intelligence quotient and final yearly grades; .512 between general scholastic average and final yearly grades; and .704 between the prognosis test scores and final yearly grades. Significantly, he reported that the prognostic instruments having the highest predictive value were those that measured the ability to translate.

Stubbins (32) reported in 1940 on the prognostic values of one secondary school entrance examination. The best of the predictors was found to be the English part of the entrance examination, with correlations of .313 with German and .365 with French for Group A, and of .314 with German and .342 with French for Group B. Coefficients of multiple correlation were also obtained, with arithmetic, English, head masters' estimates, and an intelligence test weighted. For Group A the coefficients

of multiple correlation were .36 and .38 for German and French, respectively; for Group B they were .34 and .37 for the same two languages.

In 1944 Wittenborn and Larsen (36) reported on an earlier factorial study (14) of achievement in college German. They used a number of tests, securing complete data on 79 students who had finished one semester of college German. Among their findings were the following coefficients of correlation: .55 between total scores on the English Training Test of the Iowa Placement Examination and the total scores for the Cooperative German Test, Elementary Form O; also .55 between the English Training Test and first-semester grades in German; and .37 between the total scores of the Foreign Language Aptitude Test, Iowa Placement Examination, and first-semester German grades. The investigators asserted the value of the English Training Test in predicting German achievement, tentatively identifying as a language factor that which the German achievement and English tests defined. Interestingly, they concluded that an auditory factor would be unlikely to occur in a population of normal young adults, provided that all of the stimuli were kept well above the threshold.

In view of the absence in 1945 of conclusive tests for measuring aural and oral aptitude, Bottke and

Milligan (2) suggested ways in which this measurement might be accomplished. The procedures they were using experimentally were designed to check such abilities as these: inference understanding, sound differentiation, assimilation and understanding of vocabulary in sentences, vowel timbre, word fluency, general hearing (audiometer test), ability to mimic, and transfer of rules of pronunciation to unknown material.

Bovée and Froehlich (3), having compared the Stanford-Binet intelligence quotients of 451 French students with the students' achievement in French as indicated by the Cooperative French Test, reported their findings in 1946. There were 279 first-year pupils, for whom the coefficients of correlation were .46 for the entire group, .18 for the 32 "strongest" pupils, and .65 for the 31 "weakest" pupils. The correlation coefficients for the 172 second-year pupils were .45 for the entire group, .59 for the 31 "strongest" pupils, and .51 for the 31 "weakest" pupils.

Williams and Leavitt (35) worked with prediction of success in learning Japanese and, after having used various tests, in 1947 concluded that the most discriminating tests were the Army Language Aptitude Test and the American Council on Education Psychological Examination for College Freshmen, 1943 edition. These

tests they found to be intercorrelated with a coefficient of .63.

In summarizing the data that had been collected up to 1948, Dunkel (7) regarded intelligence as an important factor in learning a second language but denied that it is the major one. He stated that the many studies had always shown a positive correlation between intelligence and foreign language achievement, with coefficients ranging from .20 to .60.

After an earlier three-semester investigation involving prognosis in German, MacNaughton and Altenhein (17) reported their findings in 1950. Among the instruments they had used were a prognosis test constructed by a committee at Hunter College and, in addition, the Artificial Language Test of the American Council on Education Psychological Examination for College Freshmen, 1935 and 1936 editions. The investigation began with the 432 students who were entering the first semester of German, but the number of students diminished as the study proceeded. Coefficients of correlation were reported as follows: .21 between prognosis and first grade in German; .33 between prognosis and an index of the three grades in German; .29 between the Artificial Language Test and the first-semester grade in German; and .20 between the same test and the three semester grades in German. The

highest coefficient of correlation obtained was .58 between prognosis test and grades for a group of students of German background.

Peters (23) published in 1953 the results of his prediction study involving college freshmen enrolled in elementary courses in French, Spanish, and German, with 47 students, 189 students, and 207 students enrolled in the respective beginning language courses. The object was to determine the predictive efficiency of the vocabulary and paragraph reading parts of the Pennsylvania State College Academic Aptitude Examination. Peters concluded that it was possible to predict success and failure, with teachers' grades as the criterion, and that the tests he had used could effectively make such a prediction.

In 1954 Salomon (28) published a review of prognosis testing, supplying a summary of much of the work done in prognosis between 1917 and 1950.

Giving his attention to the preception involved in foreign language learning, Mueller (21) reported in 1958 that approximately half of a fourth-semester French class was not able to hear the signals of the tenses or gender. There were 42 per cent who failed to hear the past tenses, 46 per cent who failed to hear the future tenses, and 60 per cent who failed to hear and

differentiate words indicating gender. In a beginning course, in which gender and plural were taught and drilled, there were 45 per cent who failed to recognize the oral signals of the feminine and 54 per cent who missed the plural.

More reviews of the research literature appeared in 1962. Pimsleur, Mosberg, and Morrison concluded that the factor they called verbal intelligence (consisting of intelligence and verbal ability) appears to correlate about .45 with foreign language achievement; however, they pointed out that this factor accounts for only about 20 per cent of the variance in achievement (24, p. 169). Carroll, after reviewing his own and other investigations, emphasized that facility in foreign language learning is relatively independent of the traits ordinarily referred to as intelligence. He also asserted that the verbal factor (vocabulary knowledge) is of little importance in predicting success in elementary audio-lingual language study. Four abilities were identified as component parts of language aptitude as measured by tests: auditory phonetic coding ability, grammatical sensitivity, rote memorization ability, and inductive language learning ability (4, p. 1088). Carroll also called attention to the evidence that the Modern

Language Aptitude Test had proved superior to intelligence tests in predictive power (4, p. 1089).

In 1963 Blickenstaff (1) indicated that the talent to discriminate pitch, as measured by one of the Seashore Measures of Musical Talents, appears to be of positive benefit to a high school or college student who is learning a foreign language, particularly if he is attempting to acquire audio-lingual skills. Subsequent studies by others (15, 16) involved the other musical elements in the Seashore Measures of Musical Talents.

In a study concluded in 1965 at the University of Missouri, Martin (19) collected data for 158 Spanish students, 222 German students, and 198 French students, all of whom were first-semester freshmen enrolled in beginning courses. Sources of predictive data were scores from the Verbal, Quantitative, and Total subtests of the Cooperative School and College Ability Tests, Form 1A, and the University of Missouri English Placement Test. The MLA - Cooperative Foreign Language Tests, Form LA, were the primary criteria for the measurement of achievement and were administered at the end of one semester of study. The highest coefficients of correlation reported for single predictors were .449 between the English sub-test and achievement

in Spanish, .557 between the English sub-test and achievement in French, and .250 between the Total test score and achievement in German. Among the coefficients of multiple correlation reported were those involving the two best predictors for each language. These were .524 for Spanish achievement as predicted by the Verbal sub-test and the University of Missouri English Placement Test, .604 for French achievement as predicted by the Total test score and the University of Missouri English Placement Test, and .272 for German achievement as predicted by the Total test score and the University of Missouri English Placement Test. One of the conclusions was that the four predictor variables provided only slightly higher predictive evidence than was provided by the two best predictors for each language.

After an investigation involving 96 high school students, Gardner and Lambert published in 1965 the results of the study, concluding that:

> . . . measures of intelligence are relatively independent of both language aptitude and second-language achievement, and moreover, that different second-language skills are related to different abilities (9, p. 191).

Interests and Language Achievement

Various investigations have also dealt with the predictive potential of the attitudes, interests, and

motivation of foreign language students. In addition, some research reports have included speculation with regard to such factors.

Kaulfers (13), in 1929, pointed out that the boys in his study generally required an intelligence quotient approximately ten points higher than that needed by the girls to achieve the same Spanish grade average. His explanation was that there was either a lack of interest or application among the male students.

Questioning 455 beginning and second-year French and Spanish students, Politzer (26) sought information regarding their motivation and interests. According to his report in the 1953-1954 volume of Language Learning, he found a far more pronounced lack of motivation among the weak students. In a later study (25), he discovered more indications of a direct relation between motivation and performance, concluding that the evidence pointed to aptitude plus a normal amount of assiduity as the best combination for success. His data showed that assiduity in laboratory attendance could evidently offset the aptitude factors for the student, but that assiduity in the doing of homework apparently would not have any such effect.

According to Carroll (4, p. 1089), motivation will relate to achievement only when it affects students' perseverance in efforts directed toward active learning.

In their 1962 report, Pimsleur, Mosberg, and Morrison (24) indicated that interest correlates positively with achievement and that the relationship between motivation and foreign language achievement may be as high as .40. There is evidence (14, 24, 25, 26) to support, with reasonable assurance, such a conclusion.

Summary

The literature reviewed in this chapter concerns studies that have dealt with the prognostic value of measures of aptitude and interest. The review has revealed that, in attempts to predict language achievement:

1. Investigators have considered a number of factors, including intelligence, verbal and mathematical abilities, grades in other subjects, auditory ability, rote memorization ability, interests, and motivation.

2. There has clearly been a developmental trend in the factors considered important for investigation. Intelligence and verbal ability are the areas which have been most thoroughly investigated. More recently, auditory ability has been looked upon as one of the most promising factors for prognosis of success in second-language learning.

3. There is evidence that better predictions can be made through the consideration of the joint action of two or more predictors than can be made through the consideration of a single predictor.

4. It is clear that much of the variance in foreign language achievement remains to be investigated.

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CHAPTER III

ORGANIZATION AND DESIGN OF THE STUDY

Selection of Subjects

The problem of this study was to determine the value of the use of selected aptitude test scores for predicting student achievement in modern foreign languages at North Texas State University. Particular emphasis was placed on freshmen enrolled in beginning courses.

Enrollment records revealed that it would be possible to include all first-semester freshmen enrolled in the beginning (101) Spanish, French, and German classes. Such a procedure seemed to be preferable to the drawing of small random samples of the population. Furthermore, the inclusion of all subjects for whom data were available and complete would make possible the administration of the measuring instruments during the regular class periods and the regular laboratory periods.

Description of Instruments

The Scholastic Aptitude Test of the College Entrance Examination Board was utilized as a measure for each

individual. This test yields two scores: verbal and mathematical. According to Dean K. Whitla, Director, Office of Tests, Harvard University, and one of the College Entrance Examination Board Committee of Examiners in Aptitude Testing for 1968-1969, the Scholastic Aptitude Test:

> . . . is designed to measure "the general ability to use language and mathematical concepts in the solution of the kinds of intellectual problems the candidate would encounter in college." From its inception, it has been an evolving test with provisions for maintaining stability of scores (1, p. 990).

Furthermore, he points out:

> The fact that three hours of paper and pencil aptitude testing produces as powerful a predictor of college achievement as does the high school record testifies to the validity of the Scholastic Aptitude Test (1, p. 993).

The MLA - Cooperative Foreign Language Tests, Form LA (7), were used to yield measures of learning achievement in listening comprehension, reading, and writing of the selected modern foreign languages. Normed and standardized, these tests were prepared through the cooperation of the United States Office of Education, the Modern Language Association of America, and the Educational Testing Service, and therefore seemed appropriate as a means of gathering data for this study. There was also the consideration of the possibility for the comparison of the results of this study with those of a study of the predictive value of the University of

Missouri freshman placement tests, including the Cooperative School and College Ability Tests, Form 1A. The MLA - Cooperative Foreign Language Tests, Form LA, were used as the criterion measure, or criterion variable, in the completed study to which reference is made (4).

Three selected tests of the Pimsleur Language Aptitude Battery were used to yield measures of student interest and of auditory ability. Paul Pimsleur, Ohio State University, and Johann F. Struth, Harcourt, Brace and World, Incorporated, describe the battery as follows:

> The Pimsleur Language Aptitude Battery predicts, within certain limits, a student's potential for foreign language learning. It is made up of six parts:
>
> 1. Grade-point average--the average of the student's most recent final grades in major subjects.
> 2. Interest--the student's desire to study a foreign language.
> 3. Vocabulary--the student's knowledge of English words.
> 4. Language analysis--the student's ability to manipulate grammar analytically.
> 5. Sound discrimination--the student's ability to tell foreign sounds apart.
> 6. Sound-symbol association--the student's ability to correctly associate sounds with their written form (5, p. 85).

Jakobovits testifies to the predictive value of the Pimsleur Language Aptitude Battery and states that an examination of the tests of the battery "may give an indication of what constitutes a 'talent for FL's'" (3, p. 442). However, he goes on to point out that not all the tests are equally related to foreign language

aptitude, indicating that when "'underachievers'" were compared to "'normal'" students in a matched-group experiment, there was no difference between the groups on the tests for vocabulary and language analysis. On the tests for interest, auditory discrimination, and sound association, however, he reports that the underachievers scored significantly lower (3, p. 442). Pimsleur's conclusion in regard to this experiment is as follows:

> According to this investigation, there does exist a "talent" for learning foreign languages--that is, a special factor beyond intelligence and industriousness which accounts for how well an individual succeeds in a language course. Our evidence indicates this special factor is auditory ability, which may be defined as the ability to receive and process information through the ear (6, p. 135).

Jakobovits also states that Carroll reached a similar conclusion after his extensive work on the Modern Language Aptitude Test, which was carried out independently of and prior to the Pimsleur investigation (3, p. 442).

Because of this evidence, the "Sound Discrimination," the "Sound-Symbol Association," and the "Interest" parts of the Pimsleur Language Aptitude Battery seemed to be the most appropriate and up-to-date devices for gathering data for this study. The "Vocabulary" and "Language Analysis" parts were omitted on the basis of the existing evidence previously described, and the Scholastic Aptitude Test scores were used in lieu of the "Grade-Point Average" part of the Pimsleur Language Aptitude Battery.

Procedures for Collecting Data

All entering freshmen are required to submit scores on the Scholastic Aptitude Test before they may enroll at North Texas State University. The Registrar's Office supplied a copy of the completed list of these scores.

The Department of Foreign Languages supplied class enrollment lists for all sections of beginning classes in modern foreign languages. These lists bore the name; the social security number; and, as a check for the completeness of the list of Scholastic Aptitude Test scores, the classification of each student. Because any modern foreign language failing to have a total enrollment of at least 40 first-semester freshmen was dropped from consideration in this study, Russian 101 was not included.

From the list of Scholastic Aptitude Test scores, the verbal and mathematical scores for all first-semester freshmen who were enrolled in Spanish 101, French 101, and German 101 were recorded on the class enrollment lists.

To all of the students in the selected elementary (101) courses were given the "Interest," the "Sound Discrimination," and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery. The scores were needed for first-semester freshmen only, but the tests were administered to all students who were enrolled in each beginning (101) section of Spanish, French, and

German. These tests were administered during the first part of the fall semester, at regularly scheduled laboratory periods.

Near the end of the semester marking the students' completion of the elementary 101 courses, the MLA - Cooperative Foreign Language Tests, Form LA, were administered to all students in each section of elementary 101 Spanish, French, and German. The tests were given during regularly scheduled class periods and laboratory sessions. For this reason, the tests were administered to all students enrolled in each section, although for the purposes of this study scores were needed for first-semester freshmen only. The achievement test scores as well as the teacher-assigned semester marks were recorded on the class enrollment lists.

Procedures for Analysis of Data

All data were coded and punched into cards for automatic data processing, and the North Texas State University Computer Center's formulae were used for all computations.

The means and standard deviations of the measures of student achievement in each of the languages and of the following aptitude measures were computed:

X_1 --Verbal scores; separate data for each language

X_2 --Mathematical scores; separate data for each language

X_3 ---Auditory scores; separate data for each language

X_4 ---Interest scores; separate data for each language

Pearson product-moment coefficients of correlation were computed between the measures of learning achievement in each of the modern foreign languages, as indicated by the MLA - Cooperative Foreign Language Tests, Form LA, and the verbal, the mathematical, the auditory, and the interest measures of aptitude. The accuracy with which the learning achievement scores can be predicted from each of the four measures of aptitude as single predictors was revealed through the computation of the standard errors of estimate. The combined action of these aptitude tests in predicting learning achievement in the appropriate language was determined by computing various coefficients of multiple correlation (R) in terms of beta coefficients (R^2). These coefficients of multiple correlation were determined for each of the combinations of independent variables outlined in Hypothesis 2, with separate data for each language. For the regression equations formulated, use was made of the process of maximizing the predictive power of the independent variables by assigning optimum weights to them.

The standard error of estimate was computed for each combination of variables considered. The standard error of estimate reveals that the chances are approximately 68 in 100, or 68.26 per cent, that the prediction of the achievement score will be accurate within plus or minus the value of one standard error of estimate.

Also computed were coefficients of correlation between teacher-assigned semester marks and measures of learning achievement in the subjects. In addition, coefficients of correlation between measures of aptitude and teacher-assigned marks were computed. The measures of aptitude yielding the highest correlations with semester marks in each of the languages were utilized in multiple correlation formulae.

Each of the hypotheses was tested in the null form. The significance of each obtained r was tested against the hypothesis that the population correlation coefficient is zero. A two-tailed test was used, with Table 25 in Garrett's Statistics in Psychology and Education serving as the appropriate guide for the critical values of the Pearson correlation coefficients (2, p. 201). Calculation of an F-ratio served to determine in each instance the significance of the coefficient of multiple correlation. F-ratios were also used to compare the effectiveness of pairs of prediction equations. The

decision as to the level of significance below which a hypothesis would be rejected was arbitrarily set at the .05 level. Significance at the .01 level has also been reported.

Summary

This chapter is a description of the procedures used in studying the relationships of selected measures of aptitude as a means of determining the predictive value of these measures for estimating a student's potential for learning achievement in Spanish 101, French 101, and German 101 at North Texas State University.

Treatment of the data resulting from the tests was conditioned by the specific hypotheses which had been formulated. Coefficients of correlation were obtained between measures of learning achievement in the modern foreign languages and selected measures of aptitude. The combined action of these aptitude tests in predicting learning achievement in Spanish 101, French 101, and German 101 at North Texas State University was determined by computing the coefficients of multiple correlation, partial regression equations, and standard errors of estimate for the combinations considered. Also computed were coefficients of correlation between teacher-assigned semester marks and

the measures of aptitude. The measures of aptitude yielding the highest correlations with semester marks in each of the three languages were utilized in multiple correlation formulae.

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CHAPTER IV

ANALYSIS OF TEST DATA

Purpose

The purpose of this chapter is to report and analyze the data which were obtained. Consideration is given to the following questions, all of which evolved from the hypotheses listed in Chapter I:

1. What is the degree of relationship, if any, between learning achievement in Spanish, French, and German, as measured by the MLA - Cooperative Foreign Language Tests, Form LA, and the following measures:

   a. Verbal ability as determined by the Scholastic Aptitude Test?

   b. Mathematical ability as determined by the Scholastic Aptitude Test?

   c. Auditory ability as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery?

   d. Student interest as determined by the "Interest" part of the Pimsleur Language Aptitude Battery?

2. What is the degree of relationship, if any, between learning achievement in Spanish, French, and German, as measured by the MLA - Cooperative Foreign Language Tests, Form LA, and the following combinations of measures:

a. Verbal and mathematical abilities as determined by the Scholastic Aptitude Test?

b. Verbal ability as determined by the Scholastic Aptitude Test and auditory ability as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery?

c. Verbal ability as determined by the Scholastic Aptitude Test and student interest as determined by the "Interest" part of the Pimsleur Language Aotitude Battery?

d. Mathematical ability as determined by the Scholastic Aptitude Test and auditory ability as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery?

e. Mathematical ability as determined by the Scholastic Aptitude Test and student interest as determined by the "Interest" part of the Pimsleur Language Aptitude Battery?

f. Auditory ability and student interest, as determined by the "Sound Discrimination," the "Sound-Symbol Association," and the "Interest" parts of the Pimsleur Language Aptitude Battery?

g. Verbal and mathematical abilities as determined by the Scholastic Aptitude Test and auditory ability as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery?

h. Verbal and mathematical abilities as determined by the Scholastic Aptitude Test, auditory ability and student interest as determined by the "Sound Discrimination," the "Sound-Symbol Association," and the "Interest" parts of the Pimsleur Language Aptitude Battery?

3. What is the degree of relationship, if any, between teacher-assigned semester marks in Spanish, French, and German and the following measures:

a. Learning achievement in the respective languages, as determined by the MLA - Cooperative Foreign Language Tests, Form LA?

b. Verbal ability as determined by the Scholastic Aptitude Test?

c. Mathematical ability as determined by the Scholastic Aptitude Test?

d. Auditory ability as determined by the "Sound Discrimination" and the "Sound-Symbol Association" parts of the Pimsleur Language Aptitude Battery?

e. Student interest as determined by the "Interest" part of the Pimsleur Language Aptitude Battery?

4. What is the degree of relationship, if any, between teacher-assigned semester marks in each modern foreign language and a combination of the two best predictors of such evaluations of learning achievement in the language as revealed by first-order coefficients of correlation?

Relationships between a Measure of Learning Achievement in Spanish and Selected Measures of Aptitude

Table I shows product-moment coefficients of correlation between a measure of learning achievement in Spanish as indicated by the MLA - Cooperative Foreign Language Tests, Form LA, and measures of aptitude as indicated by the Scholastic Aptitude Test as well as by the auditory and interest parts of the Pimsleur Language Aptitude Battery. Means and standard deviations for these measures are presented in Appendix A.

The range of coefficients of correlation between a measure of learning achievement in Spanish and the

selected measures of aptitude was .172 to .373. The lowest coefficient of correlation with the measure of learning achievement (Y) in Spanish involved the measure of mathematical ability, while the highest involved the measure of interest. The coefficients of correlation between the measure of learning achievement (Y) in Spanish and verbal ability, and between the measure of learning achievement (Y) in Spanish and auditory ability, were .280 and .230 respectively.

TABLE I

COEFFICIENTS OF CORRELATION BETWEEN A MEASURE OF LEARNING ACHIEVEMENT IN SPANISH AND SELECTED MEASURES OF APTITUDE TOGETHER WITH STANDARD ERRORS OF ESTIMATE (N = 105)

Tests	r	SE (est. Y)
Variables		
Verbal (X_1)	.280**	±31.576
Mathematical (X_2)	.172	±32.401
Auditory (X_3)	.230*	±32.011
Interest (X_4)	.373**	±30.514

*Significant at the .05 level.

**Significant at the .01 level.

An analysis of the statistical significance of the product-moment coefficients of correlation (1, p. 201) indicated the levels of significance shown in Table I. In addition, an examination of Garrett's descriptive labels for interpreting coefficients of correlation indicated that a "low" correlation appeared to exist between the scores on the criterion of learning achievement in Spanish and three of the variables: verbal, auditory, and interest. The relationship between the criterion measure of learning achievement in Spanish and mathematical ability was rated as "indifferent or negligible" (1, p. 176).

The accuracy with which learning achievement scores in Spanish can be predicted from the selected measures of aptitude is indicated by the standard errors of estimate. The standard error of estimate reveals that the chances are about 68 in 100, or 68.26 per cent, that the prediction of the Spanish learning achievement score will not miss the actual score of Spanish learning achievement by more than plus or minus the value of one standard error of estimate.

Relationships between a Measure of Learning Achievement in French and Selected Measures of Aptitude

Product-moment coefficients of correlation between a measure of learning achievement in French as indicated

by the MLA -- Cooperative Foreign Language Tests, Form LA, and measures of aptitude as indicated by the Scholastic Aptitude Test as well as by the auditory and interest parts of the Pimsleur Language Aptitude Battery, are presented in Table II. Means and standard deviations for these measures are presented in Appendix A.

The range of coefficients of correlation between a measure of learning achievement in French and the selected measures of aptitude was .207 to .322. The

TABLE II

COEFFICIENTS OF CORRELATION BETWEEN A MEASURE OF LEARNING ACHIEVEMENT IN FRENCH AND SELECTED MEASURES OF APTITUDE TOGETHER WITH STANDARD ERRORS OF ESTIMATE
(N = 80)

Tests	r	SE (est. Y)
Variables		
Verbal (X_1)	.207	±37.836
Mathematical (X_2)	.299**	±36.898
Auditory (X_3)	.322**	±36.612
Interest (X_4)	.269*	±37.248

*Significant at the .05 level.

**Significant at the .01 level.

levels of significance (1, p. 201) are appropriately indicated in Table II.

According to Garrett (1, p. 176), a "low" relationship appeared to exist between the criterion measure of learning achievement in French and each of the measures of aptitude.

The accuracy with which French learning achievement scores can be predicted from the selected measures of aptitude is indicated by the standard errors of estimate. The standard error of estimate reveals that the chances are about 68 in 100, or 68.26 per cent, that the prediction of the French learning achievement score will not miss the actual score of French learning achievement by more than plus or minus the value of one standard error of estimate.

Relationships between a Measure of Learning Achievement in German and Selected Measures of Aptitude

Table III is a presentation of the product-moment coefficients of correlation between a measure of learning achievement in German as indicated by the MLA — Cooperative Foreign Language Tests, Form LA, and measures of aptitude as indicated by the Scholastic Aptitude Test and by the auditory and interest parts of the Pimsleur Language Aptitude Battery. Means and standard deviations for these measures are presented in Appendix A.

TABLE III

COEFFICIENTS OF CORRELATION BETWEEN A MEASURE OF LEARNING ACHIEVEMENT IN GERMAN AND SELECTED MEASURES OF APTITUDE TOGETHER WITH STANDARD ERRORS OF ESTIMATE
(N = 24)

Tests	r	SE (est. Y)
Variables		
Verbal (X_1)	.179	$\pm$21.073
Mathematical (X_2)	-.224	$\pm$20.876
Auditory (X_3)	.157	$\pm$21.156
Interest (X_4)	-.038	$\pm$21.404

There were two negative coefficients of correlation between the measure of learning achievement in German and the measures of aptitude; these were -.038 for interest and German achievement, and -.224 for mathematical ability and German achievement. The positive coefficients of correlation with German achievement for auditory and verbal abilities were .157 and .179 respectively.

The negative correlation of mathematical ability with German achievement is described by Garrett as "low," and the other coefficients of correlation between German achievement and the selected measures of aptitude are

described as denoting a "negligible" relationship (1, p. 176). None was significant at the .05 level (1, p. 201).

The accuracy with which German learning achievement scores can be predicted from each of the variables presented in Table III is indicated by standard errors of estimate. The standard error of estimate reveals that the chances are about 68 in 100, or 68.26 per cent, that the prediction of the German learning achievement score will not miss the actual score of German learning achievement by more than plus or minus the value of one standard error of estimate.

Single Predictors Yielding Highest Correlation Coefficients

Of the four independent variables utilized in this study, the measure of interest was the best predictor of the measure of learning achievement (Y) in Spanish, with a product-moment coefficient of correlation of .373. The best predictor of learning achievement (Y) in French was the measure of auditory ability, with a product-moment coefficient of .322. For learning achievement (Y) in German the best predictor was the negatively correlated mathematical ability measure, with a coefficient of correlation of -.224.

Coefficients of Multiple Correlation

The extent to which learning achievement in Spanish, French, and German was determined by the combined action of the predictor variables was obtained through the use of the statistical procedure which provides coefficients of multiple correlation (R). This procedure, described by Walker and Lev (2, p. 326), involves the following basic formula:

$$R^2_{y.1234} = r_{y1}b^*_{y1.234} + r_{y2}b^*_{y2.134} + r_{y3}b^*_{y3.124} + r_{y4}b^*_{y4.123}$$

where

r_{y1} = coefficient of correlation between the first independent variable and the criterion variable.

$b^*_{y1.234}$ = relative weight which the first independent variable contributes to the criterion variable.

r_{y2} = coefficient of correlation between the second independent variable and the criterion variable.

$b^*_{y2.134}$ = relative weight which the second independent variable contributes to the criterion variable.

r_{y3} = coefficient of correlation between the third independent variable and the criterion variable.

$b^*_{y3.124}$ = relative weight which the third independent variable contributes to the criterion variable.

r_{y4} = coefficient of correlation between the fourth independent variable and the criterion variable.

$b^*_{y4.123}$ = relative weight which the fourth independent variable contributes to the criterion variable.

Coefficients of multiple correlation were determined for each of the combinations discussed in the subsequent sections of this chapter. Detailed data relative to the variables may be found in Appendix B.

Relationships between a Measure of Learning Achievement in Spanish and Combined Measures of Aptitude

Various coefficients of multiple correlation were computed to show the joint action of the measures of aptitude combined with the criterion measure of learning achievement in Spanish. Table IV summarizes the product-moment coefficients of correlation used in the computation of these coefficients of multiple correlation. Means and standard deviations for the variables are presented in Appendix A.

The correlations between a measure of learning achievement in Spanish and the selected measures of aptitude ranged from .172 to .373. The intercorrelations among the four predictor variables ranged from .003 to .550. The descriptive labels given by Garrett indicate that coefficients of correlation ranging from .00 to $\pm$.20 denote "indifferent or negligible" relationships, from $\pm$.20 to $\pm$.40 "low" relationships, and from $\pm$.40 to $\pm$.70 "substantial or marked" relationships (1, p. 176).

The coefficients of multiple correlation and their levels of significance are presented in Table V.

TABLE IV

INTERCORRELATIONS BETWEEN A MEASURE OF LEARNING ACHIEVEMENT IN SPANISH AND SELECTED MEASURES OF APTITUDE (N = 105)

Tests	Coefficients of Correlation				
	X_1	X_2	X_3	X_4	Y
Verbal (X_1)	...	.550**	.349**	.063	.280**
Mathematical (X_2)			.383**	.003	.172
Auditory (X_3)				.176	.230*
Interest (X_4)					.373**
Spanish (Y)					...

*Significant at the .05 level.

**Significant at the .01 level.

Combination of Variables One, Two, and Y

The coefficient of multiple correlation between the scores made on the criterion variable, Spanish achievement (Y), and the combined action of the independent variables, verbal (X_1) and mathematical (X_2), was .281. The proportion of the variance of the criterion measure attributed to the joint action of the two independent variables was 7.88 per cent. Of this amount, 7.83 per cent of the

total variance in Spanish learning achievement was the independent contribution of the first variable (verbal), and .05 per cent was the independent contribution of the second variable (mathematical). The remaining 92.12 per cent of the variance was attributed to other factors not measured by these two tests.

Combination of Variables One, Three, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of Spanish achievement (Y) and the combined action of the independent variables, verbal (X_1) and auditory (X_3), was .313. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 9.8 per cent. Of this amount, 7.8 per cent of the total variance in Spanish learning achievement was the independent contribution of the first variable (verbal), and 2.0 per cent was the independent contribution of the third variable (auditory). The remaining 90.2 per cent was attributable to other factors not measured by these two tests.

Combination of Variables One, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of Spanish achievement (Y) and the combined action of the independent

variables, verbal (X_1) and interest (X_4), was .453. The proportion of the variance of the criterion attributable to the joint action of the two independent variables was 20.5 per cent. Of this amount, 6.6 per cent of the total variance in Spanish learning achievement was the independent contribution of the first variable (verbal), and 13.9 per cent was the independent contribution of the fourth variable (interest). The remaining 79.5 per cent must be attributed to other factors not measured by these two tests.

Combination of Variables Two, Three, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of Spanish achievement (Y) and the combined action of the independent variables, mathematical (X_2) and auditory (X_3), was .247. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 6.1 per cent. Of this amount, 0.8 per cent of the total variance in Spanish learning achievement was the contribution of the second variable (mathematical), while 5.3 per cent was the independent contribution of the third variable (auditory). The remaining 93.9 per cent was attributed to other factors not measured by these two tests.

Combination of Variables Two, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of Spanish achievement (Y) and the combined action of the independent variables, mathematical (X_2) and interest (X_4), was .410. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 16.8 per cent. Of this amount, 2.9 per cent of the total variance in Spanish learning achievement was the independent contribution of the second variable (mathematical), and 13.9 per cent was the independent contribution of the fourth variable (interest). The remaining 83.2 per cent was attributed to other factors not measured by these two tests.

Combination of Variables Three, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of Spanish achievement (Y) and the combined action of the independent variables, auditory (X_3) and interest (X_4), was .409. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 16.7 per cent. Of this amount, 2.8 per cent of the total variance in Spanish learning achievement was the independent

contribution of the third variable (auditory), and 13.9 per cent was the independent contribution of the fourth variable (interest). The remaining 83.3 per cent was attributed to other factors not measured by these two tests.

Combination of Variables One, Two, Three, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of Spanish achievement (Y) and the combined action of the independent variables, verbal (X_1), mathematical (X_2), and auditory (X_3), was .314. The proportion of the variance attributed to the joint action of the three independent variables was 9.84 per cent. Of this amount, 7.83 per cent of the total variance in Spanish learning achievement was the independent contribution of the first variable (verbal), while 0.02 per cent was the independent contribution of the second variable (mathematical), and 1.99 per cent of the total variance was the independent contribution of the third variable (auditory). The remaining 90.16 per cent of the variance was attributed to other factors not measured by these tests.

Combination of Variables One, Two, Three, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of Spanish

achievement (Y) and the combined action of the independent variables, verbal (X_1), mathematical (X_2), auditory (X_3), and interest (X_4), was .461. The proportion of the variance attributable to the four independent variables was 21.24 per cent. Of this amount, 6.59 per cent of the total variance in Spanish learning achievement was the independent contribution of the first variable (verbal). The independent contribution of the second variable (mathematical) was .02 per cent, while that of the third variable (auditory) was .70 per cent. The fourth variable (interest) accounted for 13.93 per cent of the total variance. The remaining 78.76 per cent was attributed to other factors not measured by these tests.

Combinations Yielding Highest Multiple Correlation Coefficients

As indicated in Table V, the combination of the variables, verbal (X_1) and interest (X_4), correlated higher with the measure of learning achievement (Y) in Spanish than did any of the other combinations with two predictor variables. The coefficient of multiple correlation for this combination was .453. The combination yielding the highest correlation included all of the four predictor variables, with a coefficient of .461.

TABLE V

COEFFICIENTS OF MULTIPLE CORRELATION BETWEEN A MEASURE OF LEARNING ACHIEVEMENT IN SPANISH AND COMBINATIONS OF SELECTED MEASURES OF APTITUDE

(N = 105)

Multiple R Factors	R	R^2
$R_{y.12}$	.281**	.079
$R_{y.13}$	.313**	.098
$R_{y.14}$	.453**	.205
$R_{y.23}$	.247*	.061
$R_{y.24}$	.410**	.168
$R_{y.34}$	.409**	.167
$R_{y.123}$	.314**	.098
$R_{y.1234}$***	.461**	.212

*Significant at the .05 level.

**Significant at the .01 level.

***Variables:
1. Verbal
2. Mathematical
3. Auditory
4. Interest
Y. Spanish

Relationships between a Measure of Learning Achievement in French and Combined Measures of Aptitude

Various coefficients of multiple correlation were computed to show the joint action of the measures of aptitude combined with the criterion measure of learning achievement in French. Table VI summarizes the product-moment coefficients of correlation used in the computation of these coefficients of multiple correlation. Means and standard deviations for the variables are presented in Appendix A.

TABLE VI

INTERCORRELATIONS BETWEEN A MEASURE OF LEARNING ACHIEVEMENT IN FRENCH AND SELECTED MEASURES OF APTITUDE (N = 80)

Tests	Coefficients of Correlation				
	X_1	X_2	X_3	X_4	Y
Verbal (X_1)	...	.517**	.334**	.054	.207
Mathematical (X_2)			.360**	-.038	.299**
Auditory (X_3)				.101	.322**
Interest (X_4)					.269*
French (Y)					...

*Significant at the .05 level.

**Significant at the .01 level.

The correlations between a measure of learning achievement in French and the selected measures of aptitude ranged from .207 to .322. The intercorrelations among the combinations of the four predictor variables ranged from -.038 to .517. Garrett's descriptive labels indicate that correlations ranging from .00 to $\pm$.20 denote "indifferent or negligible" relationships, from $\pm$.20 to $\pm$.40 "low" relationships, and from $\pm$.40 to $\pm$.70 "substantial or marked" relationships (1, p. 176).

The coefficients of multiple correlation and their levels of significance are presented in Table VII.

Combination of Variables One, Two, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of French achievement (Y) and the combined action of the independent variables, verbal (X_1) and mathematical (X_2), was .305. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 9.32 per cent. Of this amount, 0.37 per cent of the total variance in French learning achievement was the independent contribution of the first variable (verbal), and 8.95 per cent was attributed to the independent contribution of the second variable (mathematical). The remaining 90.68 per cent was attributable to other factors not measured by these two tests.

Combination of Variables One, Three, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of French achievement (Y) and the combined action of the independent variables, verbal (X_1) and auditory (X_3), was .339. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 11.47 per cent. Of this amount, 1.11 per cent of the total variance in French learning achievement was the independent contribution of the first variable (verbal), and 10.36 per cent was attributed to the independent contribution of the third variable (auditory). The remaining 88.53 per cent was attributed to other factors not measured by these two tests.

Combination of Variables One, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of French achievement (Y) and the combined action of the independent variables, verbal (X_1) and interest (X_4), was .331. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 10.9 per cent. Of this amount, 3.7 per cent of the total variance in French learning achievement was the independent contribution of the first variable (verbal), and 7.2 per cent was attributed to the

independent contribution of the fourth variable (interest). The remaining 89.1 per cent was attributed to other factors not measured by these two tests.

Combination of Variables Two, Three, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of French achievement (Y) and the combined action of the independent variables, mathematical (X_2) and auditory (X_3), was .377. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 14.2 per cent. Of this amount, 3.86 per cent of the total variance in French learning achievement was the independent contribution of the second variable (mathematical), and 10.36 per cent was attributed to the independent contribution of the third variable (auditory). The remaining 85.8 per cent was attributed to other factors not measured by these two tests.

Combination of Variables Two, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of French achievement (Y) and the combined action of the independent variables, mathematical (X_2) and interest (X_4), was .410. The proportion of the variance of the criterion variable attributed to the joint action of

the two independent variables was 16.8 per cent. Of this amount, 8.95 per cent of the total variance in French learning achievement was the independent contribution of the second variable (mathematical), and 7.85 per cent was the independent contribution of the fourth variable (interest). The remaining 83.2 per cent was attributed to other factors not measured by these two tests.

Combination of Variables Three, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of French achievement (Y) and the combined action of the independent variables, auditory (X_3) and interest (X_4), was .400. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 16 per cent. Of this amount, 10.4 per cent of the total variance in French learning achievement was the independent contribution of the third variable (auditory), and 5.6 per cent was the independent contribution of the fourth variable (interest). The remaining 84 per cent was attributed to other factors not measured by these two tests.

Combination of Variables One, Two, Three, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of French achievement (Y) and the combined action of the independent variables, verbal (X_1), mathematical (X_2), and auditory (X_3), was .378. The proportion of the variance attributed to the joint action of the three independent variables was 14.26 per cent. Of this amount, 0.03 per cent of the total variance in French learning achievement was the independent contribution of the first variable (verbal), while 3.86 per cent was the independent contribution of the second variable (mathematical), and 10.36 per cent of the total variance was the independent contribution of the third variable (auditory). The remaining 85.74 per cent of the variance was attributed to other factors not measured by these tests.

Combination of Variables One, Two, Three, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of French achievement (Y) and the combined action of the independent variables, verbal (X_1), mathematical (X_2), auditory (X_3), and interest (X_4), was .455. The proportion of the variance attributable to the four independent variables was 20.67 per cent. Of this amount, 4.67 per cent of

the total variance in French learning achievement was the independent contribution of the second variable (mathematical). The independent contribution of the third variable (auditory) was 10.36 per cent, while that of the fourth variable (interest) was 5.63 per cent. The first variable (verbal) accounted for none of the total variance. There remained 79.33 per cent to be attributed to other factors not measured by the selected aptitude tests.

Combinations Yielding Highest Multiple Correlation Coefficients

As indicated in Table VII, the combination of the variables, mathematical (X_2) and interest (X_4), correlated higher with the measure of learning achievement (Y) in French than did any of the other combinations with two predictor variables. The coefficient of multiple correlation for this combination was .410. The combination yielding the highest correlation included all of the four predictor variables, with a coefficient of .455, although it should be noted that in this combination only three of the variables actually contributed to the total variance in French learning achievement. The first variable (verbal) accounted for none of the total variance.

TABLE VII

COEFFICIENTS OF MULTIPLE CORRELATION BETWEEN A MEASURE OF LEARNING ACHIEVEMENT IN FRENCH AND COMBINATIONS OF SELECTED MEASURES OF APTITUDE

(N = 80)

Multiple R Factors	R	R^2
$R_{y.12}$	.305*	.093
$R_{y.13}$	.339**	.115
$R_{y.14}$	.331**	.109
$R_{y.23}$	.377**	.142
$R_{y.24}$	.410**	.168
$R_{y.34}$	.400**	.160
$R_{y.123}$	.378**	.143
$R_{y.1234}$***	.455**	.207

*Significant at the .05 level.

**Significant at the .01 level.

*** Variables:
1. Verbal
2. Mathematical
3. Auditory
4. Interest
Y. French

Relationships between a Measure of Learning Achievement in German and Combined Measures of Aptitude

Various coefficients of multiple correlation were computed to show the joint action of the measures of aptitude combined with the criterion measure of learning achievement in German. Table VIII summarizes the product-moment coefficients of correlation used in the computation of these coefficients of multiple correlation. Means and standard deviations for the variables are presented in Appendix A.

The correlations between a measure of learning achievement in German and the selected measures of aptitude ranged from -.038 to -.224. The intercorrelations among the combinations of the four predictor variables ranged from -.024 to .440. According to Garrett's descriptive labels, correlations ranging from .00 to $\pm$.20 denote "indifferent or negligible" relationships; those ranging from $\pm$.20 to $\pm$.40 denote "low" relationships; and those that fall within the $\pm$.40 to $\pm$.70 range are indicative of "substantial or marked" relationships (1, p. 176).

The coefficients of multiple correlation are presented in Table IX. There were none found to be significant at the .05 level.

TABLE VIII

INTERCORRELATIONS BETWEEN A MEASURE OF LEARNING ACHIEVEMENT IN GERMAN AND SELECTED MEASURES OF APTITUDE
(N = 24)

Tests	Coefficients of Correlation				
	X_1	X_2	X_3	X_4	Y
Verbal (X_1)	...	.335	.440*	.096	.179
Mathematical (X_2)			.135	-.198	-.224
Auditory (X_3)				-.024	.157
Interest (X_4)					-.038
German (Y)					...

*Significant at the .05 level.

Combination of Variables One, Two, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of German achievement (Y) and the combined action of the independent variables, verbal (X_1) and mathematical (X_2), was .350. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 12.3 per cent. Of this amount, 7.3 per cent of the total variance in German learning achievement was the independent contribution of the first variable (verbal), and 5.0 per cent was attributed to the

independent contribution of the second variable (mathematical). The remaining 87.7 per cent was attributable to other factors not measured by these two tests.

Combination of Variables One, Three, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of German achievement (Y) and the combined action of the independent variables, verbal (X_1) and auditory (X_3), was .199. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 3.96 per cent. Of this amount, 3.21 per cent of the total variance in German learning achievement was the independent contribution of the first variable (verbal), and 0.75 per cent was attributed to the independent contribution of the third variable (auditory). The remaining 96.04 per cent was attributed to other factors not measured by these two tests.

Combination of Variables One, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of German achievement (Y) and the combined action of the independent variables, verbal (X_1) and interest (X_4), was .188. The

proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 3.5 per cent. Of this amount, 3.2 per cent of the total variance in German learning achievement was the independent contribution of the first variable (verbal), and 0.3 per cent was attributed to the independent contribution of the fourth variable (interest). The remaining 96.5 per cent was attributed to other factors not measured by these two tests.

Combination of Variables Two, Three, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of German achievement (Y) and the combined action of the independent variables, mathematical (X_2) and auditory (X_3), was .293. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 8.6 per cent. Of this amount, 5.0 per cent of the total variance in German learning achievement was the independent contribution of the second variable (mathematical), and 3.6 per cent was attributed to the independent contribution of the third variable (auditory). The remaining 91.4 per cent was attributed to other factors not measured by these two tests.

Combination of Variables Two, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of German achievement (Y) and the combined action of the independent variables, mathematical (X_2) and interest (X_4), was .239. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 5.7 per cent. Of this amount, 5.0 per cent of the total variance in German learning achievement was the independent contribution of the second variable (mathematical), and 0.7 per cent was the independent contribution of the fourth variable (interest). The remaining 94.3 per cent was attributed to other factors not measured by these two tests.

Combination of Variables Three, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of German achievement (Y) and the combined action of the independent variables, auditory (X_3) and interest (X_4), was .160. The proportion of the variance of the criterion variable attributed to the joint action of the two independent variables was 2.6 per cent. Of this amount, 2.5 per cent of the total variance in German learning achievement was the independent

contribution of the third variable (auditory), and 0.1 per cent was the independent contribution of the fourth variable (interest). The remaining 97.4 per cent was attributed to other factors not measured by these two tests.

Combination of Variables One, Two, Three, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of German achievement (Y) and the combined action of the independent variables, verbal (X_1), mathematical (X_2), and auditory (X_3), was .360. The proportion of the variance attributed to the joint action of the three independent variables was 12.96 per cent. Of this amount, 7.27 per cent of the total variance in German learning achievement was the independent contribution of the first variable (verbal), while 5.01 per cent was the independent contribution of the second variable (mathematical), and 0.68 per cent of the total variance was the independent contribution of the third variable (auditory). The remaining 87.04 per cent of the variance was attributed to other factors not measured by these tests.

Combination of Variables One, Two, Three, Four, and Y

The coefficient of multiple correlation between the scores made on the criterion variable of German achievement (Y) and the combined action of the independent

variables, verbal (X_1), mathematical (X_2), auditory (X_3), and interest (X_4), was .382. The proportion of the variance attributable to the four independent variables was 14.58 per cent. Of this amount, 7.27 per cent of the total variance in German learning achievement was the independent contribution of the first variable (verbal). The independent contribution of the second variable (mathematical) was 5.01 per cent, while that of the third variable (auditory) was .52 per cent. The fourth variable (interest) accounted for 1.78 per cent of the total variance. The remaining 85.42 per cent was attributed to other factors not measured by the selected aptitude tests.

Combinations Yielding Highest Multiple Correlation Coefficients

As indicated in Table IX, the combination of the variables, verbal (X_1) and mathematical (X_2), correlated higher with the measure of learning achievement (Y) in German than did any of the other combinations with two predictor variables. The coefficient of multiple correlation for this combination was .350. The combination yielding the highest correlation included all of the four predictor variables, with a coefficient of .382.

TABLE IX

COEFFICIENTS OF MULTIPLE CORRELATION BETWEEN A MEASURE OF LEARNING ACHIEVEMENT IN GERMAN AND COMBINATIONS OF SELECTED MEASURES OF APTITUDE

(N = 24)

Multiple R Factors	R	R^2
$R_{y.12}$	.350	.123
$R_{y.13}$	.199	.040
$R_{y.14}$	.188	.035
$R_{y.23}$	.293	.086
$R_{y.24}$	.239	.057
$R_{y.34}$	.160	.026
$R_{y.123}$	.360	.130
$R_{y.1234}$*	.382	.146

(All coefficients nonsignificant.)

*Variables:
1. Verbal
2. Mathematical
3. Auditory
4. Interest
Y. German

Prediction by Multiple Regression

For the computation of the multiple coefficients of correlation, use was made of the process of maximizing the predictive power of the independent variables by assigning optimum weights to them. This procedure (2, p. 324) involved the following basic formula:

$$\hat{Y}_{1234} = A_{y.1234} + b_{y1.234}X_1 + b_{y2.134}X_2 + b_{y3.124}X_3 + b_{y4.123}X_4$$

Where

$\hat{Y}_{1234}$ = predicted score on the criterion measure.

$A_{y.1234}$ = a constant.

$b_{y1.234}$ = partial regression coefficient giving the weight of the score attached to the first independent variable with the second, third, and fourth independent variables held constant.

X_1 = score on the first independent variable.

$b_{y2.134}$ = partial regression coefficient giving the weight of the score attached to the second independent variable with the first, third, and fourth independent variables held constant.

X_2 = score on the second independent variable.

$b_{y3.124}$ = partial regression coefficient giving the weight of the score attached to the third independent variable with the first, second, and fourth independent variables held constant.

X_3 = score on the third independent variable.

$b_{y4.123}$ = partial regression coefficient giving the weight of the score attached to the fourth independent variable with the first, second, and third independent variables held constant.

X_4 = score on the fourth independent variable.

All of the equations which follow are the result of the application of this basic formula. Detailed data relative to the variables may be found in Appendix B.

Prediction of Learning Achievement in Spanish

The following is the equation involving the use of the verbal (X_1) and mathematical (X_2) score weights to predict Spanish achievement:

$$\hat{Y} = 51.89 + .09X_1 + .01X_2$$

The weights of .09 and .01 indicate the amounts by which the scores on variables X_1 and X_2 must be multiplied in order to give the prediction of Y. Thus a prediction of a Spanish achievement score may be made by substituting in the regression equation the known values of X_1 and X_2. The standard error of estimate of any Spanish achievement score predicted from the above formula is ± 31.72 as shown in Table X. This means that the chances are about two in three that the forecast of the Spanish achievement score will not miss the actual score of Spanish achievement on the criterion measure by more than ± 31.72 points.

The following is the equation involving the use of the verbal (X_1) and auditory (X_3) score weights to predict Spanish achievement:

$$\hat{Y} = 25.48 + .08X_1 + .84X_3$$

The weights of .08 and .84 indicate the amounts by which the scores on variables X_1 and X_3 must be multiplied in order to give the prediction of Y. Thus a prediction of a Spanish achievement score may be made by substituting in the regression equation the known values of X_1 and X_3. The standard error of estimate of any Spanish achievement score predicted from the above formula is ± 31.39 as shown in Table X. This means that the chances are about two in three that the forecast of the Spanish achievement score will not miss the actual score of Spanish achievement on the criterion measure by more than ± 31.39 points.

The following is the equation involving the use of the verbal (X_1) and interest (X_4) score weights to predict Spanish achievement:

$$\hat{Y} = 30.78 + .09X_1 + 5.16X_4$$

The weights of .09 and 5.16 indicate the amounts by which the scores on variables X_1 and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a Spanish achievement score may be made by substituting in the regression equation the known values of X_1 and X_4. The standard error of estimate of any Spanish achievement score predicted from the above formula is ± 29.46 as shown

in Table X. This means that the chances are about two in three that the forecast of the Spanish achievement score will not miss the actual score of Spanish achievement on the criterion measure by more than $\pm$29.46 points.

The following is the equation involving the use of the mathematical (X_2) and auditory (X_3) score weights to predict Spanish achievement:

$$\hat{Y} = 34.80 + .04X_2 + 1.07X_3$$

The weights of .04 and 1.07 indicate the amounts by which the scores on variables X_2 and X_3 must be multiplied in order to give the prediction of Y. Thus a prediction of a Spanish achievement score may be made by substituting in the regression equation the known values of X_2 and X_3. The standard error of estimate of any Spanish achievement score predicted from the above formula is $\pm$.32.03 as shown in Table X. This means that the chances are about two in three that the forecast of the Spanish achievement score will not miss the actual score of Spanish achievement on the criterion measure by more than $\pm$32.03 points.

The following is the equation involving the use of the mathematical (X_2) and interest (X_4) score weights to predict Spanish achievement:

$$\hat{Y} = 41.84 + .06X_2 + 5.39X_4$$

The weights of .06 and 5.39 indicate the amounts by which the scores on variables X_2 and X_4 must be multiplied

in order to give the prediction of Y. Thus a prediction of a Spanish achievement score may be made by substituting in the regression equation the known values of X_2 and X_4. The standard error of estimate of any Spanish achievement score predicted from the above formula is ± 30.14 as shown in Table X. This means that the chances are about two in three that the forecast of the Spanish achievement score will not miss the actual score of Spanish achievement on the criterion measure by more than ± 30.14 points.

The following is the equation involving the use of the auditory (X_3) and interest (X_4) score weights to predict Spanish achievement:

$$\hat{Y} = 30.98 + .95X_3 + 4.96X_4$$

The weights of .95 and 4.96 indicate the amounts by which the scores on variables X_3 and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a Spanish achievement score may be made by substituting in the regression equation the known values of X_3 and X_4. The standard error of estimate of any Spanish achievement score predicted from the above formula is ± 30.16 as shown in Table X. This means that the chances are about two in three that the forecast of the Spanish achievement score will not miss the actual score of Spanish achievement on the criterion measure by more than ± 30.16 points.

The following is the equation involving the use of the verbal (X_1), mathematical (X_2), and auditory (X_3) score weights to predict Spanish achievement:

$$\hat{Y} = 26.10 + .08X_1 - .01X_2 + .86X_3$$

The weights of .08, -.01, and .86 indicate the amounts by which the scores on variables X_1, X_2, and X_3 must be multiplied in order to give the prediction of Y. Thus a prediction of a Spanish achievement score may be made by substituting in the regression equation the known values of X_1, X_2, and X_3. The standard error of estimate of any Spanish achievement score predicted from the above formula is ± 31.54 as shown in Table X. This means that the chances are about two in three that the forecast of the Spanish achievement score will not miss the actual score of Spanish achievement on the criterion measure by more than ± 31.54 points.

The following is the equation involving the use of the verbal (X_1), mathematical (X_2), auditory (X_3), and interest (X_4) score weights to predict Spanish achievement:

$$\hat{Y} = 13.88 + .07X_1 + .01X_2 + .48X_3 + 4.97X_4$$

The weights of .07, .01, .48 and 4.97 indicate the amounts by which the scores on variables X_1, X_2, X_3, and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a Spanish achievement score may be made by substituting in the regression equation the known

TABLE X

STANDARD ERRORS OF ESTIMATE FOR SPANISH ACHIEVEMENT SCORES PREDICTED FROM COMBINATIONS OF SELECTED MEASURES OF APTITUDE

(N = 105)

Combinations of Variables*	SE (est. Y)
Verbal (X_1) and Mathematical (X_2)	±31.72
Verbal (X_1) and Auditory (X_3)	±31.39
Verbal (X_1) and Interest (X_4)	±29.46
Mathematical (X_2) and Auditory (X_3)	±32.03
Mathematical (X_2) and Interest (X_4)	±30.14
Auditory (X_3) and Interest (X_4)	±30.16
Verbal (X_1), Mathematical (X_2), and Auditory (X_3)	±31.54
Verbal (X_1), Mathematical (X_2), Auditory (X_3), and Interest (X_4)	±29.62

*Detailed data relative to the variables are in Appendix B.

values of X_1, X_2, X_3, and X_4. The standard error of estimate of any Spanish achievement score predicted from the above formula is ± 29.62 as indicated in Table X. This means that the chances are about two in three that the forecast of the Spanish achievement score will not miss the actual score of Spanish achievement on the criterion measure by more than ± 29.62 points.

Prediction of Learning Achievement in French

The following is the equation involving the use of the verbal (X_1) and mathematical (X_2) score weights to predict French achievement:

$$\hat{Y} = 29.62 + .03X_1 + .10X_2$$

The weights of .03 and .10 indicate the amounts by which the scores on variables X_1 and X_2 must be multiplied in order to give the prediction of Y. Thus a prediction of a French achievement score may be made by substituting in the regression equation the known values of X_1 and X_2. The standard error of estimate of any French achievement score predicted from the above formula is ± 37.06 as shown in Table XI. This means that the chances are about two in three that the forecast of the French achievement score will not miss the actual score of French achievement on the criterion measure by more than ± 37.06 points.

The following is the equation involving the use of the verbal (X_1) and auditory (X_3) score weights to predict French achievement:

$$\hat{Y} = -7.70 + .05X_1 + 1.79X_3$$

The weights of .05 and 1.79 indicate the amounts by which the scores on variables X_1 and X_3 must be multiplied in order to give the prediction of Y. Thus a prediction of a French achievement score may be made by substituting in the regression equation the known values of X_1 and X_3. The standard error of estimate of any French achievement score predicted from the above formula is ± 36.62 as shown in Table XI. This means that the chances are about two in three that the forecast of the French achievement score will not miss the actual score of French achievement on the criterion measure by more than ± 36.62 points.

The following is the equation involving the use of the verbal (X_1) and interest (X_4) score weights to predict French achievement:

$$\hat{Y} = 32.54 + .08X_1 + 4.34X_4$$

The weights of .08 and 4.34 indicate the amounts by which the scores on variables X_1 and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a French achievement score may be made by substituting in the regression equation the known values of X_1 and X_4.

The standard error or estimate of any French achievement score predicted from the above formula is ± 36.73 as shown in Table XI. This means that the chances are about two in three that the forecast of the French achievement score will not miss the actual score of French achievement on the criterion measure by more than ± 36.73 points.

The following is the equation involving the use of the mathematical (X_2) and auditory (X_3) score weights to predict French achievement:

$$\hat{Y} = -14.55 + .08X_2 + 1.55X_3$$

The weights of .08 and 1.55 indicate the amounts by which the scores on variables X_2 and X_3 must be multiplied in order to give the prediction of Y. Thus a prediction of a French achievement score may be made by substituting in the regression equation the known values of X_2 and X_3. The standard error of estimate of any French achievement score predicted from the above formula is ± 36.05 as shown in Table XI. This means that the chances are about two in three that the forecast of the French achievement score will not miss the actual score of French achievement on the criterion measure by more than ± 36.05 points.

The following is the equation involving the use of the mathematical (X_2) and interest (X_4) score weights to predict French achievement:

$$\hat{Y} = 10.48 + .12X_2 + 4.71X_4$$

The weights of .12 and 4.71 indicate the amounts by which the scores on variables X_2 and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a French achievement score may be made by substituting in the regression equation the known values of X_2 and X_4. The standard error of estimate of any French achievement score predicted from the above formula is ± 35.50 as shown in Table XI. This means that the chances are about two in three that the forecast of the French achievement score will not miss the actual score of French achievement on the criterion measure by more than ± 35.50 points.

The following is the equation involving the use of the auditory (X_3) and interest (X_4) score weights to predict French achievement:

$$\hat{Y} = -10.34 + 1.87X_3 + 4.01X_4$$

The weights of 1.87 and 4.01 indicate the amounts by which the scores on variables X_3 and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a French achievement score may be made by substituting in the regression equation the known values of X_3 and X_4. The standard error of estimate of any French achievement score predicted from the above formula is ± 35.67 as shown in Table XI. This means that the chances are about two in three that the forecast of the French achievement score will not miss the actual score of French achievement on the criterion measure by more than ± 35.67 points.

The following is the equation involving the use of the verbal (X_1), mathematical (X_2), and auditory (X_3) score weights to predict French achievement:

$$\hat{Y} = -15.95 + .01X_1 + .08X_2 + 1.52X_3$$

The weights of .01, .08, and 1.52 indicate the amounts by which the scores on variables X_1, X_2, and X_3 must be multiplied in order to give the prediction of Y. Thus a prediction of a French achievement score may be made by substituting in the regression equation the known values of X_1, X_2, and X_3. The standard error of estimate of any French achievement score predicted from the above formula is ± 36.28 as shown in Table XI. This means that the chances are about two in three that the forecast of the French achievement score will not miss the actual score of French achievement on the criterion measure by more than ± 36.28 points.

The following is the equation involving the use of the verbal (X_1), mathematical (X_2), auditory (X_3), and interest (X_4) score weights to predict French achievement:

$$\hat{Y} = -31.71 + .00X_1 + .09X_2 + 1.33X_3 + 4.30X_4$$

The weights of .00, .09, 1.33 and 4.30 indicate the amounts by which the scores on variables X_1, X_2, X_3, and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a French achievement score may be made by substituting in the regression equation the

TABLE XI

STANDARD ERRORS OF ESTIMATE FOR FRENCH ACHIEVEMENT SCORES PREDICTED FROM COMBINATIONS OF SELECTED MEASURES OF APTITUDE

(N = 80)

Combinations of Variables*	SE (est. Y)
Verbal (X_1) and Mathematical (X_2)	±37.06
Verbal (X_1) and Auditory (X_3)	±36.62
Verbal (X_1) and Interest (X_4)	±36.73
Mathematical (X_2) and Auditory (X_3)	±36.05
Mathematical (X_2) and Interest (X_4)	±35.50
Auditory (X_3) and Interest (X_4)	±35.67
Verbal (X_1), Mathematical (X_2), and Auditory (X_3)	±36.28
Verbal (X_1), Mathematical (X_2), Auditory (X_3), and Interest (X_4)	±35.12

*Detailed data relative to the variables are in Appendix B.

known values of X_1, X_2, X_3, and X_4. It should be noted that in this combination only three of the variables actually contribute to the prediction of French learning achievement; the first variable (verbal) was discounted in the construction of the regression equation. The standard error of estimate of any French achievement score predicted from the above formula is ± 35.12 as indicated in Table XI. This means that the chances are about two in three that the forecast of the French achievement score will not miss the actual score of French achievement on the criterion measure by more than ± 35.12 points.

Prediction of Learning Achievement in German

The following is the equation involving the use of the verbal (X_1) and mathematical (X_2) score weights to predict German achievement:

$$\hat{Y} = 98.34 + .06X_1 - .07X_2$$

The weights of .06 and -.07 indicate the amounts by which the scores on variables X_1 and X_2 must be multiplied in order to give the prediction of Y. Thus a prediction of a German achievement score may be made by substituting in the regression equation the known values of X_1 and X_2. The standard error of estimate of any German achievement score predicted from the above formula is ± 20.53 as shown in Table XII. This means that

the chances are about two in three that the forecast of the German achievement score will not miss the actual score of German achievement on the criterion measure by more than $\pm$20.53 points.

The following is the equation involving the use of the verbal (X_1) and auditory (X_3) score weights to predict German achievement:

$$\hat{Y} = 60.23 + .03X_1 + .38X_3$$

The weights of .03 and .38 indicate the amounts by which the scores on variables X_1 and X_3 must be multiplied in order to give the prediction of Y. Thus a prediction of a German achievement score may be made by substituting in the regression equation the known values of X_1 and X_3. The standard error of estimate of any German achievement score predicted from the above formula is $\pm$21.49 as shown in Table XII. This means that the chances are about two in three that the forecast of the German achievement score will not miss the actual score of German achievement on the criterion measure by more than $\pm$21.49 points.

The following is the equation involving the use of the verbal (X_1) and interest (X_4) score weights to predict German achievement:

$$\hat{Y} = 75.37 + .04X_1 - .49X_4$$

The weights of .04 and --.49 indicate the amounts by which the scores on variables X_1 and X_4 must be multiplied

in order to give the prediction of Y. Thus a prediction of a German achievement score may be made by substituting in the regression equation the known values of X_1 and X_4. The standard error of estimate of any German achievement score predicted from the above formula is $\pm$21.54 as shown in Table XII. This means that the chances are about two in three that the forecast of the German achievement score will not miss the actual score of German achievement on the criterion measure by more than $\pm$21.54 points.

The following is the equation involving the use of the mathematical (X_2) and auditory (X_3) score weights to predict German achievement:

$$\hat{Y} = 88.39 - .05X_2 + .75X_3$$

The weights of -.05 and .75 indicate the amounts by which the scores on variables X_2 and X_3 must be multiplied in order to give the prediction of Y. Thus a prediction of a German achievement score may be made by substituting in the regression equation the known values of X_2 and X_3. The standard error of estimate of any German achievement score predicted from the above formula is $\pm$20.96 as shown in Table XII. This means that the chances are about two in three that the forecast of the German achievement score will not miss the actual score of German achievement on the criterion measure by more than $\pm$20.96 points.

The following is the equation involving the use of the mathematical (X_2) and interest (X_4) score weights to predict German achievement:

$$\hat{Y} = 126.96 - .05X_2 - .75X_4$$

The weights of -.05 and -.75 indicate the amounts by which the scores on variables X_2 and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a German achievement score may be made by substituting in the regression equation the known values of X_2 and X_4. The standard error of estimate of any German achievement score predicted from the above formula is $\pm$21.29 as shown in Table XII. This means that the chances are about two in three that the forecast of the German achievement score will not miss the actual score of German achievement on the criterion measure by more than $\pm$21.29 points.

The following is the equation involving the use of the auditory (X_3) and interest (X_4) score weights to predict German achievement:

$$\hat{Y} = 67.08 + .62X_3 - .30X_4$$

The weights of .62 and -.30 indicate the amounts by which the scores on variables X_3 and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a German achievement score may be made by substituting in the regression equation the known values of X_3 and X_4. The standard error of estimate of any German achievement

TABLE XII

STANDARD ERRORS OF ESTIMATE FOR GERMAN ACHIEVEMENT SCORES PREDICTED FROM COMBINATIONS OF SELECTED MEASURES OF APTITUDE

(N = 24)

Combinations of Variables*	SE (est. Y)
Verbal (X_1) and Mathematical (X_2)	±20.53
Verbal (X_1) and Auditory (X_3)	±21.49
Verbal (X_1) and Interest (X_4)	±21.54
Mathematical (X_2) and Auditory (X_3)	±20.96
Mathematical (X_2) and Interest (X_4)	±21.29
Auditory (X_3) and Interest (X_4)	±21.64
Verbal (X_1), Mathematical (X_2), and Auditory (X_3)	±20.96
Verbal (X_1), Mathematical (X_2), Auditory (X_3), and Interest (X_4)	±21.30

*Detailed data relative to the variables are in Appendix B.

score predicted from the above formula is $\pm$21.64 as shown in Table XII. This means that the chances are about two in three that the forecast of the German achievement score will not miss the actual score of German achievement on the criterion measure by more than $\pm$21.64 points.

The following is the equation involving the use of the verbal (X_1), mathematical (X_2), and auditory (X_3) score weights to predict German achievement:

$$\hat{Y} = 86.06 + .05X_1 - .07X_2 + .36X_3$$

The weights of .05, -.07, and .36 indicate the amounts by which the scores on variables X_1, X_2, and X_3 must be multiplied in order to give the prediction of Y. Thus a prediction of a German achievement score may be made by substituting in the regression equation the known values of X_1, X_2, and X_3. The standard error of estimate of any German achievement score predicted from the above formula is $\pm$20.96 as shown in Table XII. This means that the chances are about two in three that the forecast of the German achievement score will not miss the actual score of German achievement on the criterion measure by more than $\pm$20.96 points.

The following is the equation involving the use of the verbal (X_1), mathematical (X_2), auditory (X_3), and interest (X_4) score weights to predict German achievement:

$$\hat{Y} = 95.87 + .06X_1 - .07X_2 + .32X_3 - 1.16X_4$$

The weights of .06, -.07, .32 and -1.16 indicate the amounts by which the scores on variables X_1, X_2, X_3, and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a German achievement score may be made by substituting in the regression equation the known values of X_1, X_2, X_3, and X_4. The standard error of estimate of any German achievement score predicted from the above formula is $\pm$21.30 as indicated in Table XII. This means that the chances are about two in three that the forecast of the German achievement score will not miss the actual score of German achievement on the criterion measure by more than $\pm$21.30 points.

Comparisons of Prediction Equations

For each language, F-ratios were calculated to compare the effectiveness of pairs of regression equations in predicting achievement as measured by the MLA -- Cooperative Foreign Language Tests, Form LA.

Spanish

1. Three-predictor equation.--The three-predictor equation, including the verbal (X_1), mathematical (X_2), and auditory (X_3) variables, was shown to be:

a. Significantly better, at the .05 level, than the two-predictor equation which included the mathematical (X_2) and auditory (X_3) variables only.

b. Not significantly better than the two-predictor equation which included the verbal (X_1) and mathematical (X_2) variables.

c. Not significantly better than the two-predictor equation which included the verbal (X_1) and auditory (X_3) variables.

2. Four-predictor equation.--The four-predictor equation, including all of the independent variables, was shown to be:

a. Significantly better, at the .01 level, than the two-predictor equations which involved the following combinations: verbal (X_1) and mathematical (X_2); verbal (X_1) and auditory (X_3); mathematical (X_2) and auditory (X_3).

b. Significantly better, at the .01 level, than the three-predictor equation which included the verbal (X_1), mathematical (X_2), and auditory (X_3) variables.

c. Not significantly better than any of the two-predictor equations which included the interest (X_4) variable as one of the two predictors.

French

1. Three-predictor equation.--The three-predictor equation, including the verbal (X_1), mathematical (X_2), and auditory (X_3) variables, was shown to be:

combinations: mathematical (X_2) and interest (X_4); auditory (X_3) and interest (X_4).

German

1. Three-predictor equation.--The three-predictor equation, including the verbal (X_1), mathematical (X_2), and auditory (X_3) variables, was shown to be not significantly better than any of the two-predictor equations involving combinations of these same three independent variables.

2. Four-predictor equation.--The four-predictor equation, including all of the independent variables, was shown to be not significantly better than the three-predictor equation described above and not significantly better than any of the two-predictor equations.

Relationships between Teacher-Assigned Semester Marks and the Selected Measures of Aptitude and of Learning Achievement

The teacher-assigned semester marks were converted to their mathematical equivalents, as follows:

A = 4 points
B = 3 points
C = 2 points
D = 1 point
F = 0 points

Pearson product-moment coefficients of correlation were computed between the point equivalents of the teacher-assigned semester marks and the selected measures

combinations: mathematical (X_2) and interest (X_4); auditory (X_3) and interest (X_4).

German

1. Three-predictor equation.--The three-predictor equation, including the verbal (X_1), mathematical (X_2), and auditory (X_3) variables, was shown to be not significantly better than any of the two-predictor equations involving combinations of these same three independent variables.

2. Four-predictor equation.--The four-predictor equation, including all of the independent variables, was shown to be not significantly better than the three-predictor equation described above and not significantly better than any of the two-predictor equations.

Relationships between Teacher-Assigned Semester Marks and the Selected Measures of Aptitude and of Learning Achievement

The teacher-assigned semester marks were converted to their mathematical equivalents, as follows:

A = 4 points
B = 3 points
C = 2 points
D = 1 point
F = 0 points

Pearson product-moment coefficients of correlation were computed between the point equivalents of the teacher-assigned semester marks and the selected measures

of aptitude, as well as between the point equivalents of the teacher-assigned semester marks and the measures of learning achievement in Spanish, French, and German.

Table XIII shows the relationships found between teacher-assigned semester marks and learning achievement in Spanish, French, and German, as measured by the MLA - Cooperative Foreign Language Tests, Form LA; the respective coefficients of correlation were .706, .800, and .336. Two of the correlations, those for Spanish and French, were found to be significant at better than the .01 level. This level means that in only one case out of one hundred would the correlation be expected to be due to chance or to sampling fluctuations. The use of Garrett's terminology as a criterion would indicate that the correlations for Spanish and for French denote a "high to very high" degree of relationship between teacher-assigned semester marks and scores on the measures of learning achievement in Spanish and French. The coefficient of correlation for German, however, was described by Garrett as a "low correlation; present but slight" (1, p. 176). It was not found to be significant at the .05 level, possibly due in part to the smaller size of the population of German students.

Also indicated in Table XIII are the relationships found between teacher-assigned semester marks and the

selected measures of aptitude. The correlations ranged from .209 to .304 for Spanish, from .219 to .363 for French, and from .082 to .484 for German.

Garrett's descriptive labels classify as "low" (1, p. 176) all of the relationships involving either Spanish or French grades correlated with scores on each of the four aptitude measures. However, for both Spanish and French, the correlations between marks and the mathematical (X_2) variable, as well as between marks and the auditory (X_3) variable, are significant at the .01 level. For the same two languages the correlations between marks and the verbal (X_1) variable, as well as between marks and the interest (X_4) variable, are significant at the .05 level.

According to Garrett's classifications, there were "substantial or marked" (1, p. 176) relationships involving German grades correlated with the verbal (X_1) and the auditory (X_3) variables. Accordingly, the corresponding coefficients of correlation were found to be significant at the .05 level. On the other hand, there was a "low" correlation between grades in German and the mathematical (X_2) variable; and the correlation between German grades and the interest (X_4) variable fell in the category described as denoting an "indifferent or negligible relationship" (1, p. 176). Neither was found to be significant at the .05 level.

TABLE XIII

RELATIONSHIPS BETWEEN TEACHER-ASSIGNED SEMESTER MARKS AND THE SELECTED MEASURES OF APTITUDE AND OF LEARNING ACHIEVEMENT

Variables	Coefficients of Correlation		
	With Grades in Spanish (N=105)	With Grades in French (N=80)	With Grades in German (N=24)
Y	.706**	.800**	.336
X_1	.241*	.219*	.438*
X_2	.291**	.325**	.382
X_3	.304**	.363**	.484*
X_4	.209*	.274*	.082

*Significant at the .05 level.

**Significant at the .01 level.

Variables:

Y - Learning achievement test
X_1 - Verbal measure
X_2 - Mathematical measure
X_3 - Auditory measure
X_4 - Interest measure

Relationships between Teacher-Assigned Semester Marks in Spanish and Combinations of Measures of Aptitude

A coefficient of multiple correlation was computed utilizing the two variables which yielded the highest product-moment coefficients of correlation with grades in Spanish. Partial correlation coefficients confirmed the choice of these two variables as the best. The calculation of an F-ratio indicated a .05 level of significance for the inclusion of a third variable. Therefore, another coefficient of multiple correlation was computed to include the two originally selected variables as well as a third one. Another F-ratio indicated that the inclusion of all four variables would not produce a significantly higher coefficient of multiple correlation than was produced by the combination of three selected variables. The intercorrelations used in the computation of the coefficients of multiple correlation are presented in Table XIV.

Combination of Variables Two and Three

The coefficient of multiple correlation between teacher-assigned semester marks in Spanish and a combination of the mathematical (X_2) and auditory (X_3) variables was .358. The proportion of variance of teacher-assigned semester marks in Spanish attributed to the joint action of the two independent variables

was 12.81 per cent. Of this amount, 3.55 per cent of the total variance in teacher-assigned semester marks in Spanish was the independent contribution of the second variable (mathematical), and 9.26 per cent was the independent contribution of the third variable (auditory). The remaining 87.19 per cent of the variance was attributed to other factors not measured by these two tests. The coefficient of multiple correlation was significant at the .01 level.

TABLE XIV

INTERCORRELATIONS BETWEEN TEACHER-ASSIGNED SEMESTER MARKS IN SPANISH AND SELECTED MEASURES OF APTITUDE

(N = 105)

Variables	Coefficients of Correlation			
	X_2	X_3	X_4	Y
Mathematical (X_2)	...	.383**	.003	.291**
Auditory (X_3)			.176	.304**
Interest (X_4)				.209*
Spanish grades (Y)				...

*Significant at the .05 level.

**Significant at the .01 level.

Combination of Variables Two, Three, and Four

The selection of the interest (X_4) variable as the one to be included along with the mathematical (X_2) and auditory (X_3) variables was determined by partial correlation coefficients. Although the first variable (verbal) had a higher Pearson product-moment coefficient of correlation with marks in Spanish, the fourth variable (interest) was found to contribute more significantly to a multiple correlation involving a combination of three variables. The reason is that there was considerably less overlap involved in the contribution of the interest measure than was involved in the contribution of the verbal measure.

The coefficient of multiple correlation between teacher-assigned semester marks in Spanish and a combination of the mathematical (X_2), auditory (X_3), and interest (X_4) variables was .397. The proportion of variance of teacher-assigned semester marks in Spanish attributed to the joint action of the three independent variables was 15.76 per cent. Of this amount, 3.55 per cent of the total variance in teacher-assigned semester marks in Spanish was the independent contribution of the second variable (mathematical), and 9.26 per cent was the independent contribution of the third variable (auditory). The fourth variable (interest) accounted for 2.95 per cent of the total variance. The

remaining 84.24 per cent of the variance was attributed to other factors not measured by these three tests. The coefficient of multiple correlation was significant at the .01 level.

Relationships between Teacher-Assigned Semester Marks in French and Combinations of Measures of Aptitude

A coefficient of multiple correlation was computed utilizing the two variables which yielded the highest product-moment coefficients of correlation with grades in French.

Another coefficient of multiple correlation was computed utilizing the two variables whose partial correlation coefficients indicated the possibility of a higher coefficient of multiple correlation. The calculation of an F-ratio then indicated a .01 level of significance for the inclusion of a third variable. Therefore, another coefficient of multiple correlation was computed to include three selected variables. Another F-ratio indicated that the inclusion of all four variables would not produce a significantly higher coefficient of multiple correlation than was produced by the combination of three selected variables.

The intercorrelations used in the computation of the coefficients of multiple correlation are presented in Table XV.

Combination of Variables Two and Three

The coefficient of multiple correlation between teacher-assigned semester marks in French and a combination of the mathematical (X_2) and auditory (X_3) variables was .418. The proportion of variance of teacher-assigned semester marks in French attributed to the joint action of the two independent variables was 17.5 per cent. The remaining 82.5 per cent of the variance was attributed to other factors not measured by these two tests. The coefficient of multiple correlation was significant at the .01 level.

TABLE XV

INTERCORRELATIONS BETWEEN TEACHER-ASSIGNED SEMESTER MARKS IN FRENCH AND SELECTED MEASURES OF APTITUDE

(N = 80)

Variables	Coefficients of Correlation			
	X_2	X_3	X_4	Y
Mathematical (X_2)	...	.360**	-.038	.325**
Auditory (X_3)			.101	.363**
Interest (X_4)				.274*
French grades (Y)				...

*Significant at the .05 level.

**Significant at the .01 level.

Combination of Variables Three and Four

The coefficient of multiple correlation between teacher-assigned semester marks in French and a combination of the auditory (X_3) and interest (X_4) variables was .434. The proportion of variance of teacher-assigned semester marks in French attributed to the joint action of the two independent variables was 18.8 per cent. Of this amount, 13.1 per cent of the total variance in teacher-assigned semester marks in French was the independent contribution of the third variable (auditory), and 5.7 per cent was the independent contribution of the fourth variable (interest). The remaining 81.2 per cent of the variance was attributed to other factors not measured by these two tests. The coefficient of multiple correlation was significant at the .01 level.

Combination of Variables Two, Three, and Four

The three variables found to contribute most significantly to a multiple correlation were the mathematical (X_2), auditory (X_3), and interest (X_4) variables. Each of these three variables had also produced a higher Pearson product-moment coefficient of correlation with marks in French than was produced by the verbal (X_1) measure of aptitude.

The coefficient of multiple correlation between teacher-assigned semester marks in French and a combination of the mathematical (X_2), auditory (X_3), and interest (X_4) variables was .490. The proportion of variance of teacher-assigned semester marks in French attributed to the joint action of the three independent variables was 24.0 per cent. Of this amount, 5.2 per cent of the total variance in teacher-assigned semester marks in French was the independent contribution of the second variable (mathematical), and 13.1 per cent was the independent contribution of the third variable (auditory). The fourth variable (interest) accounted for 5.7 per cent of the total variance. The remaining 76.0 per cent of the variance was attributed to other factors not measured by these three tests. The coefficient of multiple correlation was significant at the .01 level.

Relationships between Teacher-Assigned Semester Marks in German and Combinations of Measures of Aptitude

A coefficient of multiple correlation was computed utilizing the two variables which yielded the highest product-moment coefficients of correlation with grades in German.

Another coefficient of multiple correlation was computed utilizing the two variables whose partial

correlation coefficients indicated the possibility of a higher coefficient of multiple correlation. The calculation of F-ratios indicated that the inclusion of either or both of the remaining variables would not produce a significantly higher coefficient of multiple correlation than was produced by the combination of two selected variables.

The intercorrelations used in the computation of the coefficients of multiple correlation are presented in Table XVI.

TABLE XVI

INTERCORRELATIONS BETWEEN TEACHER-ASSIGNED SEMESTER MARKS IN GERMAN AND SELECTED MEASURES OF APTITUDE

(N = 24)

Variables	Coefficients of Correlation			
	X_2	X_3	X_4	Y
Verbal (X_1)	...	.335	.440*	.438*
Mathematical (X_2)			.135	.382
Auditory (X_3)				.484*
German grades (Y)				...

*Significant at the .05 level.

Combination of Variables One and Three

The coefficient of multiple correlation between teacher-assigned semester marks in German and a combination of the verbal (X_1) and auditory (X_3) variables was .545. The proportion of variance of teacher-assigned semester marks in German attributed to the joint action of the two independent variables was 29.7 per cent. The remaining 70.3 per cent of the variance was attributed to other factors not measured by these two tests. The coefficient of multiple correlation was significant at the .05 level.

Combination of Variables Two and Three

The coefficient of multiple correlation between teacher-assigned semester marks in German and a combination of the mathematical (X_2) and auditory (X_3) variables was .580. The proportion of variance of teacher-assigned semester marks in German attributed to the joint action of the two independent variables was 33.61 per cent. Of this amount, 10.17 per cent of the total variance in teacher-assigned semester marks in German was the independent contribution of the second variable (mathematical), and 23.44 per cent was the independent contribution of the third variable (auditory). The remaining 66.39 per cent of the variance was attributed to other factors not measured

by these two tests. The coefficient of multiple correlation was significant at the .05 level.

Prediction by Multiple Regression

All of the regression equations which follow are the result of the application of the basic formula described by Walker and Lev (2, p. 324). This procedure serves to maximize the predictive power of the independent variables by the assignment of optimum weights to them.

Detailed data relative to the variables may be found in Appendix B.

Prediction of Semester Marks in Spanish

The mathematical (X_2) and auditory (X_3) variables appeared to be the best combination of two predictors, yielding a multiple correlation coefficient of .358 with semester grades in Spanish.

The following is the equation involving the use of the mathematical (X_2) and auditory (X_3) score weights to predict semester marks in Spanish:

$$\hat{Y} = -.18362 + .00254X_2 + .04341X_3$$

The weights of .00254 and .04341 indicate the amounts by which the scores on variables X_2 and X_3 must be multiplied in order to give the prediction of Y. Thus a prediction of a semester mark in Spanish may be made by

substituting in the regression equation the known values of X_2 and X_3. The standard error of estimate of any semester mark in Spanish predicted from the above formula is ± 1.0598. This means that the chances are about two in three that the forecast of the teacher-assigned semester mark in Spanish will not miss the actual mark in Spanish by more than ± 1.0598. This standard error of estimate is the mathematical equivalent of plus or minus approximately one letter grade.

The mathematical (X_2), auditory (X_3), and interest (X_4) variables appeared to be the best combination of three predictors, yielding a multiple correlation coefficient of .397 with semester grades in Spanish. Furthermore, there was a .05 level of significance found for the inclusion of the interest (X_4) variable.

The following is the equation involving the use of the mathematical (X_2), auditory (X_3), and interest (X_4) score weights to predict semester marks in Spanish:

$$\hat{Y} = -.40748 + .00271X_2 + .03655X_3 + .08673X_4$$

The weights of .00271, .03655, and .08673 indicate the amounts by which the scores on variables X_2, X_3, and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a semester mark in Spanish may be made by substituting in the regression equation the known values of X_2, X_3, and X_4. The standard error of

estimate of any semester mark in Spanish predicted from the above formula is $\pm$1.0469. This means that the chances are about two in three that the forecast of the teacher-assigned semester mark in Spanish will not miss the actual mark in Spanish by more than $\pm$1.0469. This standard error of estimate is the mathematical equivalent of plus or minus approximately one letter grade.

Prediction of Semester Marks in French

The two variables which yielded the highest Pearson product-moment coefficients of correlation with grades in French were the mathematical (X_2) and auditory (X_3) variables, with coefficients of .325 and .363, respectively. A combination of these two variables yielded a multiple correlation coefficient of .418 with semester grades in French. However, the auditory (X_3) and interest (X_4) variables appeared to be the best combination of two predictors, yielding a multiple correlation coefficient of .434 with semester grades in French.

The following is the equation involving the use of the auditory (X_3) and interest (X_4) score weights to predict semester marks in French:

$$\hat{Y} = -1.08923 + .06955X_3 + .13133X_4$$

The weights of .06955 and .13133 indicate the amounts by which the scores on variables X_3 and X_4 must be multiplied in order to give the prediction of Y. Thus

a prediction of a semester mark in French may be made by substituting in the regression equation the known values of X_3 and X_4. The standard error of estimate of any semester mark in French predicted from the above formula is ± 1.1457. This means that the chances are about two in three that the forecast of the teacher-assigned semester mark in French will not miss the actual mark in French by more than ± 1.1457. This standard error of estimate is the mathematical equivalent of plus or minus approximately one letter grade.

The mathematical (X_2), auditory (X_3), and interest (X_4) variables appeared to be the best combination of three predictors, yielding a multiple correlation coefficient of .490 with semester grades in French. Furthermore, there was a .01 level of significance found for the inclusion of the mathematical (X_2) variable.

The following is the equation involving the use of the mathematical (X_2), auditory (X_3), and interest (X_4) score weights to predict semester marks in French:

$$\hat{Y} = -1.82188 + .00309X_2 + .05099X_3 + .14141X_4$$

The weights of .00309, .05099, and $.14141X_4$ indicate the amounts by which the scores on variables X_2, X_3, and X_4 must be multiplied in order to give the prediction of Y. Thus a prediction of a semester mark in French may be made by substituting in the regression equation the

known values of X_2, X_3, and X_4. The standard error of estimate of any semester mark in French predicted from the above formula is ± 1.1155. This means that the chances are about two in three that the forecast of the teacher-assigned semester mark in French will not miss the actual mark in French by more than ± 1.1155. This standard error of estimate is the mathematical equivalent of plus or minus approximately one letter grade.

Prediction of Semester Marks in German

The two variables which yielded the highest Pearson product-moment coefficients of correlation with grades in German were the verbal (X_1) and auditory (X_3) variables, with coefficients of .438 and .484, respectively. A combination of these two variables yielded a multiple correlation coefficient of .545 with semester grades in German. However, the mathematical (X_2) and auditory (X_3) variables appeared to be the best combination of two predictors, yielding a multiple correlation coefficient of .580 with semester grades in German.

The following is the equation involving the use of the mathematical (X_2) and auditory (X_3) score weights to predict semester marks in German:

$$\hat{Y} = -2.20558 + .00295X_2 + .07560X_3$$

The weights of .00295 and .07560 indicate the amounts by which the scores on variables X_2 and X_3 must

be multiplied in order to give the prediction of Y. Thus a prediction of a semester mark in German may be made by substituting in the regression equation the known values of X_2 and X_3. The standard error of estimate of any semester mark in German predicted from the above formula is $\pm$.7742. This means that the chances are about two in three that the forecast of the teacher-assigned semester mark in German will not miss the actual mark in German by more than $\pm$.7742. This standard error of estimate is the mathematical equivalent of plus or minus slightly less than one letter grade.

The calculation of F-ratios indicated that the inclusion of either or both of the remaining variables would not produce a significantly higher coefficient of multiple correlation than was produced by the combination of the mathematical (X_2) and auditory (X_3) variables.

Additional Combinations of Aptitude Measures Correlated with Semester Marks

With regard to the multiple prediction of teacher-assigned semester marks, it seemed to be of possible interest to make various other computations which were not specifically required to test the hypotheses formulated for the study. The result was that additional multiple-predictor combinations were found to be of significance.

1. Spanish.--In addition to the best combination of two variables (X_2 and X_3) and the best combination of three variables (X_2, X_3, and X_4), the following combinations were found to be significant at the .01 level:

a. Verbal (X_1) and mathematical (X_2), with a multiple correlation coefficient of .307 with semester marks in Spanish.

b. Verbal (X_1) and auditory (X_3), with a multiple correlation coefficient of .337 with semester marks in Spanish.

c. Verbal (X_1) and interest (X_4), with a multiple correlation coefficient of .310 with semester marks in Spanish.

d. Mathematical (X_2) and interest (X_4), with a multiple correlation coefficient of .357 with semester marks in Spanish.

e. Auditory (X_3) and interest (X_4), with a multiple correlation coefficient of .343 with semester marks in Spanish.

f. Verbal (X_1), mathematical (X_2), auditory (X_3), and interest (X_4), with a multiple correlation coefficient of .401 with semester marks in Spanish.

2. French.--In addition to the best combination of two variables (X_3 and X_4) and the best combination

of three variables (X_2, X_3, and X_4), one other combination of variables (X_2 and X_3) has already been reported. In addition to these, the following combinations were found to be significant at the .01 level:

a. Verbal (X_1) and mathematical (X_2), with a multiple correlation coefficient of .331 with semester marks in French.

b. Verbal (X_1) and auditory (X_3), with a multiple correlation coefficient of .377 with semester marks in French.

c. Verbal (X_1) and interest (X_4), with a multiple correlation coefficient of .342 with semester marks in French.

d. Mathematical (X_2) and interest (X_4), with a multiple correlation coefficient of .433 with semester marks in French.

3. German.--In addition to the best combination of two variables (X_2 and X_3), one other combination of variables (X_1 and X_3) has already been reported. In addition to these, the following combinations were found to be significant at the .05 level:

a. Verbal (X_1) and mathematical (X_2), with a multiple correlation coefficient of .504 with semester grades in German.

b. Auditory (X_3) and interest (X_4), with a multiple correlation coefficient of .493 with semester grades in German.

c. Verbal (X_1), mathematical (X_2), and auditory (X_3), with a multiple correlation coefficient of .601 with semester grades in German.

d. Verbal (X_1), mathematical (X_2), auditory (X_3), and interest (X_4), with a multiple correlation coefficient of .615 with semester grades in German.

Summary

This chapter is summarized with reference to the hypotheses presented in Chapter I.

Hypothesis One

1. Spanish.--The relationships described below are those which were found between learning achievement in Spanish, as measured by the MLA - Cooperative Foreign Language Test, Form 1A, and each of the designated measures of aptitude.

a. There was a correlation of .280 with verbal ability as determined by the Scholastic Aptitude Test. As categorized by Garrett, this would indicate a "low" relationship between the measures, although the correlation coefficient was found to be significant at the .01 level. The standard error of

estimate for any Spanish score predicted from a verbal score was ±31.576.

b. There was a correlation of .172 with mathematical ability as determined by the Scholastic Aptitude Test. According to Garrett, this would indicate an "indifferent or negligible" relationship between the measures. The correlation coefficient was not large enough to be of significance at the .05 level. The standard error of estimate for any any Spanish score predicted from a mathematical score was ±32.401.

c. There was a correlation of .230 with auditory ability as determined by the appropriate parts of the Pimsleur Language Aptitude Battery. According to Garrett, this would indicate a "low" or "slight" relationship between the measures, although the correlation coefficient was found to be significant at the .05 level. The standard error of estimate for any Spanish score predicted from an auditory score was ±32.011.

d. There was a correlation of .373 with interest as determined by the appropriate part of the Pimsleur Language Aptitude Battery. As categorized by Garrett, this would indicate a "low" relationship between the measures, although the

correlation coefficient was found to be significant at the .01 level. The standard error of estimate for any Spanish score predicted from an interest score was ±30.514.

2. French.---The relationships described below are those which were found between learning achievement in French, as measured by the MLA - Cooperative Foreign Language Test, Form LA, and each of the designated measures of aptitude.

a. There was a correlation of .207 with verbal ability as determined by the Scholastic Aptitude Test. As categorized by Garrett, this would indicate a "low" relationship between the measures. The correlation coefficient was not large enough to be of significance at the .05 level. The standard error of estimate for any French score predicted from a verbal score was ±37.836.

b. There was a correlation of .299 with mathematical ability as determined by the Scholastic Aptitude Test. According to Garrett, this would indicate a "low" or "slight" relationship between the measures, although the correlation coefficient was found to be significant at the .01 level. The standard error of estimate for any French score predicted from a mathematical score was ±36.898.

c. There was a correlation of .322 with auditory ability as determined by the appropriate parts of the Pimsleur Language Aptitude Battery. According to Garrett, this would indicate a "low" relationship between the measures, although the correlation coefficient was found to be of significance at the .01 level. The standard error of estimate for any French score predicted from an auditory score was $\pm$36.612.

d. There was a correlation of .269 with interest as determined by the appropriate part of the Pimsleur Language Aptitude Battery. As categorized by Garrett, this would indicate a "low" relationship between the measures, although the correlation coefficient was found to be significant at the .05 level. The standard error of estimate for any French score predicted from an interest score was $\pm$37.248.

3. German.--The relationships described below are those which were found between learning achievement in German, as measured by the MLA - Cooperative Foreign Language Test, Form LA, and each of the designated measures of aptitude.

a. There was a correlation of .179 with verbal ability as determined by the Scholastic Aptitude Test.

As categorized by Garrett, this would indicate an "indifferent or negligible" relationship between the measures. The coefficient of correlation was not large enough to be significant at the .05 level. The standard error of estimate for any German score predicted from a verbal score was ±21.073.

b. There was a correlation of -.224 with mathematical ability as determined by the Scholastic Aptitude Test. According to Garrett, this would indicate a "low" relationship between the measures. The coefficient of correlation was not large enough to be significant at the .05 level. The standard error of estimate for any German score predicted from a mathematical score was ±20.876.

c. There was a correlation of .157 with auditory ability as determined by the appropriate parts of the Pimsleur Language Aptitude Battery. According to Garrett, this would indicate an "indifferent or negligible" relationship between the measures. The coefficient of correlation was not large enough to be significant at the .05 level. The standard error of estimate for any German score predicted from an auditory score was ±21.156.

d. There was a correlation of -.038 with interest as determined by the appropriate part of the Pimsleur Language Aptitude Battery. As

categorized by Garrett, this would indicate an "indifferent or negligible" relationship between the measures. The coefficient of correlation was not large enough to be significant at the .05 level. The standard error of estimate for any German score predicted from an interest score was ±21.404.

Hypothesis Two

1. Spanish.--The relationships described below are those which were found between learning achievement in Spanish, as measured by the MLA - Cooperative Foreign Language Test, Form LA, and each of the designated combinations of aptitude measures.

a. The coefficient of multiple correlation with verbal and mathematical abilities was .281. The proportion of total variance explained by these two variables was 7.88 per cent.

b. The coefficient of multiple correlation with verbal and auditory abilities was .313. The proportion of total variance explained by these two variables was 9.8 per cent.

c. The coefficient of multiple correlation with verbal ability and student interest was .453. The proportion of total variance explained by these two variables was 20.5 per cent.

d. The coefficient of multiple correlation with mathematical and auditory abilities was .247.

The proportion of total variance explained by these two variables was 6.1 per cent.

e. The coefficient of multiple correlation with mathematical ability and student interest was .410. The proportion of total variance explained by these two variables was 16.8 per cent.

f. The coefficient of multiple correlation with auditory ability and student interest was .409. The proportion of total variance explained by these two variables was 16.7 per cent.

g. The coefficient of multiple correlation with verbal, mathematical, and auditory abilities was .314. The proportion of total variance explained by these three variables was 9.84 per cent.

h. The coefficient of multiple correlation with the verbal, mathematical, auditory, and interest variables was .461. The proportion of total variance explained by these variables was 21.24 per cent.

There was found to be a .01 level of significance for all except one of the multiple correlation coefficients involving combinations of aptitude measures correlated with Spanish achievement. A .05 level of significance was found for the coefficient of .247 involving mathematical and auditory abilities correlated with Spanish achievement.

2. French.---The relationships described below are those which were found between learning achievement in French, as measured by the MLA -- Cooperative Foreign Language Test, Form LA, and each of the designated combinations of aptitude measures.

a. The coefficient of multiple correlation with verbal and mathematical abilities was .305. The proportion of total variance explained by these two variables was 9.32 per cent.

b. The coefficient of multiple correlation with verbal and auditory abilities was .339. The proportion of total variance explained by these two variables was 11.47 per cent.

c. The coefficient of multiple correlation with verbal ability and student interest was .331. The proportion of total variance explained by these two variables was 10.9 per cent.

d. The coefficient of multiple correlation with mathematical and auditory abilities was .377. The proportion of total variance explained by these two variables was 14.2 per cent.

e. The coefficient of multiple correlation with mathematical ability and student interest was .410. The proportion of total variance explained by these two variables was 16.8 per cent.

f. The coefficient of multiple correlation with auditory ability and student interest was .400. The proportion of total variance explained by these two variables was 16.0 per cent.

g. The coefficient of multiple correlation with verbal, mathematical, and auditory abilities was .378. The proportion of total variance explained by these three variables was 14.26 per cent.

h. The coefficient of multiple correlation with the verbal, mathematical, auditory, and interest variables was .455. The proportion of total variance explained by these variables was 20.67 per cent.

There was found to be a .01 level of significance for all except one of the multiple correlation coefficients involving combinations of aptitude measures correlated with French achievement. A .05 level of significance was found for the coefficient of .305 involving verbal and mathematical abilities correlated with French achievement.

3. German.---The relationships described below are those which were found between learning achievement in German, as measured by the MLA - Cooperative Foreign Language Test, Form LA, and each of the designated combinations of aptitude measures.

a. The coefficient of multiple correlation with verbal and mathematical abilities was .350. The proportion of total variance explained by these two variables was 12.3 per cent.

b. The coefficient of multiple correlation with verbal and auditory abilities was .199. The proportion of total variance explained by these two variables was 3.96 per cent.

c. The coefficient of multiple correlation with verbal ability and student interest was .188. The proportion of total variance explained by these two variables was 3.5 per cent.

d. The coefficient of multiple correlation with mathematical and auditory abilities was .293. The proportion of total variance explained by these two variables was 8.6 per cent.

e. The coefficient of multiple correlation with mathematical ability and student interest was .239. The proportion of total variance explained by these two variables was 5.7 per cent.

f. The coefficient of multiple correlation with auditory ability and student interest was .160. The proportion of total variance explained by these two variables was 2.6 per cent.

g. The coefficient of multiple correlation with verbal, mathematical, and auditory abilities

was .360. The proportion of total variance explained by these three variables was 12.96 per cent.

h. The coefficient of multiple correlation with the verbal, mathematical, auditory, and interest variables was .382. The proportion of total variance explained by these variables was 14.58 per cent.

The findings were nonsignificant in regard to the combinations of aptitude measures correlated with German achievement.

Hypothesis Three

1. Spanish.--The relationships described below are those which were found between teacher-assigned semester marks in Spanish and each of the designated measures of aptitude or achievement.

a. There was a correlation of .706 between Spanish grades and the measure of Spanish achievement. According to Garrett, a coefficient of this size would indicate a "high" relationship between the two variables. The correlation coefficient was found to be significant at the .01 level.

b. There was a correlation of .241 between Spanish grades and verbal ability. According to Garrett, a coefficient of this size would indicate a "low" or "slight" relationship. The correlation

coefficient was found to be significant at the .05 level, however.

c. There was a correlation of .291 between Spanish grades and mathematical ability. According to Garrett, this would indicate a "low" relationship, although the coefficient of correlation was found to be significant at the .01 level.

d. There was a correlation of .304 between Spanish grades and auditory ability. According to Garrett, this would indicate a "low" relationship. However, the coefficient of correlation was found to be significant at the .01 level.

e. There was a correlation of .209 between Spanish grades and student interest. Garrett labels a coefficient of this size as an indication of a "low" relationship. However, the correlation coefficient was found to be significant at the .05 level.

2. French.---The relationships described below are those which were found between teacher-assigned semester marks in French and each of the designated measures of aptitude or achievement.

a. There was a correlation of .800 between French grades and the measure of French achievement. According to Garrett, a coefficient of this size would indicate a "high" relationship between the two variables. The correlation coefficient was

accordingly found to be of significance at the .01 level.

b. There was a correlation of .219 between French grades and verbal ability. According to Garrett, a coefficient of this size would indicate a "low" or "slight" relationship. The correlation coefficient was significant at the .05 level.

c. There was a correlation of .325 between French grades and mathematical ability. According to Garrett, this would indicate a "low" relationship, although the coefficient of correlation was found to be significant at the .01 level.

d. There was a correlation of .363 between French grades and auditory ability. According to Garrett, this would indicate a "low" relationship. However, the coefficient of correlation was found to be significant at the .01 level.

e. There was a correlation of .274 between French grades and student interest. Garrett labels a coefficient of this size as an indication of a "low" relationship. However, the correlation was found to be significant at the .05 level.

3. <u>German</u>.--The relationships described below are those which were found between teacher-assigned semester

grades in German and each of the designated measures of aptitude or achievement.

a. There was a correlation of .336 between German grades and the measure of German achievement. According to Garrett, a coefficient of this size would indicate a "low" relationship between the two variables. The correlation coefficient was found to be nonsignificant at the .05 level.

b. There was a correlation of .438 between German grades and verbal ability. According to Garrett, a coefficient of this size would indicate a "substantial or marked" relationship. The correlation coefficient was found to be significant at the .05 level.

c. There was a correlation of .382 between German grades and mathematical ability. According to Garrett, this would indicate a "low" relationship. The correlation coefficient was found to be of no significance at the .05 level.

d. There was a correlation of .484 between German grades and auditory ability. According to Garrett, this would indicate a "substantial or marked" relationship. The correlation coefficient was found to be significant at the .05 level.

e. There was a correlation of .082 between German grades and student interest. Garrett labels a coefficient of this size as an indication of an "indifferent or negligible" relationship. The correlation coefficient was found to be nonsignificant at the .05 level.

Hypothesis Four

The relationships described below are those which were found between teacher-assigned semester marks in each modern foreign language and combinations of the best predictors of such evaluations of learning achievement in the language.

1. Spanish.--According to product-moment as well as partial correlation coefficients, the best predictors of Spanish marks were the mathematical (X_2) and auditory (X_3) variables. The coefficient of multiple correlation between Spanish grades and a combination of the independent variables, mathematical (X_2) and auditory (X_3), was .358. The proportion of total variance explained by these two independent variables was 12.81 per cent. The addition of the interest (X_4) variable to the combination of predictors resulted in a multiple correlation coefficient of .397. The proportion of total variance explained by the three independent variables, mathematical (X_2), auditory (X_3), and interest (X_4), was 15.76 per cent.

Both of the multiple correlation coefficients were significant at the .01 level. In addition, the three-predictor combination was found to be significantly better, at the .05 level, than the two-predictor combination.

2. French.---According to product-moment coefficients of correlation, the best predictors of grades in French were the mathematical (X_2) and auditory (X_3) variables. The coefficient of multiple correlation between French grades and a combination of the independent variables, mathematical (X_2) and auditory (X_3), was .418. The proportion of total variance explained by these two variables was 17.5 per cent. However, the best predictors as revealed by partial correlation coefficients were the auditory (X_3) and interest (X_4) variables. The coefficient of multiple correlation between French grades and a combination of the independent variables, auditory (X_3) and interest (X_4), was .434. The proportion of total variance explained by these two variables was 18.8 per cent. The addition of the mathematical (X_2) variable to the latter combination of predictors resulted in a multiple correlation coefficient of .490. The proportion of total variance explained by the three independent variables, mathematical (X_2), auditory (X_3), and interest (X_4), was 24.0 per cent. All three of the

multiple correlation coefficients were significant at the .01 level. In addition, the three-predictor combination was found to be significantly better, at the .01 level, than the two-predictor combination of the auditory (X_3) and interest (X_4) variables.

3. German.--According to product-moment coefficients of correlation, the best predictors of learning achievement as revealed by grades were the verbal (X_1) and auditory (X_3) variables. The coefficient of multiple correlation between German grades and a combination of the independent variables, verbal (X_1) and auditory (X_3), was .545. The proportion of total variance explained by these two independent variables was 29.7 per cent. According to partial correlation coefficients, the two best predictors were the mathematical (X_2) and auditory (X_3) variables. The coefficient of multiple correlation between German grades and a combination of the independent variables, mathematical (X_2) and auditory (X_3), was .580. The proportion of total variance explained by these two independent variables was 33.61 per cent. Both of the coefficients of multiple correlation were found to be significant at the .05 level.

Additional Findings

For each language, several additional multiple correlation coefficients were computed in order that

a report might be made of the relationships between teacher-assigned semester marks and various other possible combinations of the selected aptitude measures. A listing was made of those found to be significant at the .01 and .05 levels.

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CHAPTER V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

In attempts to predict language achievement, investigators have considered a number of factors, including intelligence, verbal and mathematical abilities, grades in other subjects, auditory ability, rote memorization ability, interests, and motivation. A review of the literature related to language achievement prediction revealed that there has clearly been a developmental trend in the factors considered important for investigation. Intelligence and verbal ability are the areas which have been most thoroughly investigated. More recently, auditory ability has been looked upon as one of the most promising factors for prognosis of success in second-language learning, especially in view of the evidence that much of the variance in foreign language achievement remains to be explained.

This study was an attempt to determine the value of the use of selected aptitude test scores for predicting a student's learning achievement in Spanish, French, or German at North Texas State University. In order that an investigation might be made of the

relationships between measures of learning achievement in these languages and the selected measures of aptitude, standardized achievement tests were administered to all class sections of Spanish 101, French 101, and German 101 at North Texas State University. Although teacher-assigned semester marks were used as one way of evaluating achievement, the primary criterion measures of learning achievement in the three languages were the MLA - Cooperative Foreign Language Tests, Form LA. These tests were administered in December, 1970, after students had received one semester of instruction. These same students had earlier been tested and scored on the auditory and interest parts of the Pimsleur Language Aptitude Battery. In addition, there were available the students' verbal and mathematical scores on the Scholastic Aptitude Test. Data were complete for 105 first-semester freshmen in Spanish, 80 first-semester freshmen in French, and 24 first-semester freshmen in German.

Separate data for each language were treated statistically to derive the following:

1. Product-moment coefficients of correlation between the selected measures of aptitude and the measure of learning achievement.

2. Coefficients of multiple correlation between the measure of learning achievement and combinations of the selected measures of aptitude.

3. The proportion of variance of a measure of learning achievement attributable to the joint action of the selected measures of aptitude, including the proportion of variance explained by each.

4. Partial coefficients of correlation used in the construction of regression equations for the prediction of scores on a measure of learning achievement.

5. Product-moment coefficients of correlation between teacher-assigned semester marks and the measure of learning achievement.

6. Product-moment coefficients of correlation between teacher-assigned semester marks and the selected measures of aptitude.

7. Coefficients of multiple correlation between teacher-assigned semester marks and combinations of selected measures of aptitude.

8. The proportion of variance of teacher-assigned semester marks attributable to the joint action of selected measures of aptitude, including the proportion of variance explained by each.

9. Partial coefficients of correlation used in the construction of regression equations for the prediction of teacher-assigned semester marks.

Summary of Significant Findings

The following are the most significant findings of this study:

1. The Pearson product-moment coefficient of correlation was .706 between teacher-assigned semester marks and learning achievement in Spanish, as measured by the MLA - Cooperative Foreign Language Test, Form LA. This correlation coefficient is significant at better than the .01 level and would indicate a high relationship between the variables.

2. The Pearson product-moment coefficient of correlation was .800 between teacher-assigned semester marks and learning achievement in French, as measured by the MLA - Cooperative Foreign Language Test, Form LA. This correlation coefficient is significant at better than the .01 level and would indicate a high relationship between the variables.

3. The Pearson product-moment coefficient of correlation between the criterion measure of learning achievement in Spanish and the measure of verbal ability was .280, and the Pearson product-moment coefficient of correlation was .373 between the criterion measure of learning achievement in Spanish and the measure of student interest. Both of these correlation coefficients were significant at better than the .01 level.

The product-moment correlation coefficient of .230 between the criterion measure of learning achievement in Spanish and the measure of auditory ability was significant at better than the .05 level.

4. The Pearson product-moment coefficient of correlation between the criterion measure of learning achievement in French and the measure of auditory ability was .322, and the Pearson product-moment coefficient of correlation was .299 between the criterion measure of learning achievement in French and the measure of mathematical ability. Both of these correlation coefficients were significant at better than the .01 level. The product-moment correlation coefficient of .269 between the criterion measure of learning achievement in French and the measure of student interest was found to be significant at better than the .05 level.

5. The Pearson product-moment coefficients of correlation between teacher-assigned semester marks in Spanish and each of the measures of mathematical and auditory abilities were .291 and .304 respectively. Each was significant at better than the .01 level. The product-moment coefficients of correlation between Spanish grades and each of the measures of verbal ability and student interest were .241 and .209 respectively. Each was significant at better than the .05 level.

6. The Pearson product-moment coefficients of correlation between teacher-assigned semester marks in French and each of the measures of mathematical and auditory abilities were .325 and .363 respectively. Each was significant at better than the .01 level. The product-moment coefficients of correlation between French grades and each of the measures of verbal ability and student interest were .219 and .274 respectively. Both were significant at the .05 level.

7. The Pearson product-moment coefficients of correlation between teacher-assigned semester marks in German and each of the measures of verbal and auditory abilities were .438 and .484 respectively. Each was significant at better than the .05 level.

8. The coefficient of multiple correlation was .453 between the criterion measure of learning achievement in Spanish and the combined measures of verbal ability and student interest. The proportion of the variance of a measure of learning achievement in Spanish attributed to the joint action of the measures of verbal ability and student interest was 20.5 per cent. The coefficient of multiple correlation was .461 between the criterion measure of learning achievement in Spanish and the combined measures of all of the independent variables: verbal, mathematical, auditory, and interest. The

proportion of the variance of a measure of learning achievement in Spanish attributed to the joint action of these four variables was 21.24 per cent. Both of these coefficients of multiple correlation were found to be significant at better than the .01 level.

9. The coefficient of multiple correlation between the criterion measure of learning achievement in French and the independent variables, mathematical and interest, was .410. The proportion of the variance of the criterion measure of learning achievement in French explained by these two independent variables was 16.8 per cent. The coefficient of multiple correlation was .455 between the criterion measure of learning achievement in French and the three independent variables: mathematical, auditory, and interest. The proportion of the variance of the criterion measure of learning achievement in French attributed to the joint action of these three independent variables was 20.67 per cent. Both of these coefficients of multiple correlation were found to be significant at better than the .01 level. The use of all four independent variables yielded the same coefficient of multiple correlation as was found for the combination of the three variables: mathematical, auditory, and interest.

10. The coefficient of multiple correlation between teacher-assigned semester marks in Spanish and a combination of the mathematical and auditory measures was .358. The proportion of the variance in Spanish grades explained by these two variables was 12.81 per cent. The addition of the interest variable to this combination of predictors resulted in a multiple correlation coefficient of .397 and raised the proportion of total variance explained by known factors to 15.76 per cent. Both of these coefficients of multiple correlation were found to be significant at better than the .01 level. The inclusion of all four independent variables in the correlation with Spanish grades resulted in a higher multiple correlation coefficient of .401, also found to be significant at better than the .01 level, although not significantly higher than the coefficient of .397 produced by the three-variable combination.

11. The coefficient of multiple correlation between teacher-assigned semester marks in French and a combination of the auditory and interest measures was .434. The proportion of the variance in French grades explained by these two variables was 18.8 per cent. The addition of the mathematical variable to this combination of predictors resulted in a multiple correlation

coefficient of .490 and raised the proportion of total variance explained by known factors to 24.0 per cent. Both of these multiple correlation coefficients were found to be significant at better than the .01 level.

12. The coefficient of multiple correlation between teacher-assigned semester marks in German and a combination of the mathematical and auditory measures was .580. The proportion of the variance in German grades explained by these two measures was 33.61 per cent, and the multiple correlation coefficient was found to be significant at better than the .05 level. Also found to be significant at this level were two higher multiple correlation coefficients: .601 between German grades and a combination of the verbal, mathematical, and auditory variables; and .615 between German grades and all four independent variables. Neither was significantly higher, however, than the coefficient of .580 produced by the two-variable combination of mathematical and auditory measures correlated with German grades.

Prediction of Achievement as Measured by a Standardized Test

Spanish Achievement Predictions

Of the combinations with two predictor variables, the combination of the verbal and interest measures

produced the most accurate prediction of Spanish learning achievement as measured by a standardized test. The multiple regression equation giving the score weights to be attached to these two independent variables, verbal (X_1) and interest (X_4), was:

$$\hat{Y} = 30.78 + .09X_1 + 5.16X_4$$

The standard error of estimate was ± 29.46. When the four independent variables, verbal (X_1), mathematical (X_2), auditory (X_3), and interest (X_4), were combined to predict Spanish learning achievement as measured by a standardized test, the multiple regression equation was:

$$\hat{Y} = 13.88 + .07X_1 + .01X_2 + .48X_3 + 4.97X_4$$

The standard error of estimate was ± 29.62.

French Achievement Predictions

Of the combinations with two predictor variables, the combination of the mathematical and interest measures produced the most accurate prediction of French learning achievement as measured by a standardized test. The multiple regression equation giving the score weights to be attached to these two independent variables, mathematical (X_2) and interest (X_4), was:

$$\hat{Y} = 10.48 + .12X_2 + 4.71X_4$$

The standard error of estimate was ± 35.50. When the four independent variables, verbal (X_1), mathematical (X_2), auditory (X_3), and interest (X_4), were combined to predict

French learning achievement as measured by a standardized test, the multiple regression equation was:

$$\hat{Y} = -31.71 + .00X_1 + .09X_2 + 1.33X_3 + 4.30X_4$$

The standard error of estimate was ± 35.12. It should be noted that in the four-predictor combination only three of the variables actually made a contribution, as the verbal (X_1) measure was discounted in the regression equation.

German Achievement Predictions

None of the regression equations can be recommended, since all findings were nonsignificant with regard to coefficients of multiple correlation between aptitude-measure combinations and German learning achievement as measured by a standardized test.

Prediction of Teacher-Assigned Semester Marks

Spanish Grades

The mathematical (X_2) and auditory (X_3) variables appeared to be the best combination of two predictors. The multiple regression equation giving the score weights to be attached to these two independent variables was:

$$\hat{Y} = -.18362 + .00254X_2 + .04341X_3$$

The standard error of estimate was ± 1.0598.

The mathematical (X_2), auditory (X_3), and interest (X_4) variables appeared to be the best combination of three predictors. The multiple regression equation giving the score weights to be attached to these three independent variables was:

$$\hat{Y} = -.40748 + .00271X_2 + .03655X_3 + .08673X_4$$

The standard error of estimate was ± 1.0469.

French Grades

The auditory (X_3) and interest (X_4) variables appeared to be the best combination of two predictors. The multiple regression equation giving the score weights to be attached to these two independent variables was:

$$\hat{Y} = -1.08923 + .06955X_3 + .13133X_4$$

The standard error of estimate was ± 1.1457.

The mathematical (X_2), auditory (X_3), and interest (X_4) variables appeared to be the best combination of three predictors. The multiple regression equation giving the score weights to be attached to these three independent variables was:

$$\hat{Y} = -1.82188 + .00309X_2 + .05099X_3 + .14141X_4$$

The standard error of estimate was ± 1.1155.

German Grades

The mathematical (X_2) and auditory (X_3) variables appeared to be the best combination of two predictors.

The multiple regression equation giving the score weights to be attached to these two independent variables was:

$$\hat{Y} = -2.20558 + .00295X_2 + .07560X_3$$

The standard error of estimate was $\pm .7742$.

The verbal (X_1), mathematical (X_3), and auditory (X_3) variables appeared to be the best combination of three predictors. The multiple regression equation involving these three predictors has been omitted because it is not significantly better than the two-predictor regression equation.

Conclusions

The findings revealed by the statistical analysis of the data would appear to warrant these conclusions:

1. No product-moment correlation coefficient of sufficient magnitude and significance was found to justify the use of any one measure of aptitude as a single predictor of modern foreign language learning achievement as measured by a standardized test or as indicated by teacher-assigned semester marks.

2. The verbal part of the Scholastic Aptitude Test and the interest part of the Pimsleur Language Aptitude Battery appeared to be the best combination of two predictors when the MLA -- Cooperative Foreign Language Test, Form LA, Spanish, was used as a criterion.

3. The mathematical part of the Scholastic Aptitude Test and the interest part of the Pimsleur Language Aptitude Battery appeared to be the best combination of two predictors when the MLA -- Cooperative Foreign Language Test, Form LA, French, was used as a criterion.

4. The verbal and mathematical parts of the Scholastic Aptitude Test appeared to be the best combination of two predictors when the MLA - Cooperative Foreign Language Test, Form LA, German, was used as a criterion. However, the multiple correlation coefficient yielded by the joint action of these two variables was nonsignificant at the .05 level. For this reason, it is clear that no predictions of German achievement test scores can be made or should be attempted on the basis of the findings of this study.

5. The mathematical part of the Scholastic Aptitude Test and the auditory part of the Pimsleur Language Aptitude Battery appeared to be the best combination of two predictors when teacher-assigned semester marks in Spanish were used as the criteria of achievement. Consideration of the interest part of the Pimsleur Language Aptitude Battery seemed to be advantageous as well. There would thus be a total of three predictors.

6. The auditory and interest parts of the Pimsleur Language Aptitude Battery appeared to be the best

combination of two predictors when teacher-assigned semester marks of French were used as the criteria of achievement. Consideration of the Scholastic Aptitude Test mathematical scores seemed to be advantageous as well. There would thus be a total of three predictors.

7. The mathematical part of the Scholastic Aptitude Test and the auditory part of the Pimsleur Language Aptitude Battery appeared to be the best combination of two predictors when teacher-assigned semester grades in German were used as the criteria of achievement.

8. It would be expedient in each attempt at actual prediction to use the best combination of two or three predictors, for there is little advantage to be gained from the use of all four predictor variables.

9. Any additional pertinent information available should be considered in attempts to predict learning achievement in Spanish, French, or German. Due to the percentage of unexplained variance in such achievement, the subjective consideration of various personal, emotional, and social factors cannot be omitted.

10. This study has identified the best combinations of selected aptitude measures for the prediction of modern foreign language learning achievement as measured by standardized tests and as indicated by teacher-assigned semester marks. The information provided by the study may be used to supplement the consideration of other

pertinent information about individual students. In order to assure the proper weighting of the scores, the process of establishing predictive indices of learning achievement as measured by semester marks is presented in Appendix C.

Recommendations for Further Study

Definitive answers to the following questions would possibly provide information relevant to the unexplained variance in the learning of Spanish, French, and German:

1. What personal, social, and emotional factors are associated with success in modern foreign language study? What personal, social, and emotional factors are associated with failure? Other than interest or the lack of it, what qualities can be identified as crucial to success or failure in Spanish, French, or German? Would quantitative measures of such qualities be possible? If so, would such measurements provide information relevant to the unexplained variance in the learning of modern foreign languages?

2. What would be the quantitative effect of absences and withdrawals in reducing the predictive power of aptitude measures by narrowing the range of variability in aptitude and on the criterion measure? To what degree, if any, are students' course withdrawals closely associated with or directly related to low scores on one or more of the aptitude measures? Is there a relationship between

aptitude test scores and the regularity of class attendance?

3. What additional information might be supplied by a replication of this study or by a longitudinal study involving prediction of language learning at North Texas State University? To what degree of accuracy can actual predictions be based on the findings of this study? What information could teachers and students supply to account for any inaccuracies?

4. In predicting language achievement, what would be the quantitative effect of a consideration given to students' percentile ranks in their high school graduating classes?

5. If aptitude measures were used for diagnostic purposes, what possibilities would there be for specific training to improve language aptitude, particularly auditory ability? What other factors in language aptitude might be found through experiences with such attempts at training?

Educational Implications

The major purpose of this investigation was to ascertain the predictive value of certain selected measures of aptitude in estimating the degree of achievement a first-semester freshman might be expected to attain by the end of one semester of instruction in

Spanish 101, French 101, or German 101 at North Texas State University. Therefore, certain educational implications should be recognized by foreign language educators and advisors. Within the limits imposed by the setting and the tests used, the following implications seem to be pertinent:

1. A relationship appears to exist between students' mathematical aptitude and the marks they earn in beginning modern foreign language courses. Perhaps many foreign language educators are unaware of the plausibility of such a relationship. Among the abilities common to both mathematical success and language aptitude, one might point out such qualities as sensitivity to relationships, inductive learning ability, memorization ability, a kind of coding ability for the assimilation and use of information, and instantaneous, accurate recall.

2. Predictions of learning achievement can be more accurately made through the use of a combination of measures of aptitude than through the use of a single group measure of aptitude. Various combinations of measures of interest, auditory ability, verbal ability, and mathematical ability have been used in this study. The auditory scores made a very significant contribution, especially for the prediction of teacher-assigned marks.

3. Predictions based on a combination of measures of aptitude can be made only when consideration is also given to many other factors that may operate to vary students' learning achievement. For this reason, the importance of careful counseling cannot be overstressed. The measures of aptitude used in this study can be very helpful in such counseling and in the diagnosis of language learning difficulties but must be supplemented by wise and carefully considered attention to possible intervening personal, social, and emotional factors.

APPENDIX A

TABLES PRESENTING ADDITIONAL DATA

TABLE XVII

MEANS AND STANDARD DEVIATIONS FOR SELECTED MEASURES OF APTITUDE AND FOR SPANISH LEARNING ACHIEVEMENT

(N = 105)

Test	Mean	S. D.
Verbal (X_1)	466.16	96.83
Mathematical (X_2)	456.55	90.09
Auditory (X_3)	43.73	5.86
Interest (X_4)	5.18	2.27
Spanish achievement test	98.05	32.73
Spanish grades	2.88	1.12

TABLE XVIII

MEANS AND STANDARD DEVIATIONS FOR SELECTED MEASURES OF APTITUDE AND FOR FRENCH LEARNING ACHIEVEMENT

(N = 80)

Test	Mean	S. D.
Verbal (X_1)	476.55	94.11
Mathematical (X_2)	483.51	99.85
Auditory (X_3)	43.81	6.11
Interest (X_4)	5.18	2.29
French achievement test	92.49	38.42
French grades	2.64	1.26

TABLE XIX

MEANS AND STANDARD DEVIATIONS FOR SELECTED MEASURES OF APTITUDE AND FOR GERMAN LEARNING ACHIEVEMENT

(N = 24)

Test	Mean	S. D.
Verbal (X_1)	562.33	101.03
Mathematical (X_2)	558.75	99.02
Auditory (X_3)	46.50	5.29
Interest (X_4)	6.08	2.39
German achievement test	93.92	20.95
German grades	2.96	0.91

APPENDIX B

TABLES PRESENTING ADDITIONAL DATA

TABLE XX

SCORES MADE BY STUDENTS OF SPANISH

Code	Prognostic Test Scores*				Criteria**	
	X_1	X_2	X_3	X_4	Test	Marks
1001	593	601	49	2	81	3
1002	628	567	50	6	104	4
1003	745	573	53	6	163	4
1004	567	489	43	2	59	1
1005	460	432	46	6	60	1
1006	403	481	41	6	109	4
1007	523	416	47	8	129	4
1008	570	419	42	6	131	4
1009	494	423	39	2	64	2
1010	567	517	51	6	65	3
1011	346	370	45	8	145	4
1012	398	451	43	0	70	2
1013	455	433	49	8	102	4
1014	557	556	53	6	130	4
1015	356	340	37	6	158	3
1016	295	404	43	2	68	3
1017	361	389	38	6	75	2
1018	569	426	49	6	91	3

TABLE XX --Continued

Code	Prognostic Test Scores*				Criteria**	
	X_1	X_2	X_3	X_4	Test	Marks
1019	453	501	40	2	59	2
1020	627	737	52	8	181	4
1021	512	518	49	6	101	4
1022	423	419	44	6	118	4
1023	384	394	35	8	89	2
1024	348	403	46	8	103	3
1025	368	323	43	6	70	1
1026	342	358	48	8	125	3
1027	460	441	39	0	72	2
1028	407	357	28	6	55	1
1029	552	481	49	6	152	4
1030	448	401	42	8	90	3
1031	342	358	40	6	89	2
1032	446	426	47	4	100	4
1033	348	338	46	6	67	1
1034	560	526	54	8	99	4
1035	365	419	40	6	40	0
1036	576	473	40	0	34	2
1037	567	423	41	6	156	4
1038	435	410	37	6	97	2
1039	414	407	36	0	64	1
1040	397	320	35	4	88	3
1041	370	309	37	6	132	3
1042	321	394	38	6	84	3
1043	534	677	49	6	121	3
1044	414	436	40	4	92	4

TABLE XX --Continued

Code	Prognostic Test Scores*				Criteria**	
	X_1	X_2	X_3	X_4	Test	Marks
1045	712	592	42	6	148	3
1046	461	528	45	2	48	0
1047	378	464	46	8	72	2
1048	481	566	51	0	113	4
1049	552	509	41	8	103	3
1050	627	394	49	6	69	2
1051	639	460	41	8	153	4
1052	585	466	46	8	70	2
1053	488	502	37	4	65	2
1054	479	518	34	4	95	4
1055	355	333	49	2	65	3
1056	412	394	49	0	100	3
1057	391	410	40	2	105	2
1058	516	439	52	4	55	0
1059	473	380	34	2	103	4
1060	480	272	37	4	107	1
1061	421	413	34	0	78	3
1062	335	412	47	4	112	4
1063	472	436	49	8	142	4
1064	365	392	39	6	92	3
1065	401	441	37	4	93	3
1066	442	383	45	4	68	1
1067	519	500	52	4	152	4
1068	487	557	41	4	87	3
1069	394	285	51	6	95	4
1070	597	507	48	4	60	3

TABLE XX --Continued

Code	Prognostic Test Scores*				Criteria**	
	X_1	X_2	X_3	X_4	Test	Marks
1071	460	421	47	6	126	3
1072	374	338	52	6	57	1
1073	384	331	46	6	107	3
1074	479	613	41	4	80	3
1075	540	507	53	8	147	4
1076	439	439	39	6	77	3
1077	712	473	40	6	99	3
1078	461	414	50	8	119	4
1079	323	379	32	8	47	0
1080	625	567	52	8	69	3
1081	487	442	41	4	134	4
1082	447	451	43	4	97	4
1083	512	520	46	8	170	4
1084	445	490	33	6	95	3
1085	348	583	52	6	118	4
1086	474	583	48	6	80	4
1087	627	466	48	8	177	4
1088	435	491	41	6	107	4
1089	478	580	48	6	80	1
1090	523	439	51	6	112	3
1091	305	385	37	6	89	2
1092	262	413	49	6	89	3
1093	460	621	48	6	98	3
1094	447	347	44	0	66	2
1095	543	567	50	4	111	4
1096	500	451	40	6	54	2

TABLE XX ---Continued

Code	Prognostic Test Scores*				Criteria**	
	X_1	X_2	X_3	X_4	Test	Marks
1097	547	507	40	4	92	2
1098	368	347	32	6	151	4
1099	461	599	47	6	108	4
1100	362	436	35	6	65	2
1101	391	367	38	8	108	3
1102	544	464	45	4	159	4
1103	509	687	49	4	112	4
1104	460	611	40	4	105	3
1105	453	520	46	4	58	3

*Variables:

X_1 - Verbal score on the Scholastic Aptitude Test.

X_2 - Mathematical score on the Scholastic Aptitude Test.

X_3 - Auditory score on the Pimsleur Language Aptitude Battery.

X_4 - Interest score on the Pimsleur Language Aptitude Battery.

**Criteria:

Test - MLA - Cooperative Foreign Language Test, Form LA, Spanish.

Marks- Teacher-assigned semester grades in Spanish.

A = 4
B = 3
C = 2
D = 1
F = 0

TABLE XXI

SCORES MADE BY STUDENTS OF FRENCH

Code	Prognostic Test Scores*				Criteria**	
	X_1	X_2	X_3	X_4	Test	Marks
2106	370	358	46	6	99	4
2107	441	309	40	6	103	3
2108	520	630	43	0	66	3
2109	474	626	42	6	81	2
2110	480	498	51	6	157	4
2111	361	347	45	4	117	2
2112	382	457	46	6	96	3
2113	696	719	52	8	184	4
2114	703	520	51	6	49	0
2115	553	668	47	0	82	3
2116	647	548	53	4	52	2
2117	467	617	45	4	146	4
2118	620	507	51	8	63	2
2119	381	460	31	6	63	1
2120	349	439	40	0	70	2
2121	615	442	34	6	78	3
2122	507	639	52	8	73	3
2123	372	482	37	6	75	2
2124	584	490	41	4	169	4
2125	371	366	44	4	52	1
2126	453	473	38	4	51	1
2127	544	419	46	6	112	3
2128	374	545	40	6	69	2
2129	444	375	40	8	85	2

TABLE XXI --Continued

Code	Prognostic Test Scores*				Criteria**	
	X_1	X_2	X_3	X_4	Test	Marks
2130	407	445	46	8	116	3
2131	405	484	27	4	47	1
2132	498	608	50	6	106	4
2133	606	529	40	6	111	4
2134	401	470	41	6	69	2
2135	520	272	36	6	38	0
2136	549	662	49	6	73	1
2137	479	445	53	6	144	4
2138	419	389	49	8	124	4
2139	626	498	37	6	115	4
2140	495	394	45	6	135	4
2141	342	412	34	0	51	0
2142	586	573	51	8	106	3
2143	467	479	46	0	73	2
2144	500	469	49	6	159	4
2145	507	479	40	4	109	4
2146	535	471	53	6	152	4
2147	460	573	29	6	143	4
2148	394	379	43	0	51	2
2149	301	375	38	4	105	3
2150	394	435	42	4	34	2
2151	434	394	44	8	67	2
2152	442	576	42	6	122	3
2153	346	338	44	8	110	3

TABLE XXI --Continued

Code	Prognostic Test Scores*				Criteria**	
	X_1	X_2	X_3	X_4	Test	Marks
2154	478	487	45	4	74	3
2155	626	696	44	6	111	4
2156	499	374	34	6	83	2
2157	404	308	41	4	37	1
2158	481	511	48	6	115	4
2159	365	356	36	6	37	1
2160	552	582	43	8	83	4
2161	439	475	43	2	82	4
2162	533	394	41	4	60	1
2163	519	356	36	8	43	2
2164	582	608	39	0	70	0
2165	481	412	46	6	63	2
2166	573	564	45	2	75	2
2167	527	572	50	4	77	2
2168	464	479	38	8	162	4
2169	496	506	37	6	93	3
2170	410	347	45	4	53	1
2171	600	621	52	6	79	3
2172	518	492	49	0	50	1
2173	362	557	47	6	160	4
2174	518	492	48	4	84	3
2175	403	452	44	6	157	4
2176	348	517	44	2	95	2
2177	335	385	41	8	42	0

TABLE XXI --Continued

Code	Prognostic Test Scores*				Criteria**	
	X_1	X_2	X_3	X_4	Test	Marks
2178	300	403	34	8	45	1
2179	356	493	54	6	57	3
2180	454	347	44	4	90	3
2181	468	509	54	6	170	4
2182	633	489	48	4	125	4
2183	610	662	52	6	169	4
2184	445	604	51	8	103	4
2185	524	548	49	6	103	4

*Variables:

X_1 - Verbal score on the Scholastic Aptitude Test.

X_2 - Mathematical score on the Scholastic Aptitude Test.

X_3 - Auditory score on the Pimsleur Language Aptitude Battery.

X_4 - Interest score on the Pimsleur Language Aptitude Battery.

**Criteria:

Test - MLA -- Cooperative Foreign Language Test, Form 1A, French.

Marks- Teacher--assigned semester grades in French.

A = 4
B = 3
C = 2
D = 1
F = 0

TABLE XXII

SCORES MADE BY STUDENTS OF GERMAN

Code	Prognostic Test Scores*				Criteria**	
	X_1	X_2	X_3	X_4	Test	Marks
3186	640	672	51	4	69	2
3187	500	592	50	8	82	3
3188	401	479	37	6	143	3
3189	644	635	52	8	88	4
3190	493	461	48	8	104	2
3191	467	581	48	8	76	3
3192	653	536	46	8	89	4
3193	653	639	50	6	89	4
3194	359	563	38	4	56	2
3195	564	529	48	0	117	3
3196	558	695	47	6	118	4
3197	635	369	52	6	90	3
3198	622	635	40	6	79	2
3199	626	536	50	4	113	4
3200	527	536	31	6	68	2
3201	348	413	45	4	80	1
3202	567	592	49	8	88	4
3203	589	679	44	6	71	2
3204	620	639	50	8	98	4
3205	647	510	47	8	94	3
3206	620	719	53	0	105	4
3207	654	389	48	8	128	2
3208	418	421	47	8	92	3
3209	691	590	45	8	117	3

TABLE XXII --Continued

*Variables:

X_1 - Verbal score on the Scholastic Aptitude Test.

X_2 - Mathematical score on the Scholastic Aptitude Test.

X_3 - Auditory score on the Pimsleur Language Aptitude Battery.

X_4 - Interest score on the Pimsleur Language Aptitude Battery.

**Criteria:

Test - MLA - Cooperative Foreign Language Test, Form LA, German.

Marks- Teacher-assigned semester grades in German.

A = 4
B = 3
C = 2
D = 1
F = 0

APPENDIX C

PREDICTIVE INDICES OF SEMESTER MARKS

For Predicting Semester Grades in Spanish

When combining scores on the Scholastic Aptitude Test and scores on the Pimsleur Language Aptitude Battery into a predictive index of a student's semester mark in Spanish, one of the three procedures given below is recommended. The procedures are listed in order of preference, with the best combination for prediction given first. If scores are not available for the student on the appropriate parts of the Pimsleur Language Aptitude Battery, the third procedure may be used, since it requires only the Scholastic Aptitude Test scores.

Procedure A.--Combination of the mathematical score on the Scholastic Aptitude Test, the auditory and interest scores on the Pimsleur Language Aptitude Battery:

1. Multiply the mathematical score by .00271.
2. Multiply the auditory score by .03655.
3. Multiply the interest score by .08673.
4. Add the products of the above steps.
5. Subtract .40748 from the total found in step 4.

6. Allow for an error of estimate to within at least ±1.0469. This allowance for error is the mathematical equivalent of plus or minus approximately one letter grade, since A = 4; B = 3; C = 2; D = 1; F = 0.

Procedure B.---Combination of the mathematical score on the Scholastic Aptitude Test and the auditory score on the Pimsleur Language Aptitude Battery:

1. Multiply the mathematical score by .00254.
2. Multiply the auditory score by .04341.
3. Add the products of the above steps.
4. Subtract .18362 from the total found in step 3.
5. Allow for an error of estimate to within at least ±1.0598. This allowance for error is the mathematical equivalent of plus or minus approximately one letter grade, since A = 4; B = 3; C = 2; D = 1; F = 0.

Procedure C.---Combination of the verbal and mathematical scores on the Scholastic Aptitude Test:

1. Multiply the verbal score by .00136.
2. Multiply the mathematical score by .00282.
3. Add the products of the above steps.
4. Add .95428 to the total found in step 3.
5. Allow for an error of estimate of at least plus or minus one letter grade. This is based on the 4.0 system, with A = 4; B = 3; C = 2; D = 1; F = 0.

The index provided by either of the above procedures may best be used to supplement the consideration of other pertinent information about individual students.

For Predicting Semester Grades in French

When combining scores on the Scholastic Aptitude Test and scores on the Pimsleur Language Aptitude Battery into a predictive index of a student's semester mark in French, one of the three procedures given below is recommended. The procedures are listed in order of preference, with the best combination for prediction given first. If scores are not available on the appropriate parts of the Pimsleur Language Aptitude Battery, the third procedure may be used, since it requires only the Scholastic Aptitude Test scores.

Procedure A.--Combination of the mathematical score on the Scholastic Aptitude Test, the auditory and interest scores on the Pimsleur Language Aptitude Battery:

1. Multiply the mathematical score by .00309.
2. Multiply the auditory score by .05099.
3. Multiply the interest score by .14141.
4. Add the products of the above steps.
5. Subtract 1.82188 from the total found in step 4.
6. Allow for an error of estimate to within at least $\pm$1.1155. This allowance for error is the

mathematical equivalent of plus or minus approximately one letter grade, since A = 4; B = 3; C = 2; D = 1; F = 0.

Procedure B.--Combination of the auditory and interest scores of the Pimsleur Language Aptitude Battery:

1. Multiply the auditory score by .06955.
2. Multiply the interest score by .13133.
3. Add the products of the above steps.
4. Subtract 1.08923 from the total found in step 3.
5. Allow for an error of estimate to within at least $\pm$1.1457. This allowance for error is the mathematical equivalent of plus or minus approximately one letter grade, since A = 4; B = 3; C = 2; D = 1; F = 0.

Procedure C.--Combination of the verbal and mathematical scores on the Scholastic Aptitude Test:

1. Multiply the verbal score by .00093.
2. Multiply the mathematical score by .00364.
3. Add the products of the above steps.
4. Add .43532 to the total found in step 3.
5. Allow for an error of estimate of at least plus or minus one letter grade. This is based on the 4.0 system, with A = 4; B = 3; C = 2; D = 1; F = 0.

The index provided by either of the above procedures may best be used to supplement the consideration of other pertinent information about individual students.

For Predicting Semester Grades in German

When combining scores on the Scholastic Aptitude Test and scores on the Pimsleur Language Aptitude Battery into a predictive index of a student's semester grade in German, one of the two procedures given below is recommended. The better combination for prediction is given first. However, if scores are not available for the auditory part of the Pimsleur Language Aptitude Battery, the second procedure may be used. It requires only the Scholastic Aptitude Test scores.

Procedure A.---Combination of the mathematical score on the Scholastic Aptitude Test and the auditory score on the Pimsleur Language Aptitude Battery:

1. Multiply the mathematical score by .00295.
2. Multiply the auditory score by .07560.
3. Add the products of the above steps.
4. Subtract 2.20558 from the total found in step 3.
5. Allow for an error of estimate to within at least $\pm$.7742. This allowance for error is the mathematical equivalent of plus or minus slightly less than one letter grade, since A = 4; B = 3; C = 2; D = 1; F = 0.

Procedure B.---Combination of the verbal and mathematical scores on the Scholastic Aptitude Test:

1. Multiply the verbal score by .00314.

2. Multiply the mathematic score by .00243.

3. Add the products of the above steps.

4. Subtract .16190 from the total found in step 3.

5. Allow for an error of estimate of at least plus or minus one letter grade. This is based on the 4.0 system, with A = 4; B = 3; C = 2; D = 1; F = 0.

The index provided by either of the above procedures may best be used to supplement the consideration of other pertinent information about individual students.

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